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AFISHE

Development of Aquaculture and Fisheries Education for Green Deal in Armenia and Ukraine: from education to ecology

BENCHMARK REPORT

COMPARATIVE FORM OF THE CURRICULUM AND COURSES FOR AQUACULTURE AND FISHERIES MASTER'S DEGREE PROGRAM

WP2. Preparation

Contents

PART I
GENERAL INFORMATION

1.1 The goal and the main results of AFISHE project

The overall goal of this project is to decrease the negative impact of aquaculture and fishery industry on the environment in Armenia and Ukraine through the designing and development of Master's degree programs in aquaculture and fisheries, that is benchmarked to high-quality similar programs in Europe and responsive to national and regional needs, and strengthening the university-enterprise-research cooperation (concept "from education to ecology").

AFISHE project will create a network between Armenia, Ukraine and EU partner countries in the fields of aquaculture and fisheries. This network will serve as a platform for the implementation of joint educational and research activities with the purpose of promoting the best ecology-based approaches and activities in these fields in line with UN SDG goals and EU Green Deal.

AFISHE project will strengthen university-enterprises cooperation resulting in the implementation of research-based and ecology-based operations and increasing operational effectiveness of aquaculture and fishery enterprises.

The main activities of the project are the creation and development of Master's degree study programs with all supporting materials, the establishment of laboratories, and the training of teaching and non–teaching staff of Armenia and Ukraine.

The main results of the project are:

- 3 new and updated Master's degree programs in Armenia and Ukraine,
- teaching and learning materials,
- modernized infrastructure and well-trained teaching and non-teaching staff,
- as well as a network, established between HEIs and the labor market, who will contribute to education and retraining of needed specialists in Armenia and Ukraine.

During the implementation of the project 44 teaching staff, 8 non-teaching staff, and each year about 25 Master's students will benefit. Due to this project, a sustainable network will be created between Armenian, Ukrainian, EU universities and the labor market, which will act jointly on behalf of sustainable environment.

1.2 Scope and the goal of the benchmark

1) The scope of benchmarking includes the analysis of master's degree programs at Armenian and Ukrainian (if any) universities and EU partner universities.

2) The goals of benchmarking are to identify benchmark master's degree programs at Armenian and Ukrainian universities and partner universities, curricula and syllabuses of study courses, which will allow to compare existing curricula and learning outcomes and to develop a new master's degree program.

1.3 Methodology of the benchmark

1) monitoring and identification of universities that offer a master's degree program related to aquaculture and fishery.

2) monitoring of master's curricula and course syllabuses in the identified universities offering a master's degree program related to aquaculture and fishery to identify a "benchmark" that corresponds to the title and content of the master's degree program in aquaculture and fisheries.

3) analysis of found "benchmark" curricula that correspond to the title and content of the master's program in aquaculture and fisheries, and analysis of course syllabuses in order to identify the best learning outcomes.

4) selection of "benchmark" learning outcomes for the master's program and "benchmark" criteria for curricula and course syllabuses, which will allow developing a new master's program or the improvement of an existing program through comparison.

5) comparison of "benchmark" master's curriculum with existing curriculum or curriculum to be developed.

6) comparison of the "benchmark" learning outcomes with the existing learning outcomes or learning outcomes to be developed.

1.4 Team members

Leading organization:

ANAU

Garegin Hambardzumyan – Project coordinator
Gayane Marmaryan – Assoc. Prof. at the Chair of Biosciences and general Chemistry
Arman Harutyunyan – Assoc. Prof at the Chair of Agribusiness and Policy

UNIDU

Tatjana Dobroslavich – Prof., Head of Department of Applied Ecology
Vlasta Bartulovic – Prof., Department of Applied Ecology

U.PORTO

Augusto Faustino – Prof.
Paulo Vaz-Pires – Assoc. Prof., ICBAS - Instituto de Ciências Biomédicas de Abel Salazar

SUA

Radovan Kasadra – Prof., vice-dean FAaFR
Martin Fik – Assoc. Prof.
Nina Moravcikova – Assoc. Proff.

ISEC NAR RA and SCZHE

Arusyak Harutyunyan - Head of Foreign Affairs Department
Bardukh Gabrielyan - Head of Ichthyology Laboratory
Hranush Melkonyan - Senior Researcher
Oleg Shcherbakov - Senior Researcher
Vardan Asatryan - Leading Researcher

SNAU

Viktoria Vechorka - Dean of the Biological and Technology Faculty, Doctor of agricultural sciences, Professor of Department of Animal genetics, breeding and biotechnology.

Oleksandr Kyselov - Dean deputy for scientific work, Candidate of agricultural sciences, Associate Professor of Department of feed technologies and animal feeding.

Oleksandr Mykhalko - Lecturer of Department of feed technologies and animal feeding.

NUWEE

Grochovska Julia - Doctor of Agricultural, Associate Professor, Professor of the Department of Water Bioresources

Sergii Konotsev - Doctor of Technical Sciences, Professor of the Department of Water Bioresources

Olha Biedunkova - Doctor of Biological Sciences, Associate Professor, Professor of the Department of Ecology.

1.5 The results of the benchmark

General overview

The main principles of higher education reform in Europe today, in line with the Bologna Process, include the following:

– Implementation two higher education;
– Use of the European credit transfer system ECTS;
– Mobility of students and teachers;
– Support for graduate employment;
– Software quality education.
– Implementation of tricyclic systems in higher education;
– Implementation of policies that teach throughout the lifespan;

– Social and global measurements;
– Implementation of the principle of "student-centered" education;
– Implementation of framework qualifications;
– Internationalization of higher education.

In recent years, 47 countries that signed the Bologna Declaration have agreed to implement student–centered, outcomes-based, and transparent higher education programs based on three successive cycles: Bachelor's, Master's, and Doctoral. A number of relevant tools have been developed to facilitate this process. Student-centered degree programs require a paradigm shift and thus a change in the mindset of faculty responsible for developing and delivering educational programs. This means organizing degree programs with desired outcomes in mind. Today, among most master's degree programs at EU universities, there are many programs that are structured according to the traditional approach based on available resources. However, classical programs are constantly being replaced by student-centered programs, which is in line with the global trend of educational innovations.

At present, there is a healthy and competitive aquaculture industry in Europe, which is developing rapidly and requires not only basic technical specialists, but also, and above all, highly qualified specialists at the management level. If we also take into account that the boom of aquaculture will continue to spread on a European and global level, then it is easy to understand the need to train personnel who are competitive on a national and international level. The higher education system of EU countries pays a lot of attention to the research and study of aquaculture and, consequently, to the training of qualified personnel. Many EU universities offer both bachelor's and master's degree programs, which are constantly being improved and attract the interest of a large number of students from different countries.

Benchmarked universities

The universities we benchmarked in the EU, North America, and Australia were students-oriented and publicly available to interested parties. The list of benchmarked universities included 28 higher educational institutions. The universities studied and their master's programs in aquaculture and fisheries mainly follow the concept of "student-centered" education.

Benchmarked master's degree programs

All of the programs studied in the benchmarking exercise can be considered student–centered because they are designed to help students develop a set of competencies that are considered useful and necessary for the academic, professional, and/or vocational field in the field of aquaculture and fisheries. The master's programs studied provide verifiable learning outcomes described by learning outcomes and credits. The learning outcomes of the master's programs studied determine the scope and level or standard of competencies, including knowledge, that students must develop in the field of Aquaculture and Fisheries with some exceptions. The programs of the universities studied provide students with the exact number of credits assigned to an individual component of the program or to the program as a whole, they fully reflect the time required for students to achieve the corresponding learning outcomes.

The master's programs in aquaculture and fisheries of the universities that came into focus during the AFISHE project benchmarking in the context of student–centered learning for the educational process were mostly transparent and traceable. This allows students to know in advance exactly what each program entails and what outcomes they can expect from it. However, some master's programs did not meet the stated criteria, requiring additional monitoring and investigation. On average, the master's programs had a course load of 120 ETCS credits, offered a simple type of diploma upon completion with a duration of 4 semesters, of which 2 semesters are devoted to classroom training and 2 to the completion of a master's thesis and internship.

In addition, the master's programs included several knowledge areas and sciences in aquaculture, fisheries, ecology, management, health care, processing and production, and were monodisciplinary and focused on marine or freshwater aquaculture. The combination of knowledge areas and sciences covered by the master's programs at the universities surveyed was quite diverse. In particular, the most common combinations were: Aquaculture and Management; Aquaculture and Fisheries; Aquaculture, Management and Production/Processing.

However, we note that there were exceptions to the described situation and some programs were characterized by individual parameters or did not fit into the European qualification framework.

In selecting a benchmark master's program, we did not focus on the fit of the entire master's program with our local needs, but on the fit of individual elements of each program with the desired parameters and characteristics of the master's program we considered as a reference. That is, we did not single out a single master's program as a benchmark, but rather formed a benchmark program from collective elements of different programs that fit our idea of a benchmark.

Benchmarked objectives of master's degree programs

The objectives of master's degree programs in Aquaculture and Fisheries at the universities studied were clear and understandable, took into account trends in labor market development, and were publicly available at most universities. The structure and content of all the programs studied were consistent with their objectives.

Benchmarked software competencies

Each master's degree program profile is based on a set of key competencies that the student must develop as part of the particular educational program.

The exact set of competencies in the educational programs studied varied among themselves, even within the same academic or professional field. We assessed the key competencies included in the profiles of the educational programs studied as the most important competencies that a graduate can achieve and develop as a result of completing each specific educational program. A preliminary review found that key program competencies were similar or comparable between two educational programs, e.g., the first cycle of the same subject area in different higher education institutions. However, some differences were found in the future, as each educational institution made its own personal choice, taking into account the mission of the university and the resources available for implementation. In the competencies of the master's programs studied, a distinction was made between integral, general and professional competencies.

It is also worth highlighting that among the large number of competencies we were able to analyze, competencies related to ecology and rational nature management represented 1–5% and competencies related to fisheries represented 1–2% of the total number of competencies of all master's programs. Most competencies were related to direct issues of Aquaculture, management, processing or manufacturing of products, and health care, depending on the focus of the master's program. Most universities made this information publicly available, but not all.

Benchmarked learning outcomes

The purpose of learning outcomes is to provide a thorough description of a student's learning outcomes that can be reviewed at a specific point in time, such as at the end of a degree program, course, or in–service internship. Learning outcomes describe what a student should know, understand, and be able to demonstrate upon successful completion of a segment of study. They are statements of specific, verifiable characteristics that demonstrate/confirm how intended competencies, including required knowledge levels, have been developed or acquired. Learning outcome statements can be formulated to describe any type of verifiable learning, whether achieved in formal, informal, or non–formal contexts. The learning outcomes of the aquaculture and fisheries master's degree programs studied were mostly publicly available for analysis.

Analysis of the learning outcomes of the master's programs revealed that they are a set of statements of what a student in aquaculture and fisheries is expected to know, understand, and be able to demonstrate after completing all assignments and successfully passing all exams/assessments and receiving a degree. Master's degree programs that identified structured elective blocks of disciplines or individual courses of study provided additional learning outcomes to demonstrate the outcomes of these specialized blocks or courses of study.

The learning outcomes of the master's degree programs studied in aquaculture and fisheries and other knowledge and science areas were essentially:

– Specific (sufficiently detailed, written in understandable language);
– Objective (neutrally worded, avoiding subjectivity and ambiguity);
– Achievable (realistic in terms of the time and resources needed to achieve the objectives);
– Useful (perceived as meeting the level of higher education and the requirements/expectations of civil society);
– Appropriate (meets qualification requirements);

– Corresponded to the nature of the standards (defines the standard requirements that the student must meet).

Learning outcomes were analyzed for their relevance to the field of aquaculture and fisheries and selected in a separate list of benchmarked master's programs in part II.

Benchmarked assessment methods

Universities provided a list of assessment methods in their master's programs, both in general and for each individual course, which allowed students to get a full picture of the expected assignments and the scope and rules of course assessment. At the same time, some universities left this feature of the master's program inaccessible to the public, making qualitative assessment difficult.

Benchmarked teaching and learning methods

Most of the surveyed universities provided public access to the teaching methods they plan to use in master's degree programs. The full list of teaching methods presented in part II of this report includes: Lectures, seminars, laboratory work, teamwork, fieldwork, industrial visits, teaching away from home, self–study, individual training, field trip, practical PC room teaching, theater role–playing, internships, project work, tutorials, and conferences. However, it can be stated that the most common teaching methods we found in universities were classical lectures, seminars and laboratory work. However, there were exceptions, and some master's programs offered unique learning methods, which were to some extent associated with a more developed material and technical base to ensure the educational process. The most common methods of studying the course material were: Working with lecture notes, working with a book, working with legal acts, summarizing, systematizing, deepening the material, performing calculations, developing a research plan. In addition, universities offered students field work, practical work, experiment, diving, underwater practice, collection and analysis of socio–economic data, experiment, scientific work, research project, case study.

Benchmarked material and technical support

A comprehensive list of material and technical support for the educational process of master's degree programs in aquaculture and fisheries was provided by only a few of the universities studied. Most were limited to mentioning the available scientific and practical laboratories or left students and interested parties without any information about them. The full list of types of material and technical support available at the universities surveyed included: reference centers, research laboratory, engineering offices, educational parks, field workplaces, AquaHealth clubs.

Benchmarked individual student educational trajectories

The individual educational trajectory of a student is a personal path to the realization of the personal potential of the educational student, formed taking into account his abilities, interests, needs, motivation, opportunities and experiences based on the types, forms and pace of education chosen by the student, the subjects of educational activities and proposed educational programs, educational disciplines and their degree of complexity, methods and means of education. Most of the studied universities met this criterion of the Bologna process, which determines the modern vector of development of master's degree programs by giving students the opportunity to freely choose the courses. However, it was found that not all master's programs offered students the opportunity to freely choose the fields of study.

Benchmarked methods for students' soft skills training

Soft skills are universal competencies, the degree of which mostly depends on the type of personality, character traits and temperament. Soft skills include, first of all, sociability, the ability to work in conditions of force majeure, and the inclination to work in a team. It is extremely difficult to evaluate them in concrete terms, but it is possible to develop them. Among the latest trends in the development of higher education is the ability of master's programs to directly or indirectly influence the development of software students' skills through various teaching methods.

The studied master's programs in aquaculture and fisheries ensure the development of students' soft skills. The main soft skills that could be developed through master's degree programs were: Communication, working in a team, cooperation, emotional intelligence, critical thinking, design thinking (creativity), the ability to persuade, adaptability, analytical thinking, strategic thinking, business analysis, affiliate marketing. The study of the structure and content of the master's programs, as well as the profiles of the courses, showed that universities pay the most attention to soft skills such as communication, teamwork and critical thinking.

Comparative analyses of the master's programs

We conducted an analysis of 27 universities in EU countries, one university in the USA, one university in Canada, one university in Australia, and one university in Israel among 30 master's degree programs in aquaculture and fisheries. Initial monitoring of master's programs included examining the type of university, total number of courses, number of credits (ECTS), and type of degree graduates will receive.

University profiles				
Name of the University	Type of university Classic Applied Public	The total number of program curses	Type of diploma (Double/ Simple)	Total number of credits (ECTS)
Nord University	C	19	S	120
Polytechnic University of Valencia, UPV	A	18	S	60
University of Patras	C	10	S	90
University of Algavre, UAlg	A	20	S	78
University of Dubrovnik, UNIDU	A	22	S	120
Ghent University of Belgium, Aquaculture	A	28	D	120
Ghent University of Belgium, HM in Aquaculture	A	16	D	120
Wageningen University and Research, Aquaculture	A	18	S	120
Wageningen University and Research, Marine Resources and Ecology	A	18	S	120
University of Rostock	P	22	S	120
University of Plymouth	C	6	S	120
Universidad de Cádiz	A	12	S	60
University of Vigo	A	18	S	90
Fleming College Canada	A	21	S	34
Kentucky State University	A	15	S	120
Porto University	C+A	15	S	120
Utrecht University	A	22	S	120
UiT's the Norwegian College of Fishery Science	A	28	S	120
University of Aberdeen	C	11	S	120
Vrije University Brussels	C	49	S	120
Slovak University of Agriculture	C+A	27	S	120
TECH Technological University	C	10	S	N/A
University of Warmia and Mazury in Olsztyn	A	24	S	90
Norwegian University of Life Sciences	A	18	S	120
James Cook University	C	15	S	120
University of Santyago de Compostella	C	26	S	96
Daugavpils University	C	19	S	120
University of Klaipeda	C	25	S	120
University of St Andrews	C	21	S	120

As we can see, most of the universities offering master's programs in aquaculture and fisheries are universities of applied sciences in the EU and North America, with the exception of: James Cook University, Nord University, University of Santyago de Compostella Aquaculture, University of Aberdeen, Vrije University of Brussels, Daugavpils. Also, most universities form the study volume of master's programs 120 credits (ECTS), but there are exceptions, for example. University of Santyago de Compostella Aquaculture – 96 credit ETCS, University of Vigo, University of Warmia and Mazury in Olsztyn, whose study volume is 90 credits (ECTS), University of Algavre (Aquaculture and Fisheries) – 78 credits (ECTS), Universidad de Cádiz – 60 credits (ECTS), Polytechnic University of Valencia (Aquaculture) – 60, University of Patras (Sustainable Fisheries, Aquaculture) – 60 credits (ETCS) and Fleming University Canada – 34 credits (ECTS). In addition, most students have the opportunity to receive a simple diploma upon completion of the master's program and, as an exception, a double diploma at Ghent University in Belgium. Master's programs include an average of 19 courses. The largest number of courses in the master's program Aquaculture (Ghent University, Belgium) is 28, and the smallest number is 12 in Aquaculture and fisheries

(Universidad de Cádiz). TECH Technological University (Aquaculture) has not made the data on the number of credits in the master's program available to interested parties and students (Figure 1).

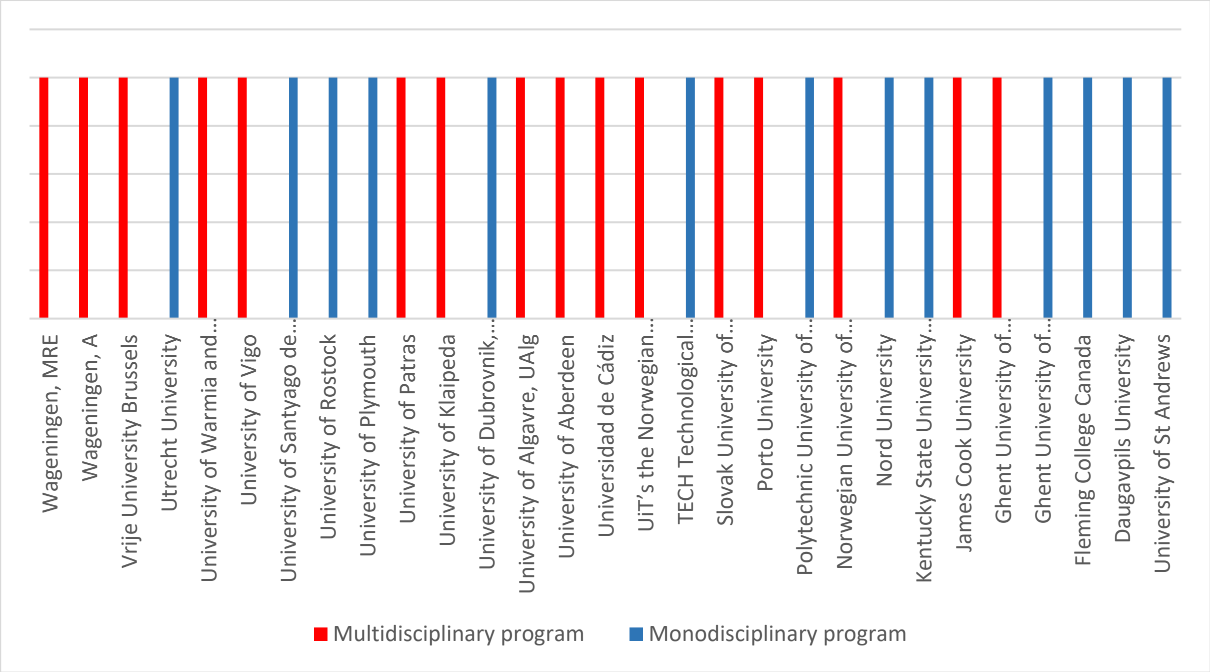

Figure 1. Distribution of universities according to the educational field of their master's programs

The analysis of the orientation of master's programs by fields of knowledge and science suggests that both monodisciplinary and multidisciplinary master's programs are common at the universities studied. In our opinion, this depends on the specifics of the local fishing industry, the geographical conditions of the countries, and the needs of the product market and the labor market in this field (Figure 2).

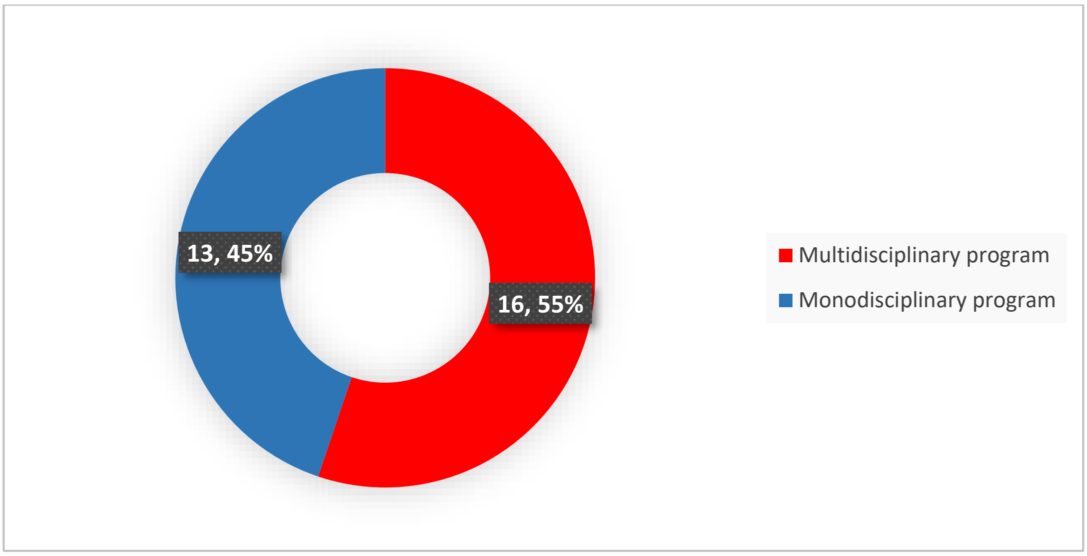

Figure 2. Distribution of master's programs according to the educational area

The distribution of master's programs according to this criterion describes an almost equal ratio between them. In particular, we found 14 multidisciplinary and 16 monodisciplinary master's programs (Figure 3).

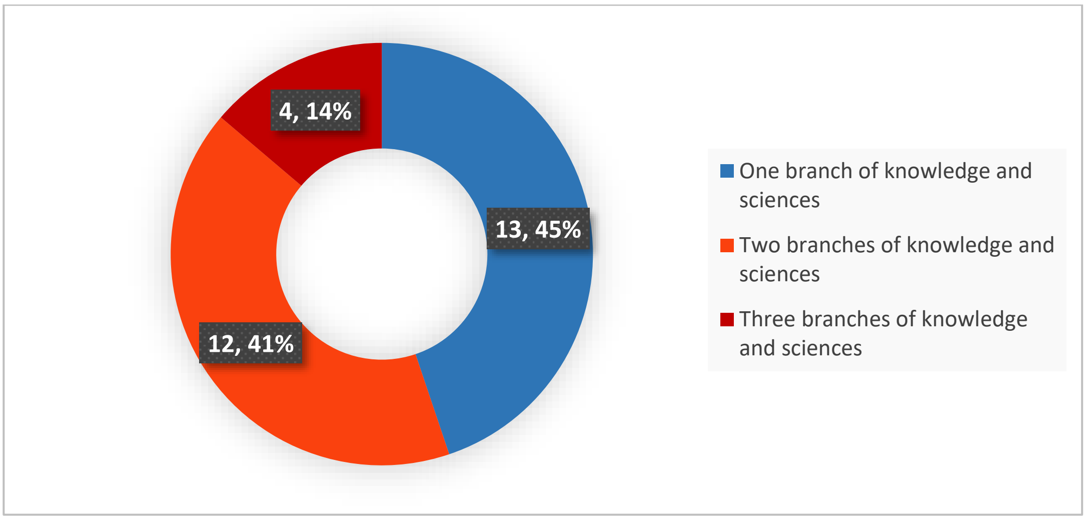

Figure 3. Distribution of master's programs according to the number of educational areas in one program

A detailed examination of the sectoral orientation of the master's programs among the universities studied revealed their diverse focus. Some master's programs covered 3 fields of knowledge and science, notably: Wageningen University and Research (Aquaculture and Marine Resource Management: Marine Resources and Ecology), Norwegian University of Science and Technology, University of Aberdeen, Slovak University of Agriculture. Other Master's programs covered only 2 fields of knowledge and science, in particular: University of Patras, University of Algavre, Ghent University of Belgium (Health Management in Aquaculture), Wageningen (Aquaculture and Marine Resource Management: Aquaculture), Universidad de Cádiz, UiT's the Norwegian College of Fishery Science, Vrije University of Brussels, Autonomous University of Barcelona (UAB), Norwegian University of Life Sciences, James Cook University, Porto University. Among the universities that had mono–branch master's programs were: Nord University, University of St. Andrews, Polytechnic University of Valencia, UPV, University of Dubrovnik, UNIDU, Ghent University of Belgium (Aquaculture), University of Rostock, University of Plymouth, Fleming College Canada, Kentucky State University, Utrecht University, Daugavpils University.

The combination of knowledge areas and sciences covered by the master's programs of the universities studied is quite diverse. In particular, the most frequent combinations were:

– Aquaculture and Management: Norwegian University of Life Sciences, Vrije University of Brussels;

– Aquaculture and Fisheries: Universidad de Cádiz, University of Algavre, University of Patras;

– Aquaculture, Management and Production/processing: Slovak University of Agriculture, Norwegian University of Science and Technology;

Targeted combinations of knowledge areas and sciences in master's programs were found at the following universities:

– Aquaculture, Fisheries and Ecology: University of Aberdeen, Porto University;

– Aquaculture, Ecology: Wageningen (Aquaculture and Marine Resource Management: Marine Resources and Ecology) (Figure 4).

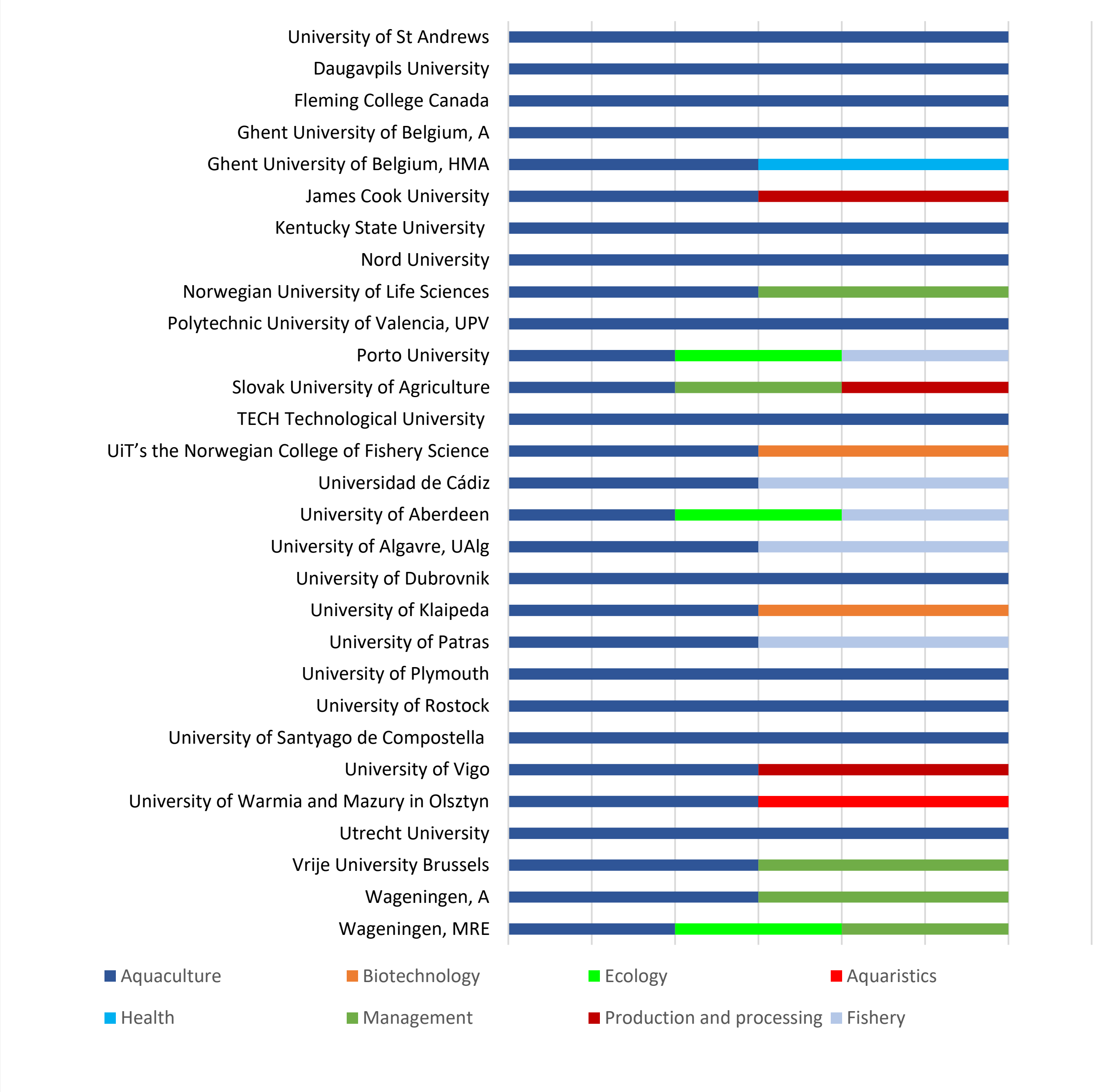

Figure 4. Distribution of master's programs according to the type of their multidisciplinarity

Among the multidisciplinary master's programs, the combination of such fields of knowledge and sciences in one program was most often found: Aquaculture and Management – 3 programs (10%), Aquaculture and Fisheries – 3 programs (10%), Aquaculture, Ecology and Fisheries – 2 programs (7%), Aquaculture and Health – 2 programs (7%), Aquaculture and Processing/Production – 2 programs (7%), Aquaculture, Management and Processing/Production – 2 programs (7%). The remaining combinations of the combination of knowledge and sciences in one master's program met only once, which was less than 4% for each of them (Figure 5).

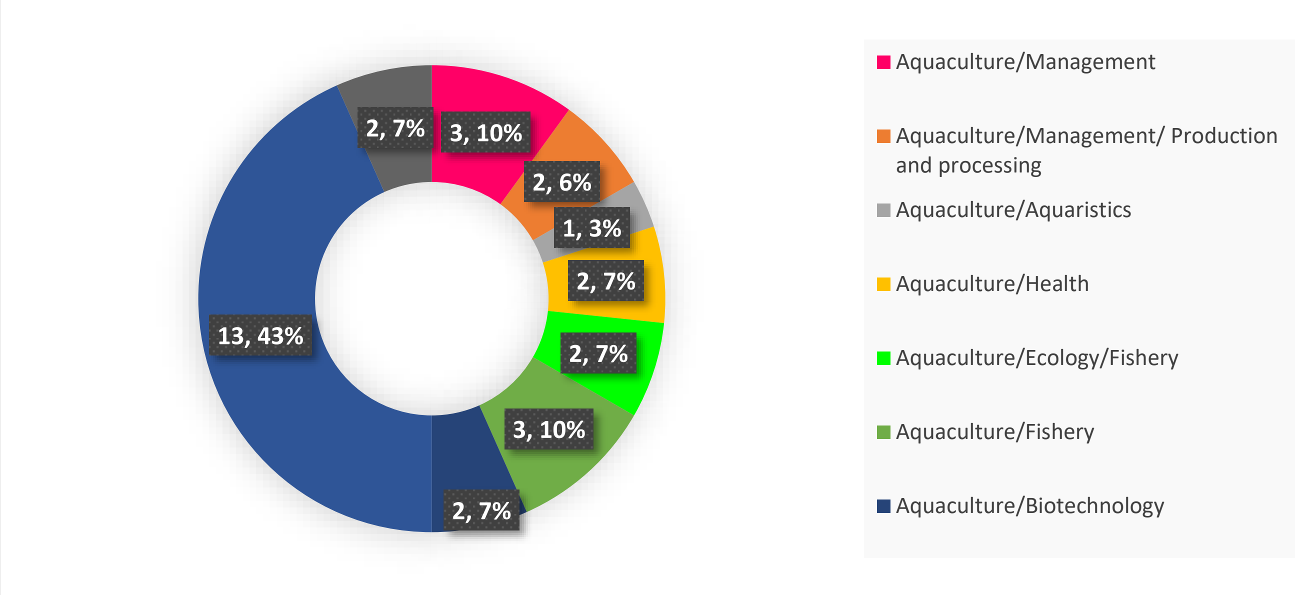

Figure 5. Number and ratio of monodisciplinary and multidisciplinary master's programs

The next stage of monitoring master's degree programs was to study the characteristics that determine the duration of study within the program and the duration of face-to-face training for students. We also studied the relationship between the objectives of the program and its structure and content, as well as their interrelation. The study also focused on the extent to which the master's program can influence students' individual educational trajectory of the possibility of subject choice. In addition, the availability of free access to the study results according to the study program and methods of assessing students' knowledge were examined.

Setting the master's programs							
Name of the University	**Duration of the program (semesters)**	**Duration of classroom studying (semesters)?**	**Does the structure and content of the program meet the objectives of the program? Yes/No**	**Does the program provide for the formation of an individual educational trajectory of the student? Yes/No**	**Is program purpose publicly available? Yes/No**	**Are learning outcomes publicly available? Yes/No**	**Are assessment methods publicly available? Yes/No**
Nord University	4	4	Y	Y	Y	Y	Y
Polytechnic University of Valencia, UPV	2	2	Y	Y	Y	Y	Y
University of Patras	3	3	Y	N	Y	Y	N
University of Algavre, UAlg	3	3	Y	Y	Y	Y	Y
University of Dubrovnik, UNIDU	4	4	Y	Y	N	N	N
Ghent University of Belgium, Aquaculture	4	2	Y	Y	Y	Y	Y
Ghent University of Belgium, HM in Aquaculture	4	2	Y	Y	Y	Y	Y
Wageningen, Aquaculture	4	2	Y	Y	Y	Y	Y

Wageningen, Marine Resources and Ecology	4	2	Y	Y	Y	Y	Y
University of Rostock	4	2	Y	Y	Y	Y	Y
University of Plymouth	4	2	Y	Y	Y	Y	Y
Universidad de Cádiz	4	2	Y	N	Y	N	N
University of Vigo	4	2	Y	N	Y	N	N
Fleming College Canada	3	3	Y	N	Y	Y	N
Kentucky State University	2	2	Y	Y	Y	Y	N
Porto University	4	2	Y	Y	Y	Y	Y
Utrecht University	4	2	Y	Y	Y	Y	Y
UiT's the Norwegian College of Fishery Science	4	2	Y	Y	Y	Y	Y
University of Aberdeen	4	4	Y	Y	Y	Y	Y
Vrije University Brussels	4	4	Y	Y	Y	Y	Y
Slovak University of Agriculture	4	4	Y	Y	Y	Y	Y
TECH Technological University	2	2	Y	N	N	Y	Y
University of Warmia and Mazury in Olsztyn	3	2	Y	Y	Y	Y	Y
Norwegian University of Life Sciences	2	2	Y	Y	Y	Y	Y
James Cook University	3	3	Y	Y	Y	N	N
University of Santyago de Compostella	2	2	Y	Y	Y	N	Y
Daugavpils University	4	4	Y	N	Y	Y	Y
University of Klaipeda	4	4	Y	Y	Y	Y	Y
University of St Andrews	3	3	Y	Y	Y	N	Y

Analysis of the data collected showed that most master's programs have a duration of 4 semesters. However, there were exceptions where students were offered a duration of 3 semesters: Fleming College Canada (Aquaculture), University of Warmia and Mazury in Olsztyn (Aquaculture and Aquaristics), University of Algavre (Aquaculture and Fisheries), University of Patras (Sustainable Fisheries, Aquaculture) and 2 semesters: Kentucky State University (Aquaculture), Norwegian University of Science and Technology (Health Management in Aquaculture), Polytechnic University of Valencia (Aquaculture). With a duration of the educational process of 4 semesters, most master's programs offer 2 semesters of face-to-face study and 2 semesters of extracurricular work on the master's thesis and an internship.At the same time, some master's programs offer to combine classroom training with the preparation of a master's thesis during the entire period of study, which is 3 semesters: Fleming College Canada (Aquaculture), James Cook University (Aquaculture Science & Technology) and Kentucky State University (Aquaculture).

In the process of studying the correspondence between the goals of master's programs and their structure and content, we did not find any inconsistencies in all the studied universities.

In general, master's programs provide for the formation of a student's individual overall trajectory due to the possibility of choosing disciplines. However, among the studied universities, exceptions were found when such an option of the educational process (formation of a student's individual overall trajectory) was not provided in the master's program, in particular: Universidad de Cádiz (Aquaculture and Fishing), University of Vigo (Aquaculture), Norwegian University of Science and Technology (Health Management in Aquaculture), Fleming College Canada (Aquaculture), University of Patras (Sustainable Fisheries, Aquaculture).

Our research has made it possible to establish that public dissemination of the objectives of the master's program is a good practice among most universities and allows the future student to make the right choice before entering the study. But unfortunately, we found an exception to this rule, when objectives of programs were not available: Norwegian University of Science and Technology (Health Management in Aquaculture), University of Vigo (Aquaculture), University of Dubrovnik (Mariculture).

It is known that an important parameter of the master's program is the availability of learning outcomes for the general public of society, interested parties and future students. Most of the master's programs from the promoted universities provided the opportunity to study the results of studies through their publication on their websites. However, some universities did not provide public access to this information, including: Universidad de Cádiz (Aquaculture and Fishing), Fleming College Canada

(Aquaculture) and Kentucky State University (Aquaculture), James Cook University (Aquaculture Science & Technology),), University of Dubrovnik (Mariculture), University of Santyago de Compostella Aquaculture.

The further stage of monitoring was aimed at identifying free access to master's program competencies, including integral, general and professional competencies.

Software competencies and Resource support				
Name of the University	**Are the integral competencies publicly available? Yes/No**	**Are the general competencies publicly available? Yes/No**	**Are professional competencies publicly available? Yes/No**	**Is list of material and technical means for education publicly available? Yes/No**
Nord University	Y	Y	Y	N
Polytechnic University of Valencia, UPV	N	N	Y	N
University of Patras	N	N	Y	N
University of Algavre, UAlg	Y	N	N	N
University of Dubrovnik, UNIDU	N	N	N	Y
Ghent University of Belgium, Aquaculture	N	N	N	Y
Ghent University of Belgium, HM in Aquaculture	Y	Y	Y	Y
Wageningen, Aquaculture	Y	Y	Y	Y
Wageningen, Marine Resources and Ecology	Y	Y	Y	Y
University of Rostock	Y	N	N	Y
University of Plymouth	Y	Y	Y	Y
Universidad de Cádiz	N	N	N	N
University of Vigo	N	N	N	Y
Fleming College Canada	N	N	N	Y
Kentucky State University	N	N	Y	N
Porto University	Y	Y	N	N
Utrecht University	Y	Y	Y	Y
UiT's the Norwegian College of Fishery Science	Y	Y	N	Y
University of Aberdeen	N	N	N	Y
Vrije University Brussels	N	N	N	Y
Slovak University of Agriculture	N	N	N	Y
TECH Technological University	N	N	N	Y
University of Warmia and Mazury in Olsztyn	Y	Y	Y	Y
Norwegian University of Life Sciences	Y	Y	Y	Y
James Cook University	N	N	N	N
University of Santyago de Compostella	Y	Y	Y	N
Daugavpils University	N	N	N	Y
University of Klaipeda	N	N	N	Y
University of St Andrews	N	Y	N	Y

According to the results of the analysis of the collected data, it was possible to establish that part of the master's programs had the indicated indicators available on their university websites and other sources of obtaining public information, while the other part did not publish lists of relevant competencies. Among the master's programs with open access to the competencies that students can obtain were: Ghent

University of Belgium (HM in Aquaculture), Wageningen (Aquaculture), Wageningen (Marine Resources and Ecology), University of Rostock (Aquakultur), University of Plymouth (Sustainable Aquaculture), Utrecht University (Marine Sciences), UiT's the Norwegian College of Fishery Science (Marine Biotechnology), Norwegian University of Science and Technology (Health Management in Aquaculture), University of Warmia and Mazury in Olsztyn (Aquaculture and Aquaristics), Porto University (Marine Sciences – Marine Resources), Nord University (Master of Science in Aquaculture), University of Santyago de Compostella Aquaculture. Master's programs that did not present free public access to competencies were: Ghent University of Belgium (Aquaculture), Universidad de Cádiz (Aquaculture and Fishing), Fleming College Canada (Aquaculture) and Kentucky State University (Aquaculture), James Cook University (Aquaculture Science & Technology), University of Dubrovnik (Mariculture). It is also important to note that the University of Rostock (Aquakultur), Norwegian University of Science and Technology (Health Management in Aquaculture), Porto University (Marine Sciences – Marine Resources) and UiT's the Norwegian College of Fishery Science (Marine Biotechnology), Polytechnic University of Valencia (Aquaculture), University of Algavre (Aquaculture and Fisheries), University of Patras (Sustainable Fisheries, Aquaculture), University of Aberdeen (Marine and Fisheries Ecology), Slovak University of Agriculture (Management of Animal Production) provided only partial competencies specifying either only integral or only general competencies, which also limits full access to this type of information.

Information about the availability of material and technical support for the educational process under the master's program allows us to draw conclusions about the quality of education as a whole. At the same time, among the majority of universities that took care of the availability of relevant data, several universities were found that did not publish information about the material and technical support of the educational process, in particular: Kentucky State University (Aquaculture), Norwegian University of Science and Technology (Health Management in Aquaculture), Porto University (Marine Sciences – Marine Resources) and Universidad de Cádiz (Aquaculture and Fishing), James Cook University (Aquaculture Science & Technology), Nord University (Master of Science in Aquaculture), Polytechnic University of Valencia (Aquaculture), University of Algavre (Aquaculture and Fisheries), University of Patras (Sustainable Fisheries, Aquaculture), University of Santyago de Compostella Aquaculture.

Among the types of material and technical support that the studied universities have at their disposal, the following were identified: Educational classrooms, Reference Centers, Research Labs, Engineering offices, Educational parks, Fieldwork locations, AquaHealth Clubs, Research hatcheries, Breeding parks, Vessels. It was established that each master's program that fell under the benchmarking was provided with a scientific laboratory for conducting experiments of students during master's projects and scientific work. However, some universities included a larger list of facilities available to students in the list of material and technical means of education. In particular, additional technical support was offered:

- UiT's the Norwegian College of Fishery Science (Marine Biotechnology: Reference Center, Research Labs and Engineering offices;
- Utrecht University (Marine Sciences): Reference Center, Research Labs and Fieldwork locations;
- Ghent University of Belgium (HM in Aquaculture, Aquaculture): Reference Center, Research Labs and AquaHealth Clubs.
- University of Dubrovnik (Mariculture): Chemical, biological and biotechnological laboratories at its disposal as well as Experimental research fish and shellfish Hatcheries, Breeding parks, Vessels.
- Univerity of Aberdeen (Marine and Fisheries Ecology): Lighthouse field station, Zoology museum (Figure 6).

The absence of appropriate information about material and technical means of education on the university's public website does not mean that the university does not own them or does not use them in education. But this limits the applicant's opportunities to choose the right master's program at the initial stage of the educational stage. Also, detailed information about the material and technical means of study should be a sign of openness and demonstration of the strengths of the master's program and its additional attractiveness and competitiveness in comparison with similar programs of other universities.

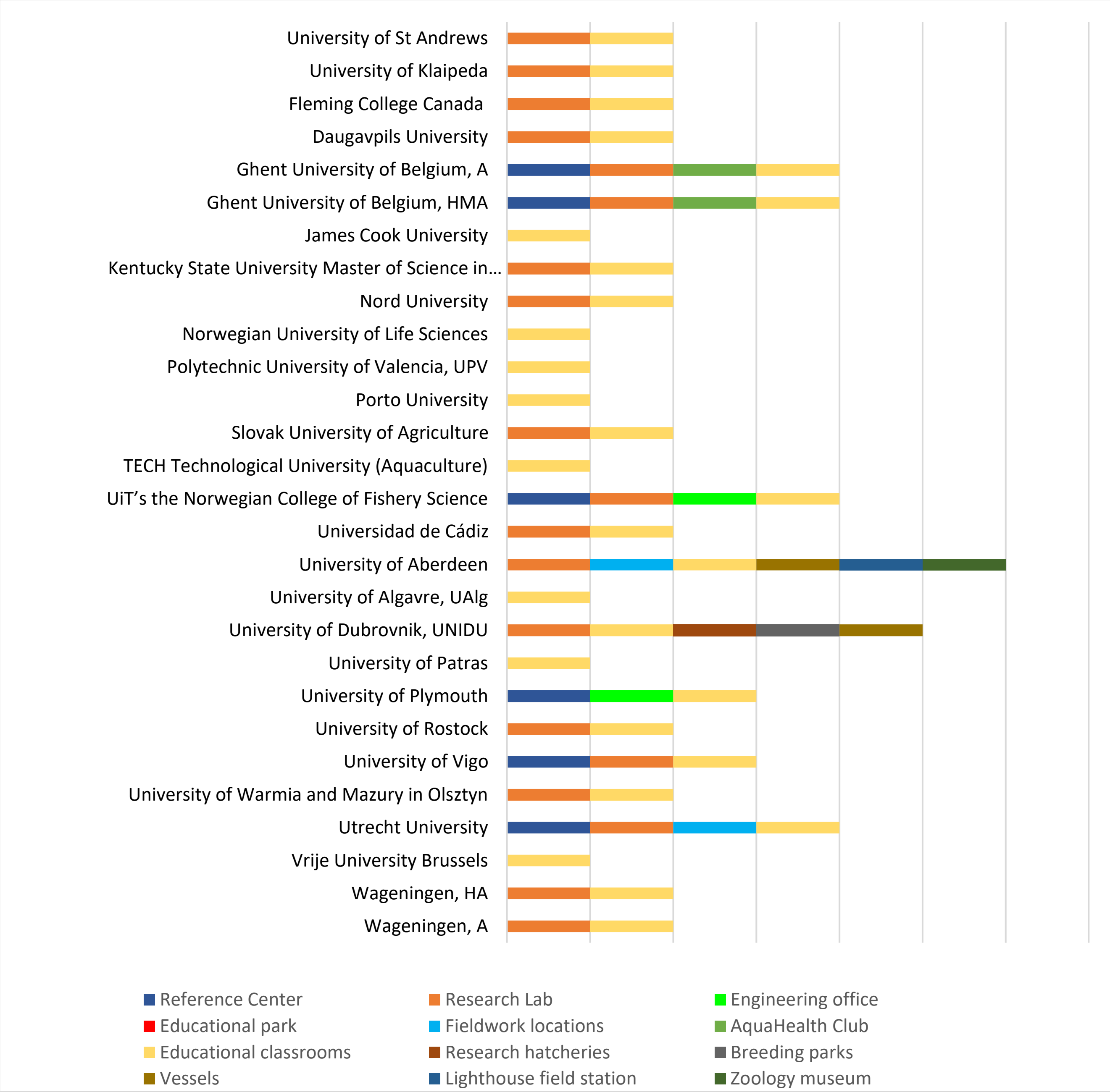

Figure 6. Material and technical support of master's programs

The next stage of monitoring master's programs included the collection of data on the availability of practical training or internships at aquaculture or fishing enterprises. It was also revealed the influence of the course disciplines on the formation of soft skills among students, whether a list of teaching and learning methods is available for students to familiarize themselves with. In addition, it was determined what type of final master's thesis was foreseen by the master's program.

The analysis of master's programs allowed us to say that all universities provided practical training and internships for masters. However, there were exceptions to this list represented by Universidad de Cádiz (Aquaculture and Fishing), University of Vigo (Aquaculture) and Fleming College Canada (Aquaculture), Polytechnic University of Valencia (Aquaculture), where master's programs did not have available data on any type of internship or practice during master's studies.

The majority of universities in their master's programs provide for the teaching of courses that allow students to develop soft skills that strengthen hard skills and ensure the student's success in society and the most effective realization of his potential. However, it is worth noting that, as an exception, the Universidad de Cádiz (Aquaculture and Fishing) did not include certain disciplines of the corresponding purpose in the list of educational components of the master's program.

Publishing in public access the list of teaching and learning methods that will be used during master's studies is a good practice of modern universities. Most of the universities included in the monitoring list openly demonstrated the specified information on their websites. At the same time, Universidad de Cádiz (Aquaculture and Fishing) and Kentucky State University (Aquaculture) kept these data hidden, University of Dubrovnik (Mariculture). University of Patras (Sustainable Fisheries, Aquaculture).

Features of the master's programs				
Name of the University	Is there practical training (internship) for students? Yes/No	Do modules (courses) create soft skills of students? Yes/No	Are teaching and learning methods publicly available? Yes/No	Type of final control of the master's program: Thesis – T; Exam – E; Project – P
Nord University	Y	Y	Y	T
Polytechnic University of Valencia, UPV	Y	Y	Y	T
University of Patras	N	Y	N	T
University of Algavre, UAlg	N	Y	Y	T
University of Dubrovnik, UNIDU	Y	Y	N	T
Ghent University of Belgium, Aquaculture	Y	Y	Y	T
Ghent University of Belgium, HM in Aquaculture	Y	Y	Y	T
Wageningen, Aquaculture	Y	Y	Y	T
Wageningen, Marine Resources and Ecology	Y	Y	Y	T
University of Rostock	Y	Y	Y	T
University of Plymouth	Y	Y	Y	T
Universidad de Cádiz	N	N	N	T
University of Vigo	N	Y	Y	T
Fleming College Canada	N	Y	Y	T
Kentucky State University	Y	Y	N	T
Porto University	Y	Y	Y	T
Utrecht University	Y	Y	Y	T
UiT’s the Norwegian College of Fishery Science	Y	Y	Y	T
University of Aberdeen	N	Y	Y	P
Vrije University Brussels	Y	Y	Y	T
Slovak University of Agriculture	Y	Y	Y	T+E
TECH Technological University	N	Y	Y	E
University of Warmia and Mazury in Olsztyn	Y	Y	Y	T
Norwegian University of Life Sciences	Y	N	Y	T
James Cook University	Y	Y	Y	Y
University of Santyago de Compostella	Y	Y	Y	T
Daugavpils University	Y	Y	Y	T
University of Klaipeda	Y	Y	Y	T
University of St Andrews	N	Y	Y	T

All master's programs, as the completion of studies and confirmation of the master's qualification, provide that the student will develop a master's degree under the guidance of a supervisor and conduct its public defense.

The evaluation of master's programs of universities by the number of mandatory courses shows that universities determine their number and the scope of their educational load in different ways (Figure 7).

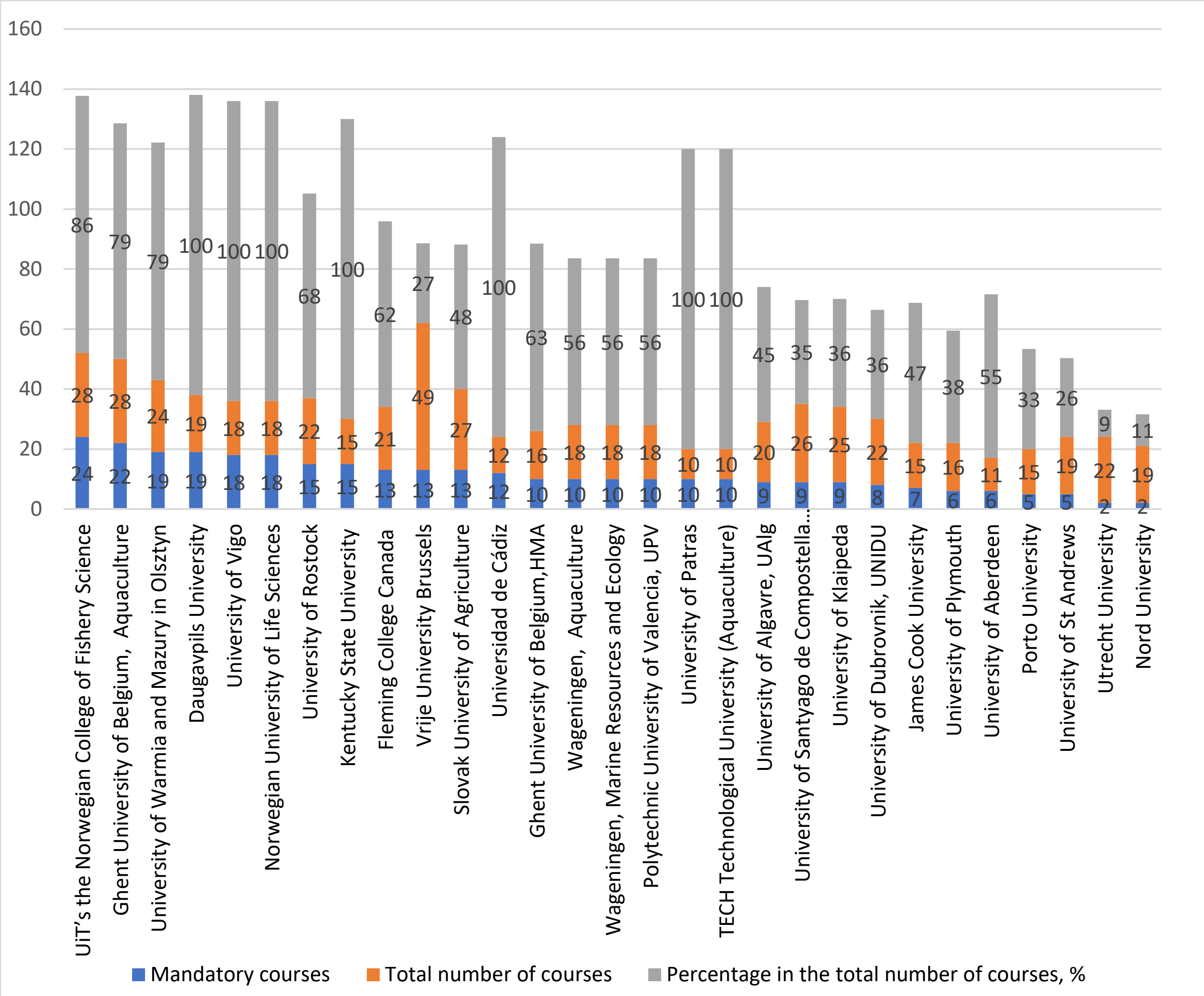

Figure 7. Distribution of universities by the number of mandatory courses

The greater the number of mandatory courses in relation to the total number of courses in the master's program, the less its ability to shape the student's individual learning trajectory, which minimizes the chances of effectively using each individual individuality more widely to form a versatile specialist or a specialist in a narrow field. The largest number of mandatory disciplines among the following master's programs: University of Patras (Sustainable Fisheries, Aquaculture) – 100%, UiT's the Norwegian College of Fishery Science (Marine Biotechnology) – 86%, Ghent University of Belgium (Aquaculture) – 79%, University of Warmia and Mazury in Olsztyn (Aquaculture and Aquaristics) – 79%, Polytechnic University of Valencia (Aquaculture) – 10 (56%), Slovak University of Agriculture (Management of Animal Production) – 13 (48%), University of Algavre (Aquaculture and Fisheries) – 9 (45%), University of Dubrovnik (Mariculture) – 8 (36%), James Cook University (Aquaculture Science & Technology) – 20%. However, the University of Vigo (Aquaculture), Universidad de Cádiz (Aquaculture and Fishing), Norwegian University of Science and Technology (Health Management in Aquaculture), and Kentucky State University (Aquaculture) offered only 100% of required courses in their programs. Utrecht University (Marine Sciences) offered the fewest mandatory courses 9% and Nord University (Master of Science in Aquaculture) offered 11% of mandatory courses.

The distribution of credits for studying the mandatory courses of the master's program showed a leading position in the Norwegian University of Science and Technology (Health Management in Aquaculture) – 120 ETCS (100%), Ghent University of Belgium (Aquaculture) – 115 ETCS (96%), UiT's the Norwegian College of Fishery Science (Marine Biotechnology) – 110 ETCS (92%), University of Klaipeda (Marine Biotechnology) – 78 ETCS (65%), University of Patras (Sustainable Fisheries, Aquaculture) – 60

ETCS (67%), University of Algavre (Aquaculture and Fisheries) – 42 ETCS (54%), Polytechnic University of Valencia (Aquaculture) – 36 ETCS (60%), Slovak University of Agriculture (Management of Animal Production) – 60 ETCS (50%). The following programs had the lowest number of credits for compulsory courses: James Cook University (Aquaculture Science & Technology) – 24 ETCS (20%), Porto University (Marine Sciences – Marine Resources) – 25 ETCS (21%) and Utrecht University (Marine Sciences) – 15 ETCS (13%), Nord University (Master of Science in Aquaculture) – 10 ETCS (8%) (Figure 8).

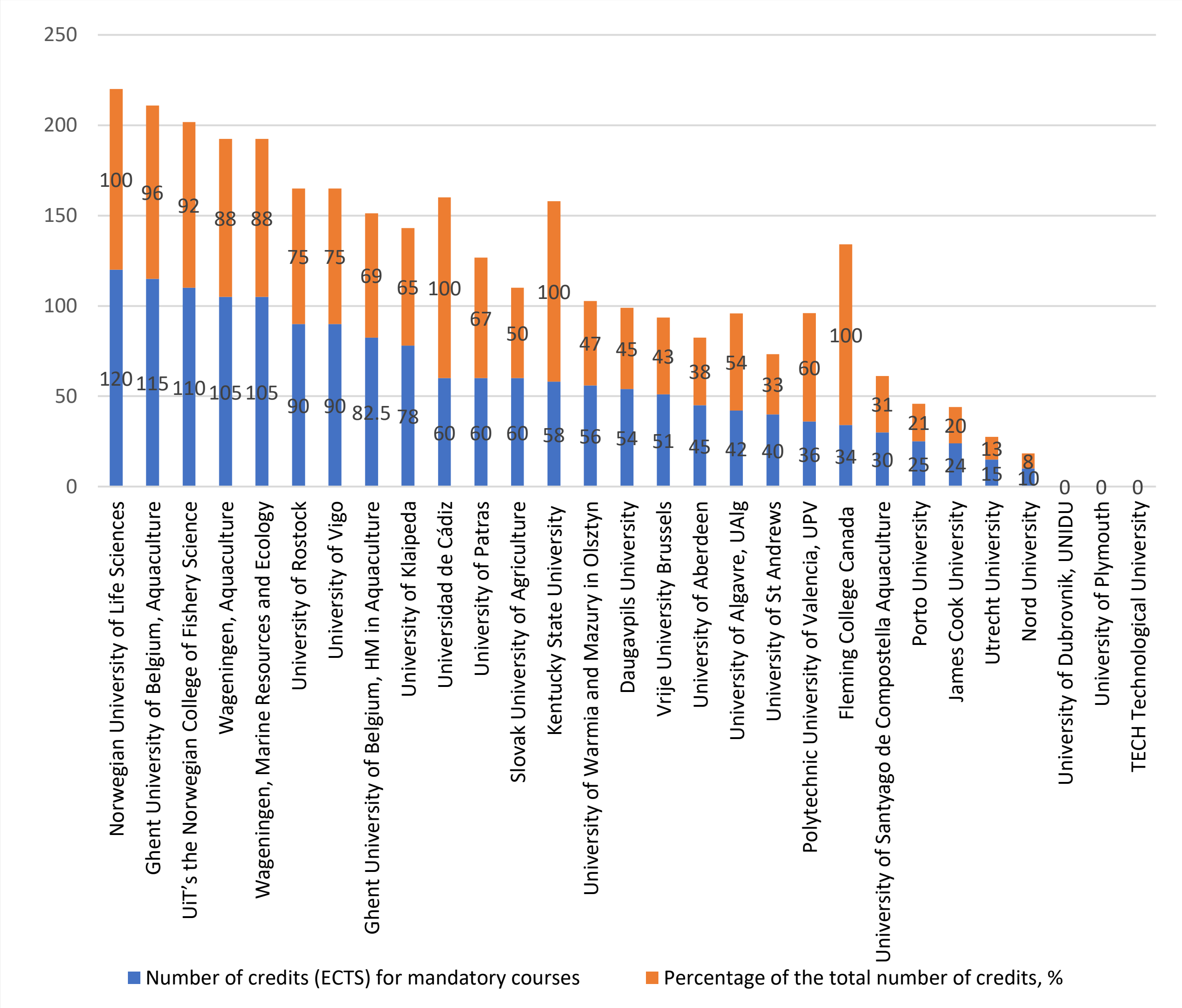

Figure 8. Distribution of universities by the number of credits (ECTS) for mandatory courses

Among the other master's programs of the surveyed universities, the distribution of credits for manatory courses ranged from 56 ETCS (47%) to 105 ETCS (88%). University of Dubrovnik (Mariculture) has left data on the number of credits for mandatory courses unavailable to interested parties and students.

The analysis of the number of elective courses allows us to draw a conclusion about the availability of the program option regarding the formation of an individual educational trajectory. At the same time, both the number of courses and their percentage in the total educational load are important. Among all universities, the highest number and percentage of elective courses in such master's programs as: Utrecht University (Marine Sciences) – 20 (91%), Nord University (Master of Science in Aquaculture) – 17 (89%), University of Rostock (Aquakultur) – 17 (77%), Vrije University Brussels (Marine and Lacustrine Science and Management, Oceans and Lakes) – 36 (73%), University of Klaipeda (Marine Biotechnology) – 16 (64%), (University of Dubrovnik (Mariculture) – 14 (64%), University of Algavre (Aquaculture and Fisheries) – 11 (55%), Slovak University of Agriculture (Management of Animal Production) – 14 (52%), University of Aberdeen (Marine and Fisheries Ecology) – 5 (45%), Wageningen (Aquaculture and Marine Resource Management: Aquaculture) – 8 (44%), Wageningen (Aquaculture and Marine Resource Management: Marine Resources and Ecology) – 8 (44%), Polytechnic University of Valencia (Aquaculture)

– 10 (44%), University of Warmia and Mazury in Olsztyn (Aquaculture and Aquaristics) – 7 (29%), James Cook University (Aquaculture Science & Technology) – 5 (33%), Ghent University of Belgium (Health Management in Aquaculture) – 6 (38%). UiT's the Norwegian College of Fishery Science (Marine Biotechnology) program was distinguished by the smaller number of optional courses and their percentage in the total number of courses – 4 (14%). The rest of the master's programs did not have elective courses or did not present information about their presence in the curriculum (Figure 9).

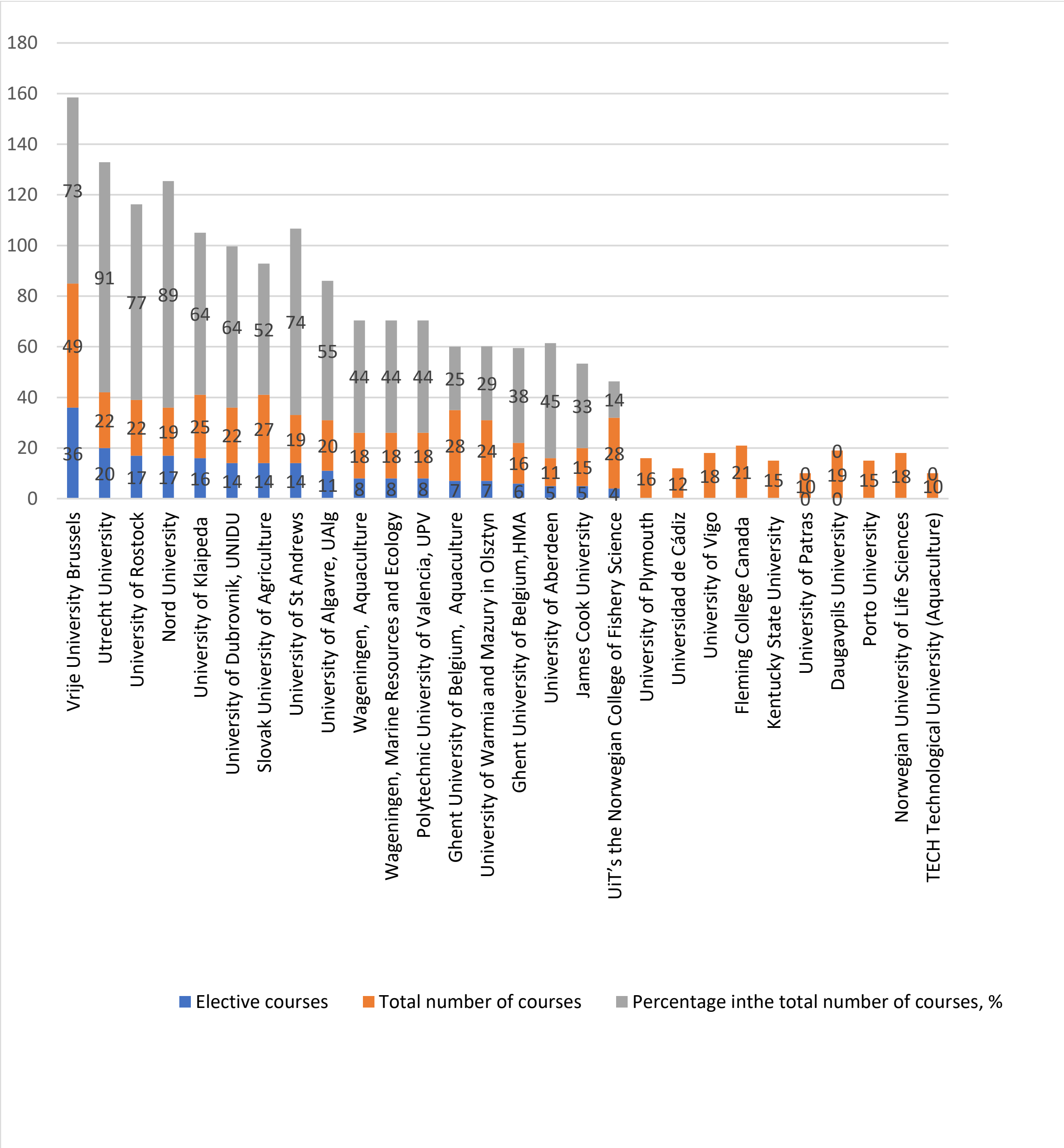

Figure 9. Distribution of universities by the number of elective courses

An important indicator that characterizes the option of building a student's individual educational trajectory and is a sign of student–centered teaching of the master's program is the percentage of ETCS credits for studying elective disciplines among the entire load of the program in ETCS (Figure 10).

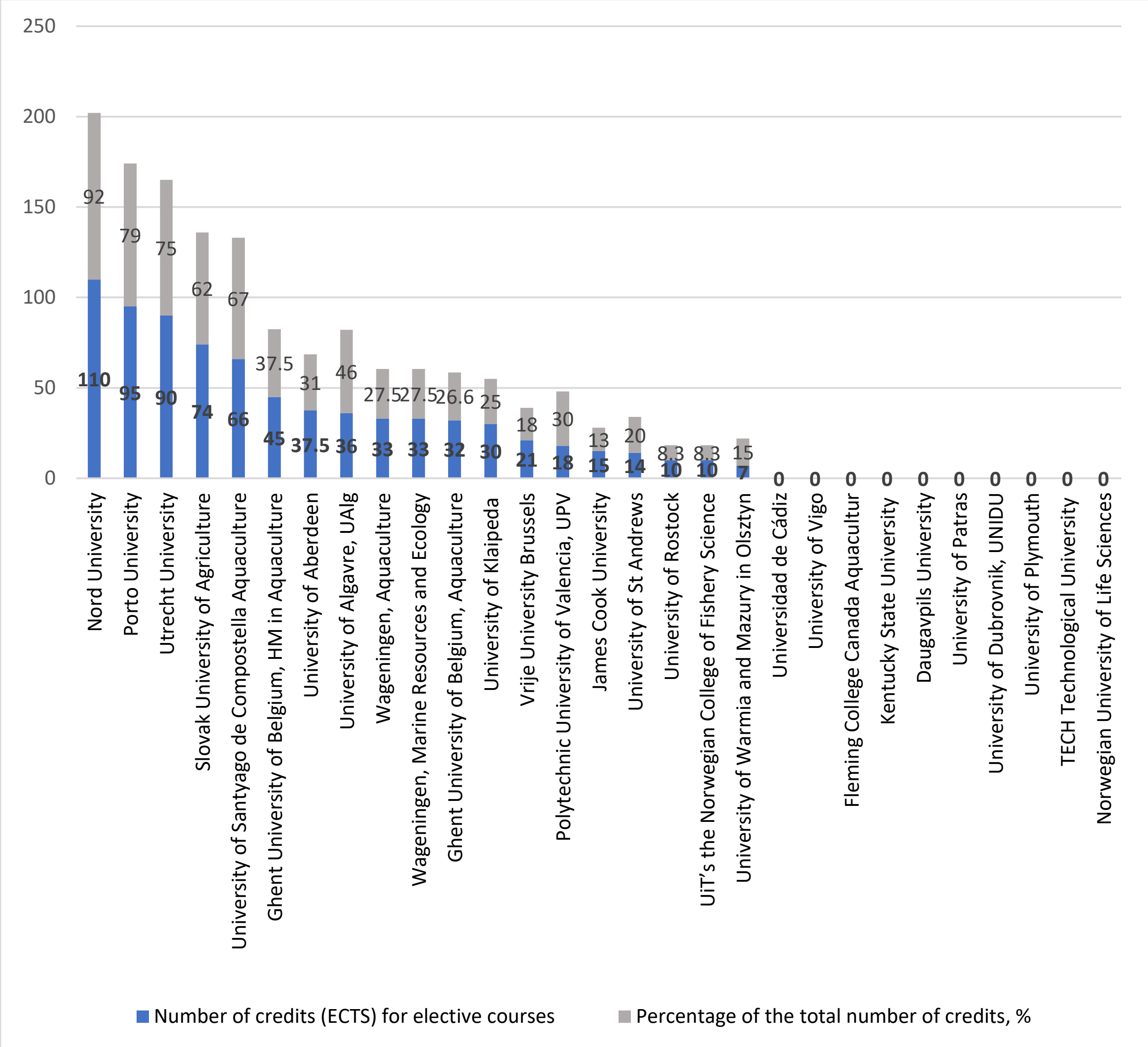

Figure 10. Distribution of universities by the number of credits (ETCS) for elective courses

As we can observe the largest number of ETCS credits both in absolute and relative terms are offered by such master programs as: Nord University (Master of Science in Aquaculture) – 110 (92%), Porto University (Master Degree in Marine Sciences – Marine Resources) – 95 ETCS (79%), Utrecht University (Marine Sciences) – 90 ETCS (75%), University of Santyago de Compostella Aquaculture – 66 ETCS (67%), Slovak University of Agriculture (Management of Animal Production) – 74 (62%), Ghent University of Belgium (Health Management in Aquaculture) – 45 ETCS (37.5%), University of Algavre (Aquaculture and Fisheries) – 36 ETCS (46%), Polytechnic University of Valencia (Aquaculture) – 18 ETCS (30%), James Cook University (Aquaculture Science & Technology) – 15 ETCS (13%). Again, the rest of the universities had no elective courses at all. University of Dubrovnik (Mariculture) has left data on the number of credits for elective courses unavailable to interested parties and students.

The importance of practical training and internship is beyond doubt in any educational system. Usually, a greater amount of time spent by a student during practical exercises directly at an industrial enterprise allows to form a high–quality specialist in advance even before the completion of the educational process at the university (Figure 11).

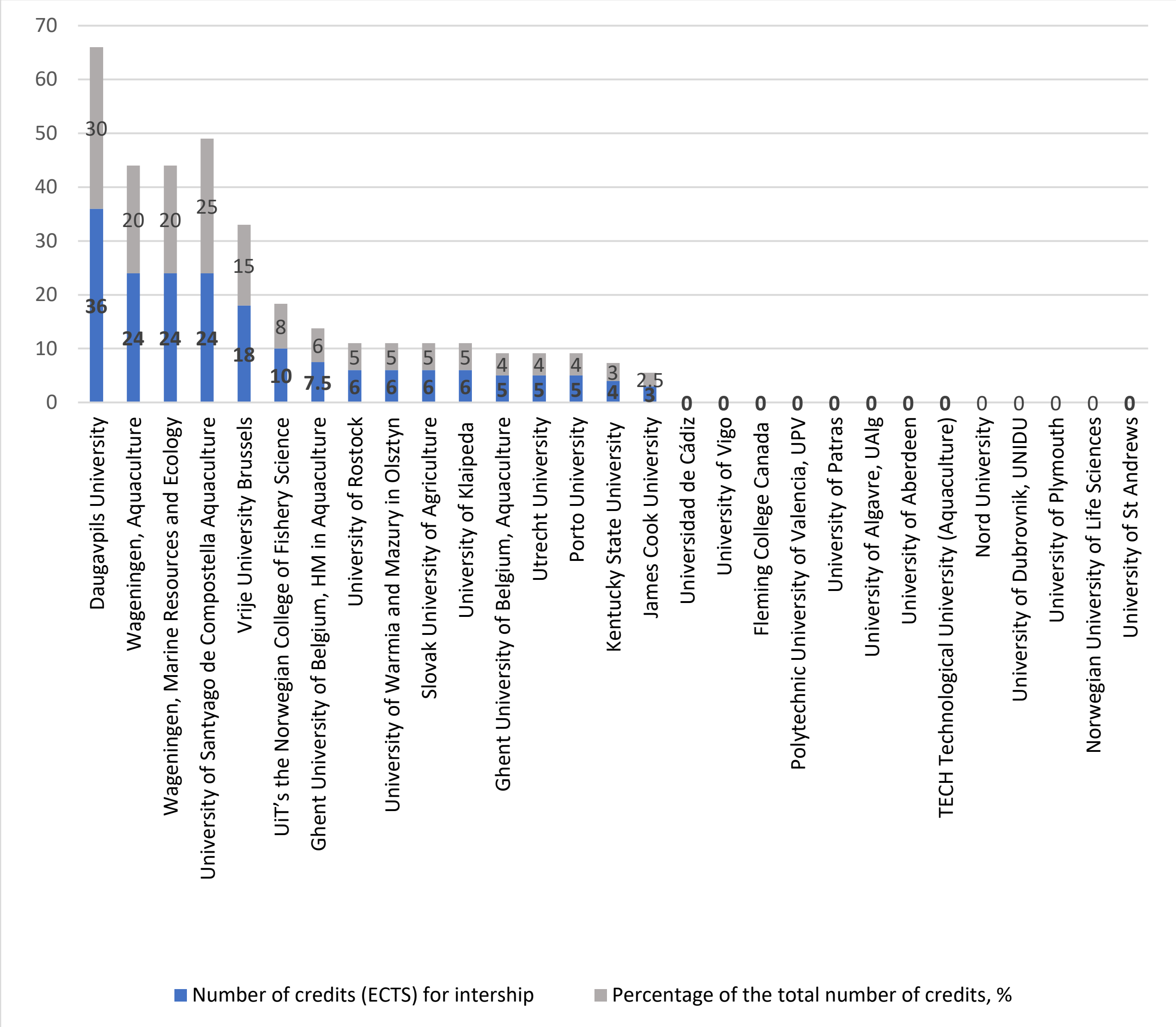

Figure 11. Distribution of universities by the number of credits for internship

The most credits for the practical training of students and their internships were allocated in the master's programs: Daugavpils University(Aquaculture) – 36 ETCS (30%), University of Santyago de Compostella Aquaculture – 24 ETCS (25%), Wageningen (Aquaculture and Marine Resource Management: Aquaculture) – 24 (20%), Wageningen (Aquaculture and Marine Resource Management: Marine Resources and Ecology) – 24 (20%), UiT's the Norwegian College of Fishery Science (Marine Biotechnology) – 10 (8%), Norwegian University of Life Sciences (Aquaculture, Management and Farming Technology) – 10 (8%), James Cook University (Aquaculture Science & Technology) – 3 (2.5%). Some master's programs offered 3 to 6 credits (3–6%) for practical training, and the rest either did not include it in the program at all or did not provide relevant information. University of Dubrovnik (Mariculture), Polytechnic University of Valencia (Aquaculture), University of Patras (Sustainable Fisheries, Aquaculture), University of Aberdeen (Marine and Fisheries Ecology), TECH Technological University (Aquaculture) have left data on the number of credits for internship unavailable to interested parties and students.

Most often, when they talk about skills, they mean professional knowledge and skills. But no less important are Soft Skills, universal non–professional qualities that help us interact with each other in a team, regardless of the field of activity. Study courses of master's programs include in the topics of the course questions that help to develop them directly or indirectly. That is, there are courses for the direct development of soft skills and courses that develop hard skills and soft skills at the same time (Figure 12).

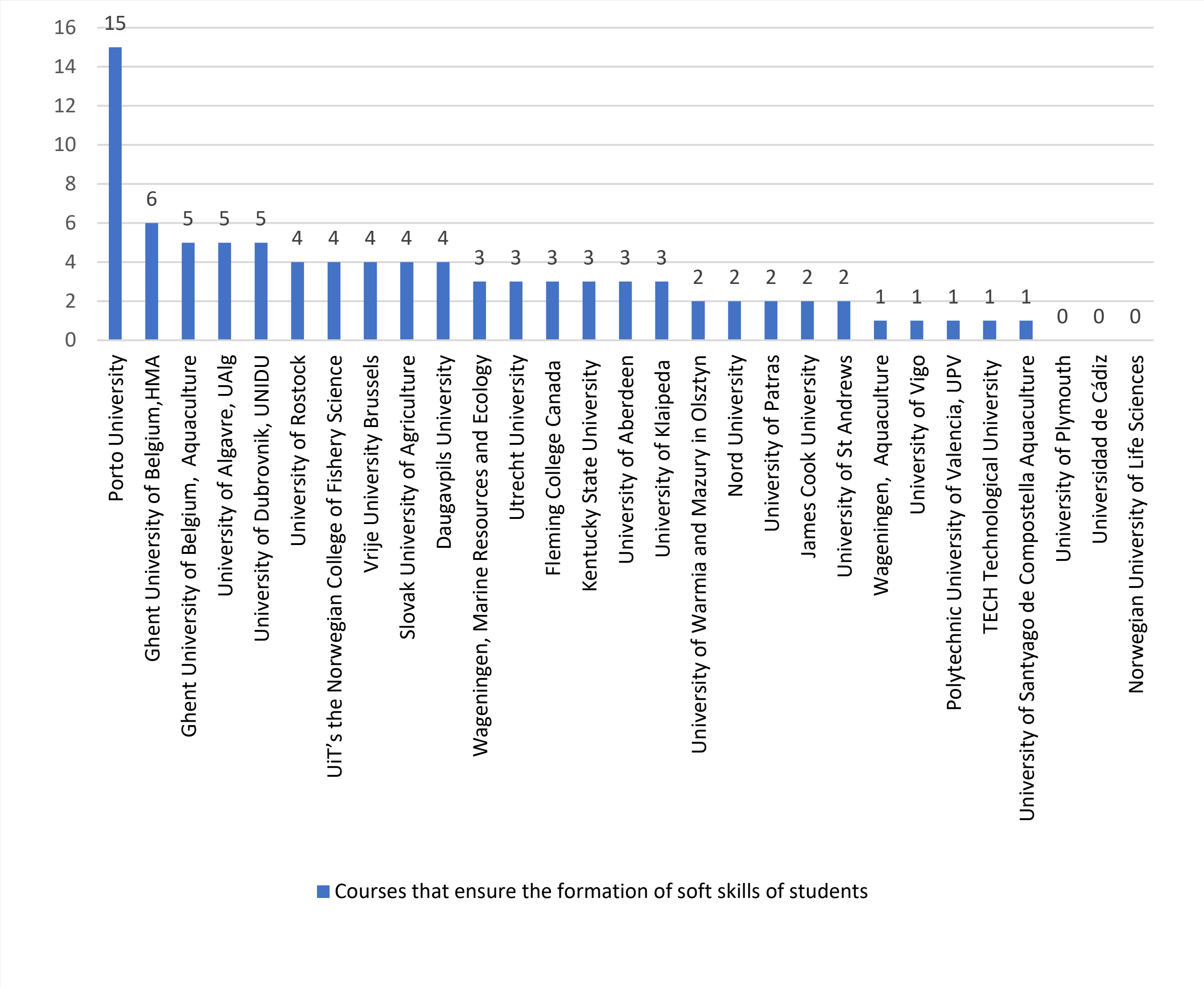

Figure 12. Distribution of universities by the number of courses that ensure the formation of student's soft skills

Master's programs that include training courses that form soft skills produce more successful students. In particular, the most courses that directly or indirectly form soft skills in students are: Porto University (Master Degree in Marine Sciences – Marine Resources) – 15 courses, Ghent University of Belgium (Health Management in Aquaculture) – 6 courses and Ghent University of Belgium (Aquaculture) – 5 courses, University of Dubrovnik (Mariculture) – 5, University of Algavre (Aquaculture and Fisheries) – 5. Some universities have, on average, 1–4 courses that form the soft skills of students or do not have such courses at all.

The master's educational and professional program includes two components of approximately equal scope – educational and research. A master's thesis is an important type of independent scientific work of students, during the writing of which they master the methods and acquire the ability to conduct scientific research. The student completes his educational and scientific training at the university with a master's thesis. Accordingly, a larger number of credits for the preparation of a master's thesis allows you to get a better prepared student.

Among universities, the largest number of hours for completing a master's thesis was allocated in the master's programs: UiT's the Norwegian College of Fishery Science (Marine Biotechnology) – 60 ETCS (50%), University of St Andrews (Master of Science Sustainable Aquaculture) – 60 ETCS (50%), Ghent University of Belgium (Aquaculture) – 30 ETCS (25%), Ghent University of Belgium (Health Management in Aquaculture) – 30 ETCS (25%), University of Patras (Sustainable Fisheries, Aquaculture) – 30 ETCS (33%), Daugavpils University(Aquaculture) – 30 ETCS (25%), Wageningen (Aquaculture and Marine Resource Management: Aquaculture) – 24 ETCS (20%), Wageningen (Aquaculture and Marine Resource Management: Marine Resources and Ecology) – 24 ETCS (20%), University of Vigo (Aquaculture) – 24 ETCS (20%), University of Warmia and Mazury in Olsztyn (Aquaculture and Aquaristics) – 24 ETCS (26%). Some of the master's programs offered 5–17 ETCS (4–14%) for the preparation of the master's thesis, and the rest of the universities did not allocate separate ETCS credits for the preparation of the master's thesis (Figure 13).

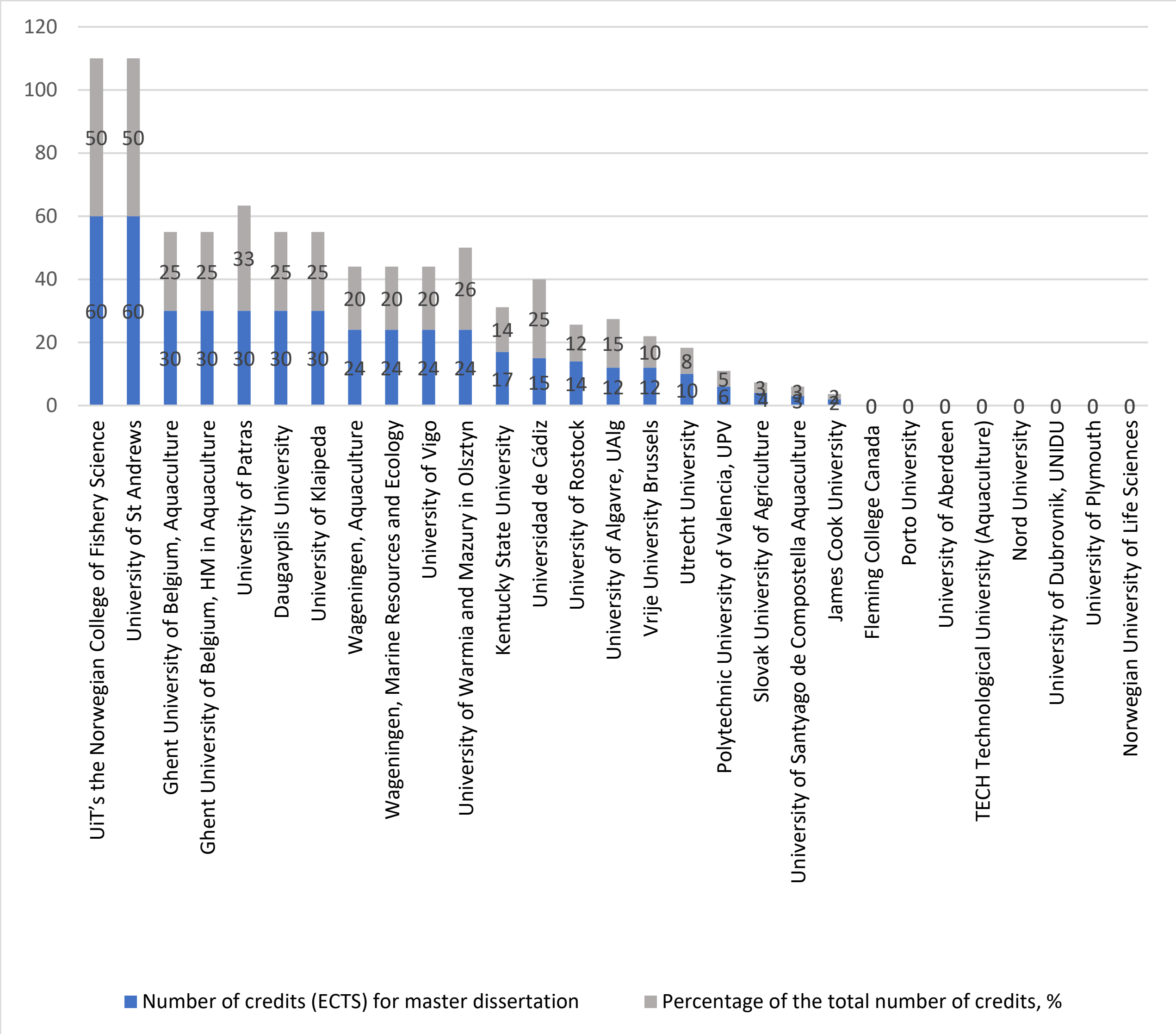

Figure 13. Distribution of universities by the number of credits (ETCS) for master dissertation (Thesis)

University of Dubrovnik (Mariculture) has left data on the number of credits for master dissertation unavailable to interested parties and students. University of Aberdeen (Marine and Fisheries Ecology) proposed project instead master dissertation.

The peculiarity of teaching methods also lies in the fact that it is a tool that is used in a two–way process of learning and connects the activities of the lecturer and those who are studying. In addition, a characteristic feature of teaching methods is that learning is not carried out directly with their help, but indirectly, thanks to the activity of the lecturer, who causes the necessary actions of those who study.

The universities we researched used different methods in their master's programs related to Aquaculture. In particular, there were mentions of such methods as: Lectures, Seminars, Laboratory Work, Working In Teams, Fieldwork, Industrial Visits, Away classes, Self–study, Personalized training, Excursion, Practical PC room classes, Theater role plays, Internship, Project Work, Tutorials and Conferences. The larger the list of study methods offered by the university, the more deeply students acquire knowledge.

Among the leading universities in terms of the number of teaching methods used in Master's courses in Aquaculture were: Ghent University of Belgium, Wageningen, University of Rostock, Fleming College Canada, UiT's the Norwegian College of Fishery Science. Some universities had a minimal list of teaching methods that did not appear to be innovative, but involved classic lectures, seminars and laboratory sessions, among them: Universidad de Cádiz, University of Vigo, Kentucky State University, University of Warmia and Mazury in Olsztyn.

The most common teaching tools were lectures, seminars, Internship, Project Work and laboratory classes, less popular were such work methods as Fieldwork and Working In Teams. The most rare method of learning educational material was proposed as Theater role plays Tutorials and Conferences. Some universities did not show full information about the teaching methods used (Figure 14).

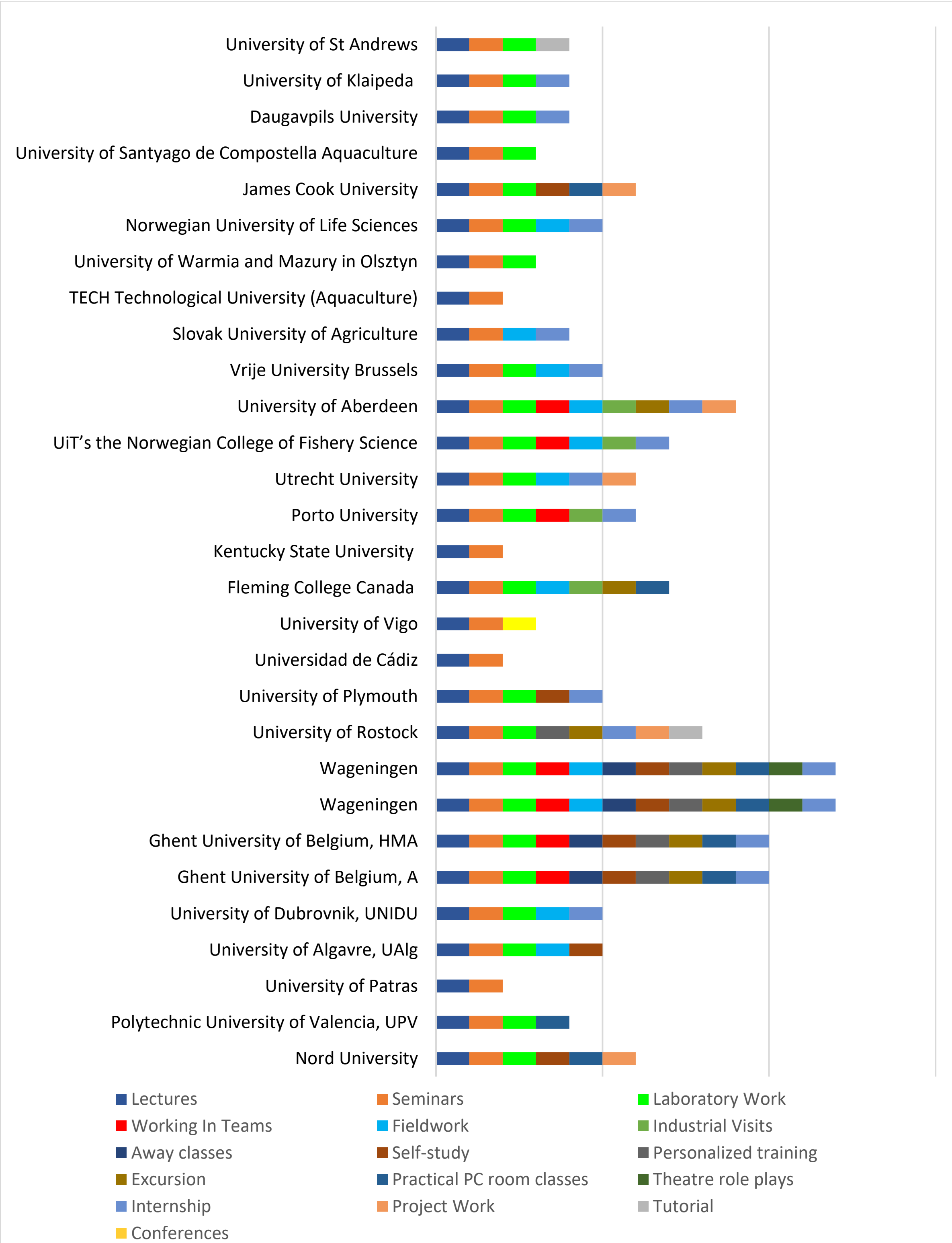

Figure 14. Use of teaching and learning methods by universities

The most common methods of studying the educational material were: working with lecture notes, working with a book, working with regulatory and legal acts, summarizing, systematizing, deepening the material, conducting calculations, developing a research plan.

Comparative analysis of the learning outcomes

The first step in designing or redesigning a program is to formulate learning outcomes. The purpose of learning outcomes is to clearly describe what the student is expected to demonstrate upon completion of the entire program, a module, or a course.

It is worth noting that benchmarks are based on the formulated learning outcomes. In the literature on benchmarking and learning outcomes, there are many different definitions of learning outcomes or competences.

The European Qualifications Framework (EQF)11 defines learning outcomes as follows: Statements of what a learner knows, understands, and is able to do when they have completed a learning process; these are defined in terms of knowledge, skills, and competence. According to the EQF, competence is the demonstrated ability to apply knowledge, skills and personal, social and/or methodological abilities in work or study situations and in professional and personal development. According to IUCEA12, learning outcomes are considered to be what a learner is expected to know and understand and be able to do or demonstrate after completing a learning process within a recognised qualifications framework.

The concept of competencies also recurs in discussions of learning outcomes. Although the term "competence" is used regularly, it is not always clear what competencies are. All definitions refer to knowledge, knowledge application, and skills. There is also talk of skills and attitudes. It appears that competencies at the moment mean learning outcomes and more. They include relevant skills that can be acquired outside the formal teaching and learning environment of a program and are complemented by the natural abilities and experiences of learners. In short, learning outcomes are not the same as competencies, but the two are not mutually exclusive. A graduate who can demonstrate competencies in the workplace has acquired those competencies in part as a result of hisor her studies. However, some of the competencies have to do with innate characteristics.

An important step in the process of formulating learning outcomes is to determine the total number of learning outcomes in master's programs (Figure 15).

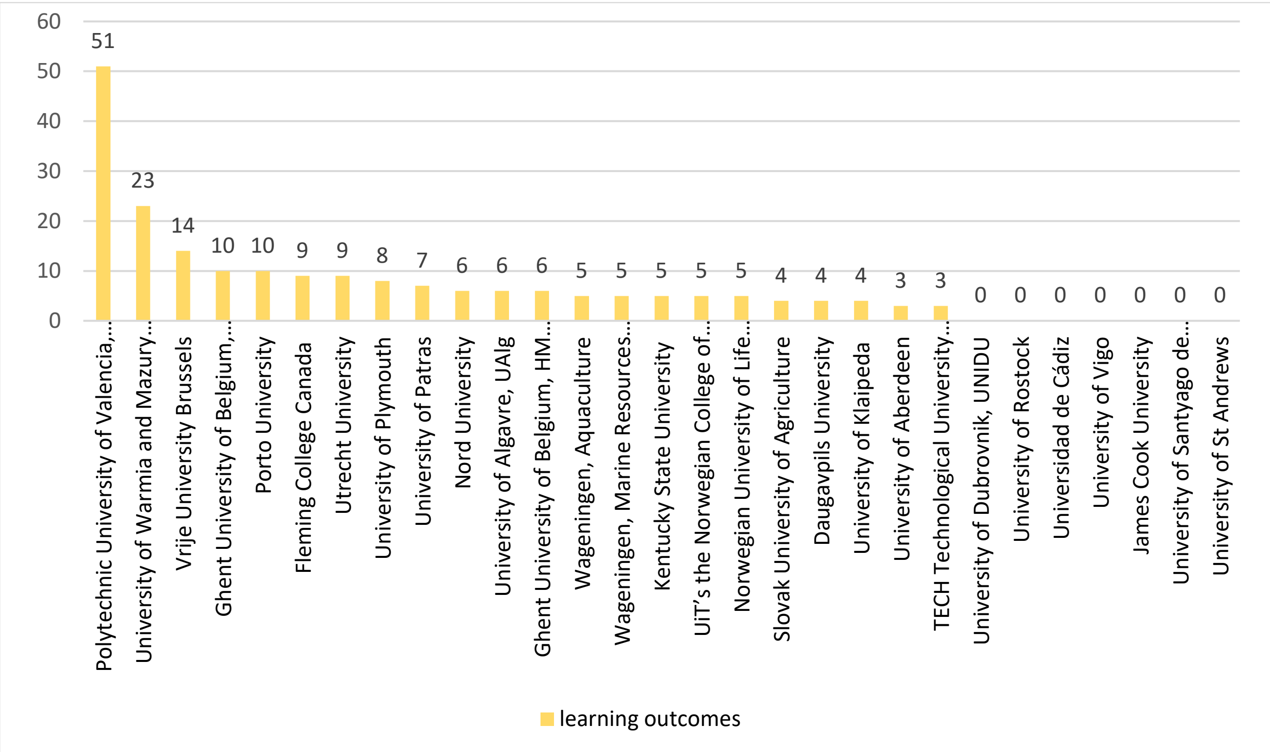

Figure 15. Total number of learning outcomes in master programs

Across all universities analyzed in the benchmarking exercise, the largest number of learning outcomes in master's programs was 51 in Polytechnic University of Valencia, 23 at the University of

Warmia and Mazury in Olsztyn, also Ghent University of Belgium 10 – programs, Aquaculture, University of Plymouth – 8 programs, Fleming College Canada – 9 programs, Porto University–10 programs, and Utrecht University –9 programs (Figure 15).

A very important step in the benchmarks of the master's programs is the analysis of the competencies acquired by the students in the field of aquaculture. It is also necessary to note that the benchmarks that follow the master's programs should be designed to be environmentally friendly (ecological) (Figure 16).

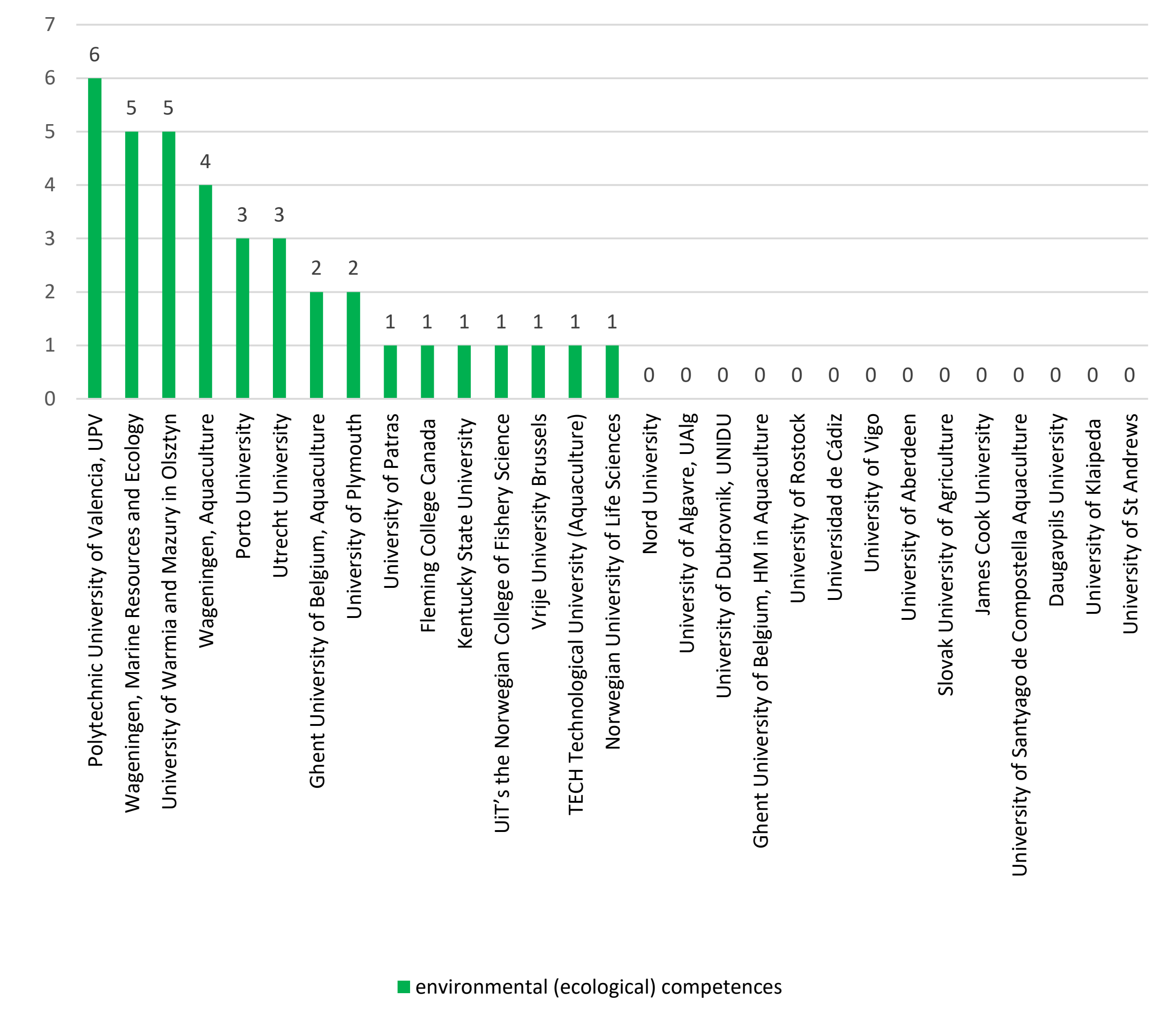

Figure 16. Number of environmental (ecological) competences in master programs learning outcomes

However, it should be noted that among the large number of competencies in the learning outcomes of the master's programs that we were able to study, the competencies related to ecology and rational use of nature were very low. The highest number of environment-related (ecological) competences in the learning outcomes of master's programs was found in the following universities: Polytechnic University of Valencia UPV – 6, University of Warmia and Mazury in Olsztyn – 5 programs, Wageningen Aquaculture – 4 programs and 5 – programs in Wageningen, Marine Resources and Ecology (Figure 16).

The next step in the process after the formulation of learning outcomes is to identify what courses are needed to achieve the learning outcomes. To check if the planned courses cover the learning outcomes environmental (ecological), we compared the obtained indicators between universities (Figure 17).

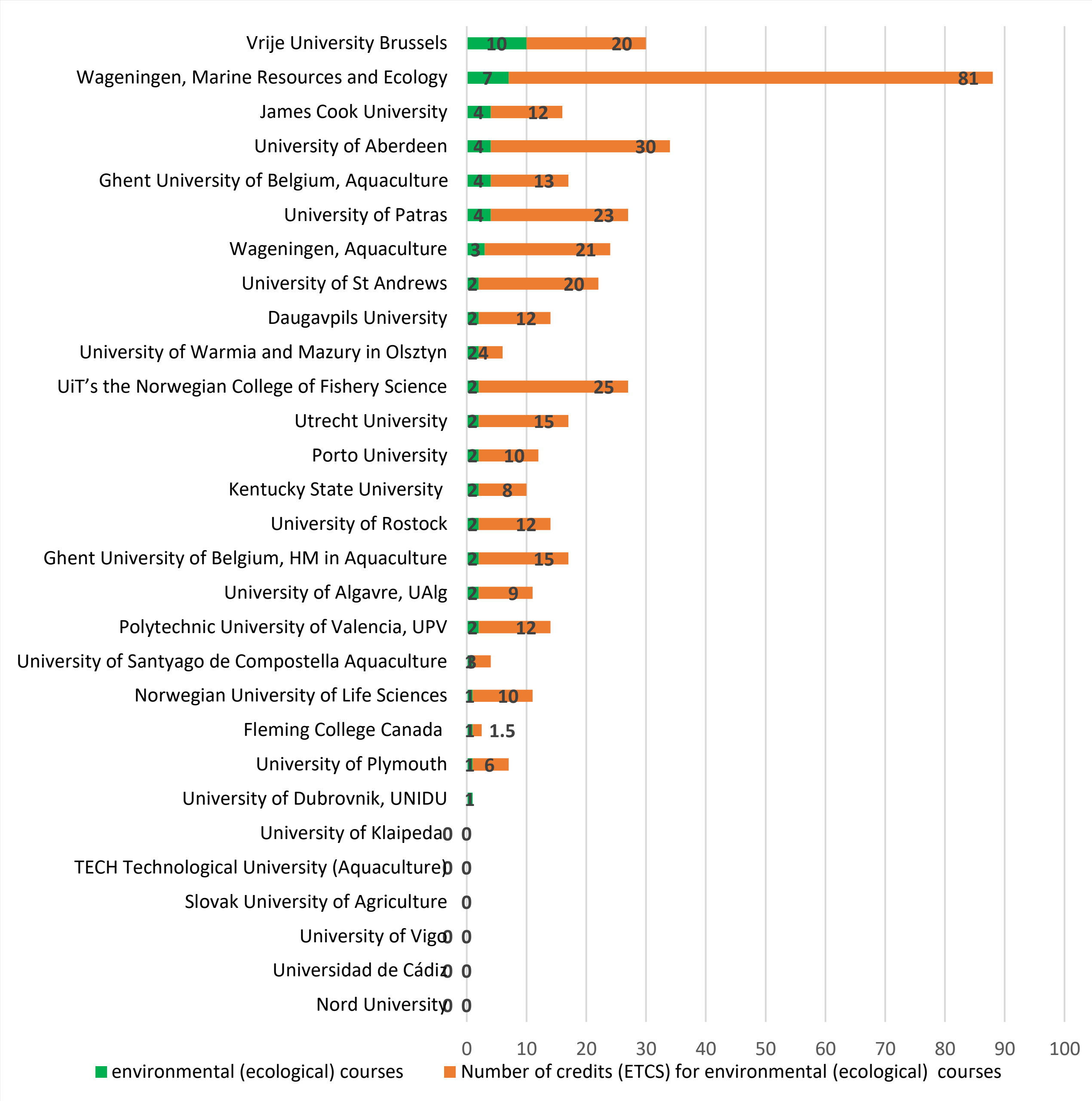

Figure 17. Number of environmental (ecological) courses and number of their credits (ETCS) in master programs

We can see is a positive relationship between number of environmental (ecological) courses and number of their credits. The division of courses and credits during benchmarking among the studied universities ranged from 7 courses of 81 credits (ETCS) in Wageningen, Marine Resources and Ecology to 1 course of 1,5 credits (ETCS) Fleming College Canada (Figure 17).

Analyzing the number of fishing competences among the master's programs of the studied universities, relevant learning outcomes were found at the University of Warmia, Mazury in Olsztyn and Utrecht University and Vrije University Brussels (Figure 18).

Figure 18. Number of fishery competences in master programs learning outcomes

In our opinion, such a low number of fishery programs is connected with the fact that each University made its personal choice, taking considering the mission of the university and the resources available for implementation.

The analysis of the number of fishing courses and the number of their credits (ETCS) in master's programs allows us to conclude that in the studied universities the choice of courses and the number of their credits is at the discretion of the university. In our opinion, this depends on the specifics of the university, staff support, material and technical support, geographical features of countries and the needs of the product market and the labor market in this area (Figure 19).

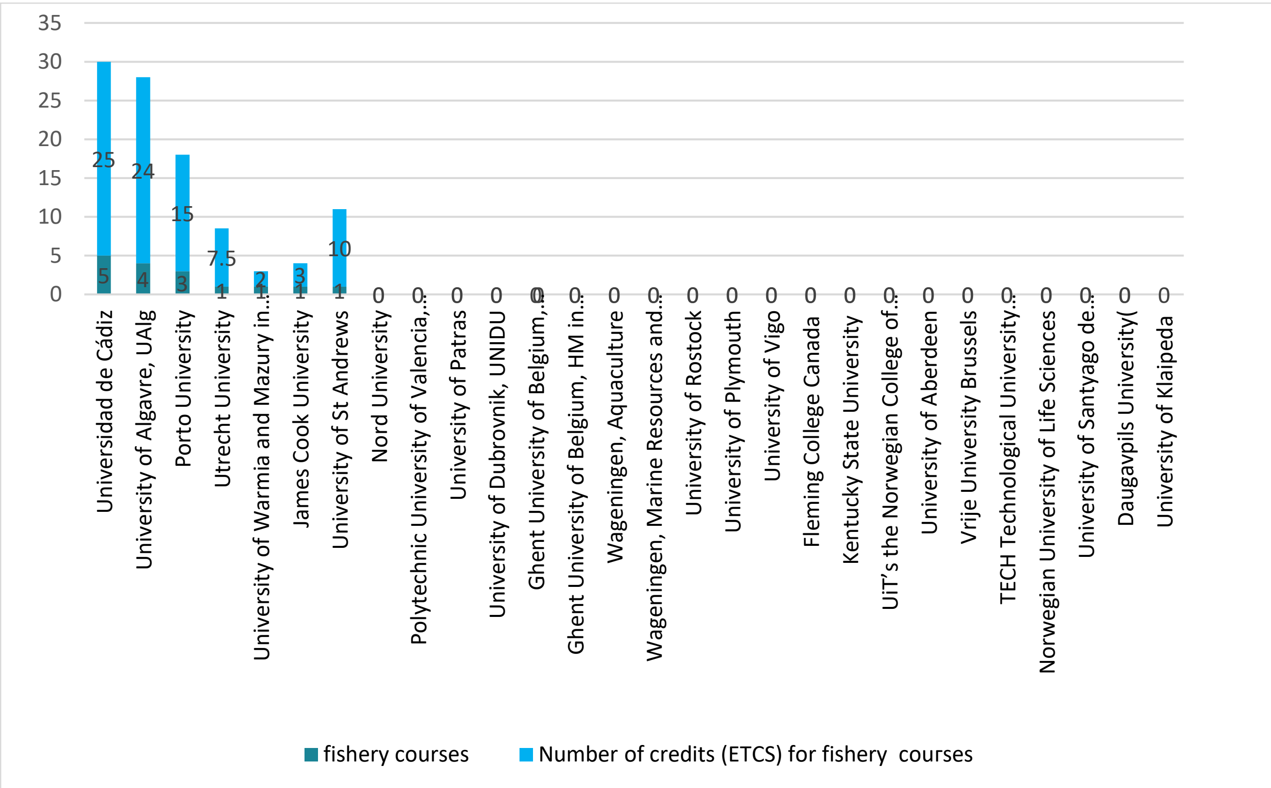

Figure 19. Number of fishery courses and number of their credits (ETCS) in master programs

The division of courses and credits during benchmarking among the studied universities ranged from 5 courses of 25 credits (ETCS) the Universidad de Cádiz to 1 course of 3 credits (ETCS) the James Cook University (Figure 19).

The latest trends in the development of higher education include the ability of master's programs to directly or indirectly influence the development of soft skills in students through various master programs courses (Figure 20).

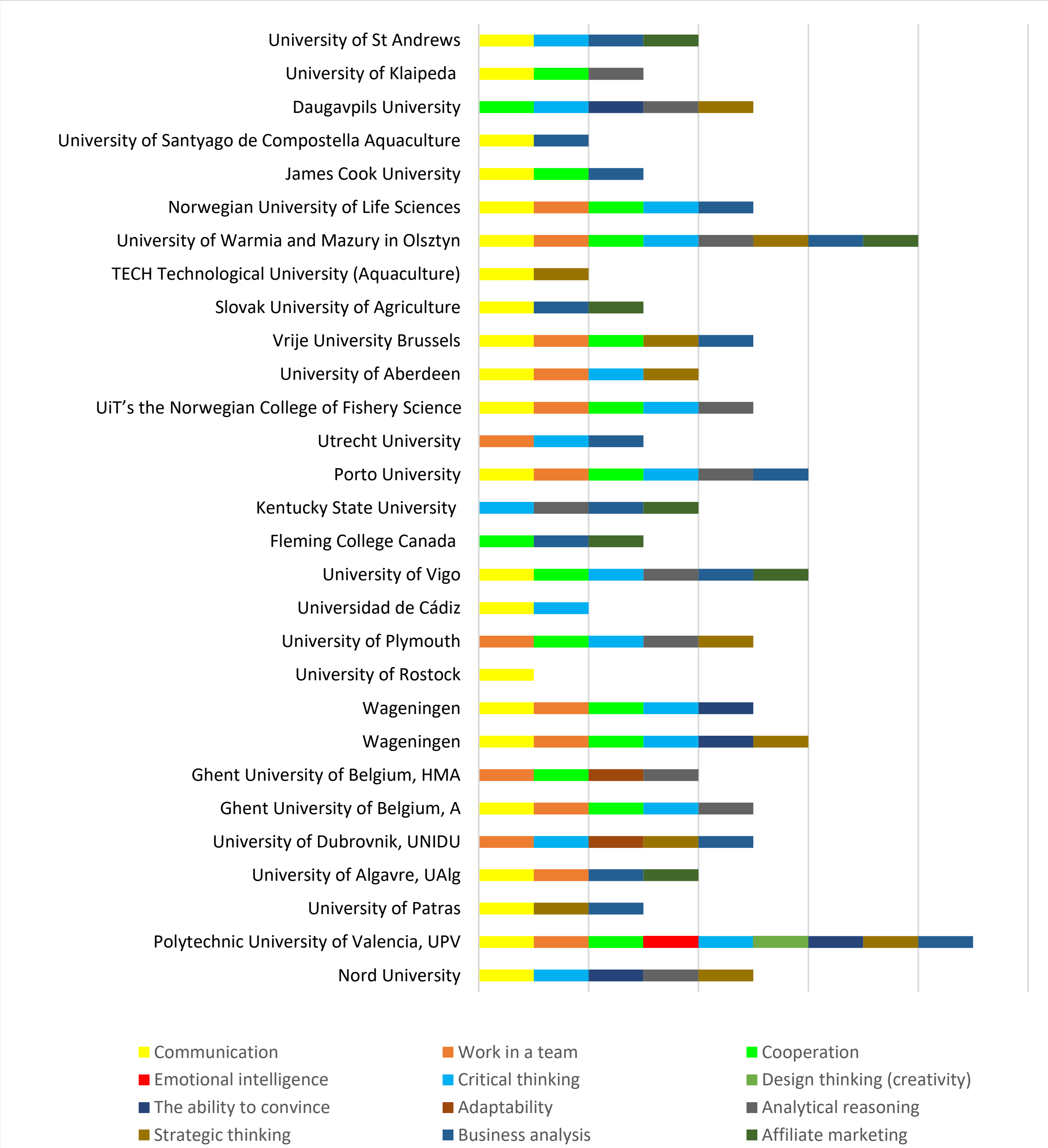

Figure 20. Distribution of soft skills between master programs courses

Among the studied universities, the number of soft skills is quite diverse. In particular, the most common are communication, work in a team, cooperation, emotional intelligence, critical thinking, creativity, business analysis and others. Analyzing the results of the benchmarking, it can be noted that soft skills courses of master's programs are quite widely represented in all the studied universities. At the same time, it should be noted that students studying at the Warmian-Masurian University in Olsztyn and the Polytechnic University of Valencia UPV have the most opportunities (Figure 20).

In formulating learning outcomes, more courses should be added to educational programs that provide students with the opportunity to cultivate soft skills (Figure 21).

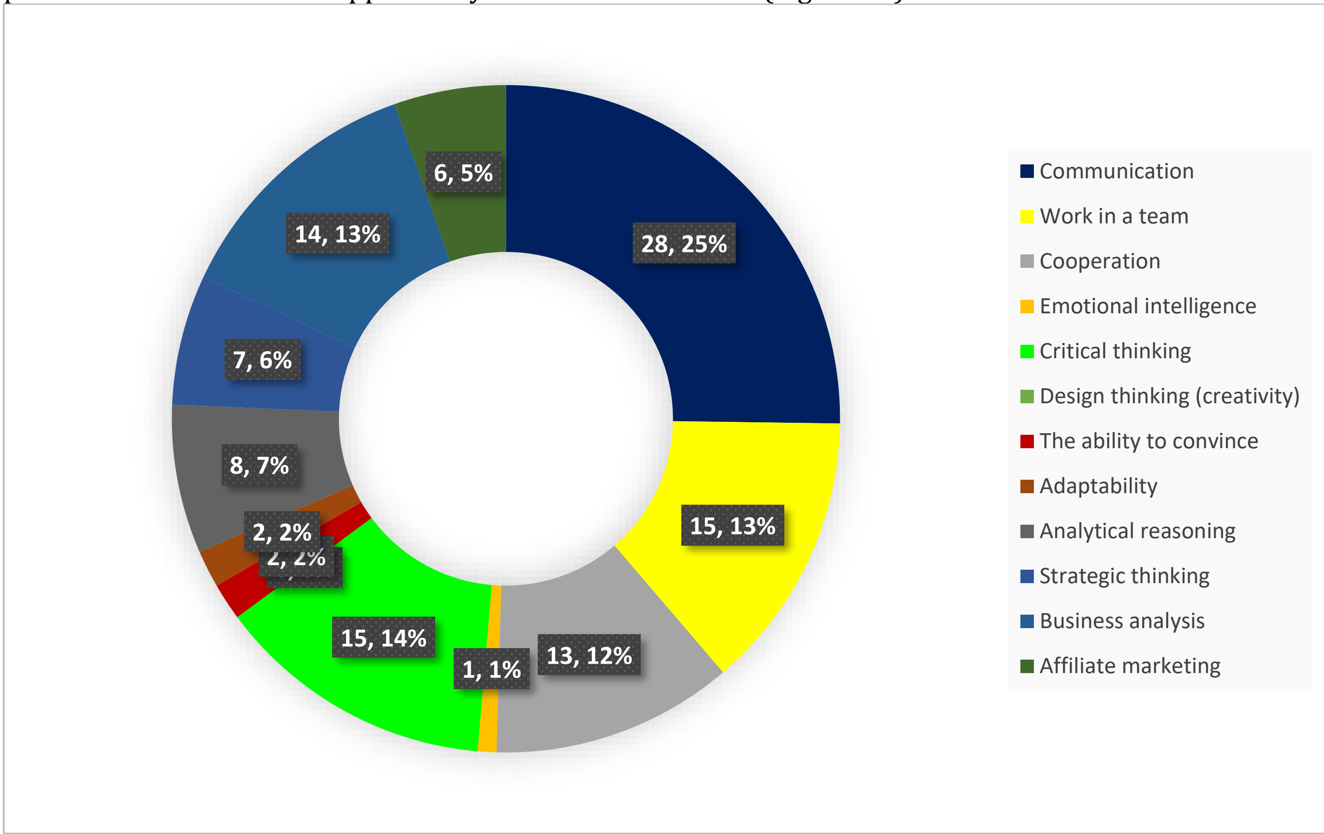

Figure 21. The frequency of studying of certain soft skills type in master's programs by universities

The largest share of the studying of certain soft skills type in master's programs among all studied universities was «communication» – 30,27%, «critical thinking» – 15,14%, «work in team» – 15,13%, «cooperation» – 13,12% and «business analysis» – 3.12% (Fig.7).

When analyzing the results of the following diagram, it should be noted that it contains the results of our benchmarking at leading European universities, where the maximum presence of the studied indicators in the master's programs indicates the high quality of both the educational programs and the success of the educational system at a particular university.

These benchmarks aim to ensure the important processes of harmonization of education of master's programs and are undoubtedly useful for all the universities we have studied during our comparative study and search for the best reference program for students in aquaculture and fisheries. The analysis of the studied Master's degree programs of all universities shows that they all aim to ensure that students have the opportunity to develop the necessary competencies during their studies, which are important and useful both from the point of view of academic and professional training in aquaculture and fisheries. At the same time, such main indicators as: ETCS volume, general and professional competences, assessment methods, material and technical support, sost skills, fishery competences, objectives, learning outcomes, teaching methods and others were evaluated. As we can see from the diagram, according to these indicators, the following universities had the most effective and suitable Master's program for the Aquaculture and Fisheries profile: Utrecht University, University of Warmia and Mazury in Olsztyn, Wageningen, Aquaculture, Wageningen, Marine Resources and Ecology.

Thus, we can conclude that all the analyzed programs are modern and unique, each of them taking into account both geographical and national specificities of aquaculture and fish farming. Despite their diversity, all benchmarked master's programs provide high quality education for students and meet the criteria of the Bologna Process (Figure 22).

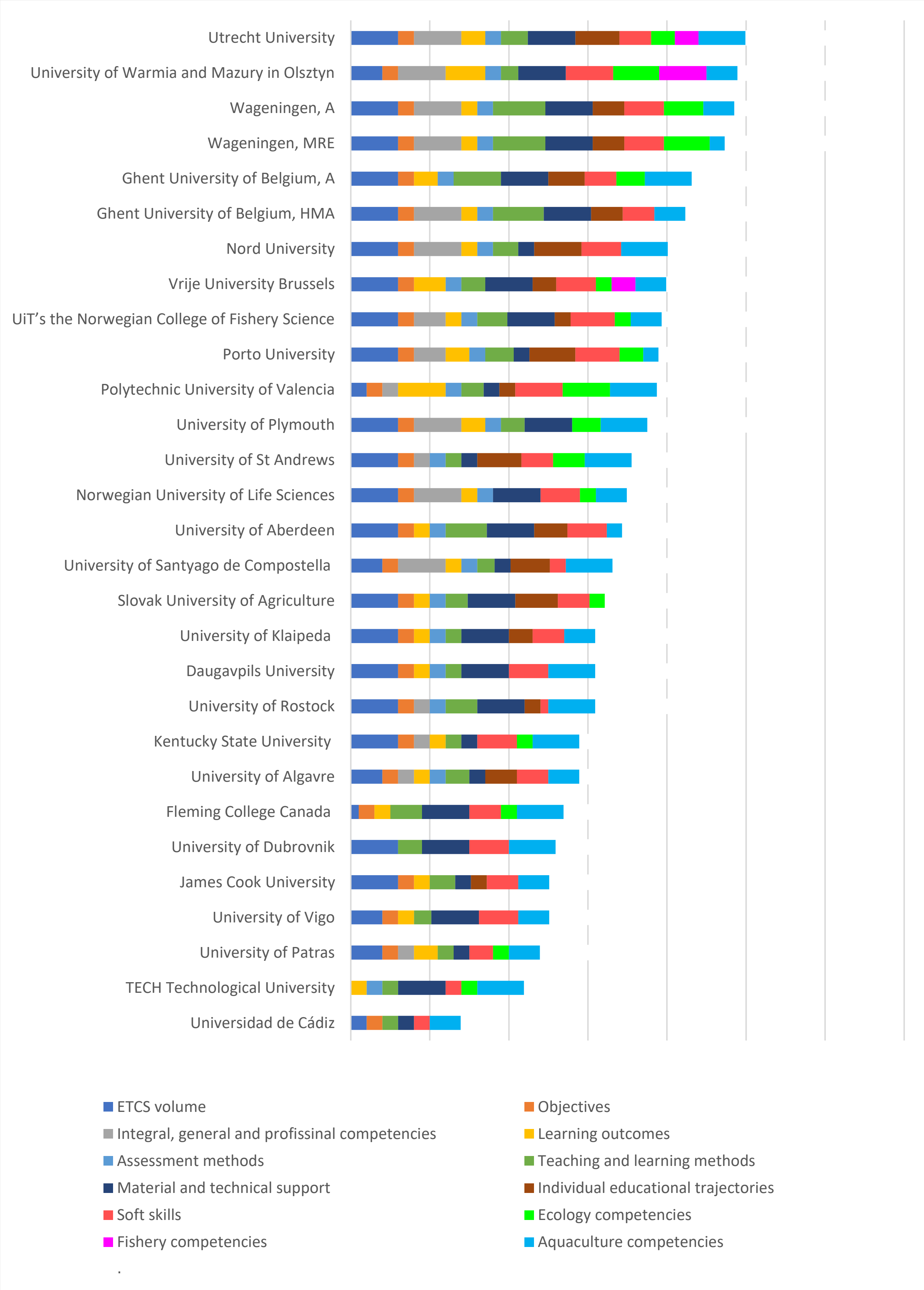

Figure 22. Evaluation of master's degree programs based on the availability of their characteristics, quantitative and qualitative indicators

General conclusion

The universities of the EU, North America and Australia offer modern and advanced master's degree programs in aquaculture and fisheries of different directions, but all of them have their own peculiarities and characteristics related to the local conditions of aquaculture management, which are determined by regional geography, available waters, lakes, river systems, washed seas and oceans, and the conjuncture of the labor market and the market of agricultural products, as well as the needs of the society and economy of each country. Undoubtedly, each master's program is unique, interesting and to some extent innovative for education in Armenia and Ukraine. However, it is possible to use not only one master's degree program as a benchmark, but elements of different program that correspond to the respective ideas of a future master's degree program in aquaculture and fisheries, taking into account the specifics of each country and the requirements of national and European qualification frameworks.

PART II

BENCHMARKED MASTER'S PROGRAMS (CURRICULUMS) AND COURSES

NORD UNIVERSITY

1	Criterion A: University profile	
1.1	Name of the University	**NORD UNIVERSITY**
1.2	Classical or applied	Classical
2	Criterion B: Profile of the educational program (Curriculum)	
2.1	Number of Aquaculture disciplines	1
2.2	The name of the educational program	Master of Science in Aquaculture
2.3	Type of diploma	Diplomas are issued to students who complete a degree or vocational training programme. Diplomas contain the student's grades and a description of the study programme. Nord University introduced digital diplomas to graduating students. The diploma is available in the Diploma Registry. The Diploma registry: • makes it easier for applicants to present their results, • makes it easy for employers and educational institutions to receive results, • ensures that the shared information is valid.
2.4	Total number of credits (ECTS)	120
3	Criterion C: Setting the educational program (Curriculum)	
3.1	Duration of the program	2 years
3.2	The purpose of the educational program	This programme provides a scientific specialization in Aquaculture. It qualifies graduates for entry-level positions at research institutions or in trade and industry. Graduates can work as production managers for fish farms or in Aquaculture-related businesses, as quality managers or product developers within the farming, processing or food production industries. Other career opportunities include those in the public administration, especially as executive officer positions. If combined with a one year post-graduate certificate of education, graduates qualify to work as teachers in upper secondary schools.
4	Criterion D: Characteristics of the educational program (Curriculum)	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	
5	Criterion E: Teaching and assessment	
5.1	Teaching and learning methods	• Block-based lectures and independent assignments. • Lectures, assignments and feedback. • Mandatory participation. Some courses are given as combined lecture and laboratory exercise. • Some courses are a mix of self-study, seminars and practical exercises. • Self-study under supervision.
5.2	Assessment	The Norwegian system for grading and assessment using the letter grades A - F, in which A denotes the best/highest grade and F denotes "not passed". Grades can also be awarded as "passed", "not passed", "approved" and "not approved". Written and oral examinations. After submission of the Master thesis, the student defends his/her thesis in a public lecture. After the lecture, there will be an oral examination. Written examination, 4 hours, grading scale A-E, Beste A, Ikke bestått F Portfolio assessment, comprises 0/100 of the grade, grading scale Bestått - Ikke bestått. Must be passed prior to submission of the Written examination. Practical work - Laboratory safety, 1 days, grading scale Bestått - Ikke bestått Compulsory participation - Labotary Safty, 1 days, comprises 0/100 of the grade, grading scale Godkjent - Ikke godkjent.

		According to the general rules of the Faculty: each course has an oral evaluation with a written report at mid-semester, as well as an electronic evaluation at the end of the semester.	
6	**Criterion F: Software competencies**		
6.1	Integral competence	Be able to communicate biological issues both with the aquaculture industry, scientific environment and the public.	
6.2	General competences	Be able to work in the aquaculture industry or related industries such as feed or biotechnology companies, administrative or advisor positions in governmental or non-governmental organizations.	
6.3	Professional competences	Be able to build a scientific career and proceed to PhD studies within aquaculture and bioscience.	
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	Knowledge The candidate should: • Have general knowledge of aquaculture around the world, including the biology of major farmed aquatic species and farming technology • Have proficiency in different segments of aquaculture value-chain - reproduction, rearing, nutrition, health, disease control, product quality and food safety of farmed species • Have developed expertise in selected fields of aquaculture, based on the research work undertaken as part of the MSc programme Skills The candidate should: • Be able to apply the knowledge gained in biology to interpret and critically assess issues in aquaculture and offer practical solutions • Have intellectual and practical work skills - collect, analyse, interpret and understand biological, physical and chemical data • Be able to use scientific information and evaluate a range of research strategies and methods in aquaculture science and apply them to conduct research	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support		
8.2	Material and technical support		
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Scientific Communication and Research Methods	10	Midterm evaluation (dialogue meeting between lecturer and students). Written, web-based final evaluation.
9.1.2	Laboratory safety master	0	Practical work - Laboratory safety, 1 days, Compulsory participation
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Individual Curriculum 1	10	Mid-term oral evaluation with written report, and electronic evaluation at the end of the semester. Compound assessment, grading scale A-E, Beste A, Ikke bestått F Paper, comprises 40/100 of the grade, grading scale A-E, Beste A, Ikke bestått F. Oral Examination, comprises 60/100 of the grade, grading scale A-E, Beste A, Ikke bestått F

9.2.2	Individual Curriculum 2	5	Oral Examination, grading scale A-E, Beste A, Ikke bestått F
9.2.3	Fish muscle quality and biochemistry	10	Annual evaluations which are included in the university's quality assurance system.
9.2.4	Selected scientific methods	5	Each semester there is a an oral mid-evaluation (dialogue meeting) and an electronic final evaluation. In addition to this a written initial evaluation each fall semester.
9.2.5	Individual Curriculum 3	10	Mid-term oral evaluation with written report, and electronic evaluation at the end of the semester.
9.2.6	Individual Curriculum 4	5	Oral Examination, grading scale A-E, Beste A, Ikke bestått F
9.2.7	Reproductive Biology and Genetics in Fish	10	Compound evaluation, grading scale A-E, Beste A, Ikke bestått F Assignment, comprises 30/100 of the grade, grading scale A-E, Beste A, Ikke bestått F. Written examination, 4 hours, comprises 70/100 of the grade, grading scale A-E, Beste A, Ikke bestått F.
9.2.8	Reproductive Biology and Genetics in Fish	10	Mid-term oral evaluation with written report, electronic evaluation at the end of the semester.
9.2.9	Aquatic Genomics and Bioinformatics	10	Midterm evaluation (dialogue meeting between lecturer and students). Written, web-based final evaluation.
9.2.10	Aquatic Ecophysiology	10	Mid-term oral evaluation with written report, electronic evaluation at the end of the semester.
9.2.11	Evolutionary Behavioural Ecology	10	Compound evaluation, grading scale A-E, Beste A, Ikke bestått F Presentation, comprises 0/100 of the grade, grading scale Bestått - Ikke bestått. Oral examination, 25 minutes, comprises 100/100 of the grade, grading scale A-E, Beste A, Ikke bestått F.
9.2.12	Marine Biology	10	The study programme is evaluated annually by students by way of course evaluation studies (mid-term evaluation and final evaluation). These evaluations are included in the universitys quality assurance system.
9.2.13	Molecular Ecology	10	The study programme is evaluated annually by students by way of course evaluation studies (mid-term evaluation and final evaluation). These evaluations are included in the universitys quality assurance system.
9.2.14	Individual Curriculum 5	10	
9.2.15	Individual Curriculum 6	5	The study programme is evaluated annually by students

			by way of course evaluation studies (mid-term evaluation and final evaluation). These evaluations are included in the university¿s quality assurance system.
9.2.16	Fish muscle quality and biochemistry	10	Annual evaluations which are included in the university's quality assurance system.
9.2.17	Selected scientific methods	5	Each semester there is a an oral mid-evaluation (dialogue meeting) and an electronic final evaluation. In addition to this a written initial evaluation each fall semester.
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Final graduation examinations for the study programme are the Master thesis, trial lecture and oral examination.	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1.	The name of the course/module	Scientific Communication and Research Methods
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	This course offers practical training in basic scientific methods and communication skills for master students in aquaculture. It covers introductory experimental design and data analysis, and emphasizes development of skills for efficient retrival, critical review and management of academic information.
8.	Prerequisites for studying the course/module, connection with other educational components	All MSc students at Faculty of Biosciences and Aquaculture, UiN, and students qualified for admission to MSc in Aquaculture. Introductory courses in mathematics, statistics and computer programming.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
The student should:
- have practical knowledge of relevant scientific methods and communication
- understand common statistical methods and the general assumptions underlying both parametric and non-parametric analyses
- understand the ethical challenges involved in communicating research and world-wide dissemination of new scientific results

Skills
The student should:
- have the necessary skills for efficient retrieval, critical review and management of academic information
- be able to use relevant reference tools, presentation techniques, and demonstrate scholarly writing skills
- be able to participate in informed quantitative assessments of published results from aquaculture or marine ecology.

General competence
The student should:
- be able to apply basic research methods and academic communication skills of relevance for the completion of his/her master project
- be able to exchange views and experiences with others involved in aquaculture or marine ecology research and thereby contribute to the continued development of good research practices

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Block-based lectures and independent assignments. Lectures, assignments and feedback.	Midterm evaluation (dialogue meeting between lecturer and students). Written, web-based final evaluation.

GENERAL INFORMATION ABOUT THE COURSE #2		
1	The name of the course/module	Laboratory safety master
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Mandatory
4.	Semester	1st study year
5.	Number of ECTS credits	0
6.	The total number of hours	
7.	General description and purpose of the educational component	Laboratory safety is a course over one day. The course gives necessary information to new students and give training in how to work in the laboratory to avoid accidents and injuries. An introduction to various safety equipment and how this should be used will be given. Training will also be given for the faculty's chemical register and how waste is disposed. Must be taken at the start of the first semester of the study. Laboratory exercises cannot be performed in other courses before the KJ301F Laboratory safety course is accepted.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
The student should have knowledge about:

- what dangers that may happen in a laboratory
- what work routines that must be followed
- what kind of safety equipment that is available and when to use it safety data sheets and
- what kind of information to be found there
- the routines in case of fire or accidents/injuries

Skills

- The student shall be able to:
- work safe in a laboratory, under supervision of a supervisor know what to do in case of accidents know how to behave in case of fire

General competence
The student shall understand that:

- following the routines for work in the library, the work is safe and secure
- injuries and damages will easily happen if safety routines are not followed.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Mandatory participation. The course is given as combined lecture and laboratory exercise.	Practical work - Laboratory safety, 1 days, grading scale Bestått - Ikke bestått Compulsory participation - Labotary Safty, 1 days, comprises 0/100 of the grade, grading scale Godkjent - Ikke godkjent.

GENERAL INFORMATION ABOUT THE COURSE #3		
1	The name of the course/module	Individual Curriculum
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective

4.	Semester	1st study year
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The course covers the following topics: Literature surveys Extraction of essential information from larger bodies of publications Synthesising this information into a written project report/paper.
8.	Prerequisites for studying the course/module, connection with other educational components	Students enrolled in the MSc at Faculty of Biosciences and Aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
The student should:

- Have broad knowledge of theoretical and empirical aspects of a topic at Master¿s level within biology, chemistry or related topics.
- Be able to select the appropriate literature in order to understand a specific topic level within biology, chemistry or related topics.

Skills The student should:

- Be able to explain important theoretical and empirical aspects of a topic at Master's level as described above.
- Be able to search for appropriate references

General competence
The student should:

- Be able to communicate orally important theoretical and empirical aspects of a topic at Master's level,
- Be able to communicate in writing important theoretical and empirical aspects of a topic at Master's level.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Self-study with supervision	Self-study with supervision

GENERAL INFORMATION ABOUT THE COURSE #4

1	The name of the course/module	Individual Curriculum
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	1st study year
5.	Number of ECTS credits	5
6.	The total number of hours	
7.	General description and purpose of the educational component	The course is organized on an individual basis, i.e. the student and his/her supervisor together decide on a curriculum that is related to, though not the very background for, the thesis.
8.	Prerequisites for studying the course/module, connection with other educational components	Students enrolled in the MSc at Faculty of Biosciences and Aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

On successful completion of the course:
Knowledge
The student should:

- Have an overview of theory and problems in a topic at Master's level.
- The topic will be relevant for biology, chemistry or statistics Be able to acquire new knowledge in this topic

Skills
The student should:

• Demonstrate an overview of problems in this topic at Master's level • Know how to find relevant literature about this topic General competence The student should: • Be able to use this knowledge in his or her master thesis • Be able to communicate with other biologists about this topic at Master's level.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Self-study under supervision	The study programme is evaluated annually by students by way of course evaluation studies (mid-term evaluation and final evaluation). These evaluations are included in the university's quality assurance system.

GENERAL INFORMATION ABOUT THE COURSE #5		
1	The name of the course/module	Fish muscle quality and biochemistry
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	1st study year
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The course will provide fundamental knowledge about the chemical and biochemical composition and functional characteristic of fish muscle. After completed course the student will be able to understand how the quality of fish as raw material can vary, and be able to measure and document this variation. Content: The chemical, biochemical and structural composition of fish muscle, with main focus on muscle proteins and lipids. Post mortal changes, ice and freeze storage. Important quality aspects of fish such as colour, texture, fillet gaping, liquid binding capacity and rancidity. Influence of season, maturation, diet, feeding-regimes, photoperiod and slaughter procedures on flesh quality of fish.
8.	Prerequisites for studying the course/module, connection with other educational components	All students accepted as a Master student at University of Nordland or other institutions are qualified to attend the course. Laboratory safety or similar course must be passed prior to the lab.work. Knowledge in chemistry and biochemistry is necessary.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge The student should have: • Knowledge about the intrinsic quality of fish muscle. • Knowledge about external and internal factors affecting flesh quality in general • Good theoretical and practical knowledge of the methods used to evaluate the flesh quality of fish Skills Students should be: • Able to communicate skilled terminology with both academic research and private stakeholders within fisheries and aquaculture • Be able to perform classic quality assessments of fish using different analytical methods. • Be able to perform histological and enzymatic analysis of fish muscle Competence Students will: • Have a broad knowledge about fish quality in general Have adequate skills to participate in R & D project within seafood quality • Have extensive knowledge of the subject and ability to keep abreast of new knowledge within the field.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Five laboratory practices will illustrate important parts of the reading. 1) Analysis of protein, fat and water
2.	2) Histological freezing techniques, histochemical and immunohistochemical staining

3.	3) Proteolytic enzymes
4.	4) Liquid binding capacity
5.	5) Analysis of colour and texture.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Teaching 4 blocks per semester, 2-3 full days on each block (total of 10 days). In each block there will be obligatory laboratory work:	Annual evaluations which are included in the university's quality assurance system.

GENERAL INFORMATION ABOUT THE COURSE #6		
1	The name of the course/module	Selected scientific methods
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	1st study year
5.	Number of ECTS credits	5
6.	The total number of hours	
7.	General description and purpose of the educational component	The course is organized as seminars, with practical exercises preferably within chemical/biological analysis or data analysis. Written submissions and self tuituion must be expected. Syllabus and practical content are determined by the responsible professor. One or more students can participate, and the course should preferable be associated with the students master thesis.
8.	Prerequisites for studying the course/module, connection with other educational components	All students admittet to the Master in Aquaculture or Master in Marine Ecology at FBA or similar programs at other institutions are eligible.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge and understanding

- The student will:
- Have a broad knowledge of theoretical and empirical aspects of a topic at the master level.
- The topic can be relevant themes within aquaculture, biology, chemistry or statistics.
- Ability to acquire new knowledge within this field

Skills

The student will:

- Be able demonstrate important theoretical and empirical aspects of a topic at a master level.
- Have practical knowledge about relevant methods for data analyses or chemical/biological analytical methods within the field.

General competence

The student will:

- Be able to communicate important theoretical and empirical aspects of a topic at a master level
- Be able to communicate at the master level with other biologists on this issue

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The course is a mix of self-study, seminars and practical exercises.	

GENERAL INFORMATION ABOUT THE COURSE #7		
1	The name of the course/module	Individual Curriculum 3
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	1st study year
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The course covers the following topics: Literature surveys Extraction of essential information from larger bodies of publications Synthesising this information into a written project report/paper.
8.	Prerequisites for studying the course/module, connection with other educational components	Compulsory courses included in the study programme. Students enrolled in the MSc at Faculty of Biosciences and Aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
The student should:

- Have broad knowledge of theoretical and empirical aspects of a topic at Master's level within biology, chemistry or related topics.
- Be able to select the appropriate literature in order to understand a specific topic level within biology, chemistry or related topics.

Skills
The student should:

- Be able to explain important theoretical and empirical aspects of a topic at Master's level as described above.
- Be able to search for appropriate references

General competence
The student should:

- Be able to communicate orally important theoretical and empirical aspects of a topic at Master's level
- Be able to communicate in writing important theoretical and empirical aspects of a topic at Master's level.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	
2.	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Self-study with supervision	Mid-term oral evaluation with written report, and electronic evaluation at the end of the semester.

GENERAL INFORMATION ABOUT THE COURSE #8		
1	The name of the course/module	Individual Curriculum 4
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	1st study year
5.	Number of ECTS credits	5
6.	The total number of hours	
7.	General description and purpose of the educational component	The course is organised on an individual basis, i.e. the student and his/her supervisor together decide on a curriculum that is related to, though not the very background for, the thesis.
8.	Prerequisites for studying the course/module, connection	Compulsory courses included in the study programme. Students enrolled in the MSc at Faculty of Biosciences and Aquaculture.

	with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
The student should:
- Have an overview of theory and problems in a topic at Master's level.
- The topic will be relevant for biology, chemistry or statistics
- Be able to acquire new knowledge in this topic
- Skills

The student should:
- Demonstrate an overview of problems in this topic at Master's level
- Know how to find relevant literature about this topic General competence

The student should:
- Be able to use this knowledge in his or her master thesis
- Be able to communicate with other biologists about this topic at Master's level

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Self-study under supervision	The study programme is evaluated annually by students by way of course evaluation studies (mid-term evaluation and final evaluation). These evaluations are included in the university¿s quality assurance system.

GENERAL INFORMATION ABOUT THE COURSE #9

1	The name of the course/module	Aquaculture Nutrition
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	1st study year
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The following topics are covered, mainly pertaining to fish: Importance of nutrition and feeds in sustainable aquaculture. Approaches to study feed and nutrient requirements. Digestive physiology. Metabolic integration and energy utilization. Nutrient classes: functions and requirements for individual nutrients. Nutrition and health. Feed ingredients: nutrient digestibility and availability. Aquatic feeds: formulation and technology. Feeds and quality of farmed fish. Larval fish nutrition and feeding: an overview. Shellfish nutrition and feeding: an overview. Advances in aquaculture nutrition.
8.	Prerequisites for studying the course/module, connection with other educational components	Laboratory safety (or equivalent) must be taken prior to the lab work. This course is built upon the foundation course AK220F Fish Nutrition and Feeding offered at the Bachelor's level or similar recognized courses. It is expected that the students have an understanding of basic biochemistry including the metabolic pathways. Information on self-study web resources on these topics will be made available in the fronter classroom prior to the commencement of the teaching.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
The student should have:
- A general understanding of the importance of feeds and feeding for sustainable aquaculture
- An overview of digestive physiology and energetics; macro and micronutrient requirements of fish; larval nutrition
- An insight into the influence of nutrients, feeds and additives in maintaining fish health
- A knowledge of feed ingredients, feed technology, and quality of fish as food
- An awareness of the current trends in the feed industry and research priorities in aquaculture nutrition

Skills The student should:
- From an academic point of view become skilled in different aspects of fish nutrition including the design of nutrition experiments, formulation and preparation of experimental diets

• From an industrial point of view become familiar with different types of feeds, technology related to it and feeding practices • From an environmental perspective be able to decipher ways to find sustainable resources that may be utilized as feed ingredients General Competence The student should: • Be able to make use of the knowledge acquired through this course as a background either for undertaking further studies in aquaculture nutrition or for participating in farming activities or for working in the feed industry • Be able to competently discuss issues related to aquafeeds

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
There will be four blocks of teaching during the semester. Each block extends over 2 days and includes approximately 12 hours of teaching. In addition there will be laboratory classes (of approximately 8 hours).	The study programme is evaluated annually by students by way of course evaluation studies (mid-term evaluation and final evaluation). These evaluations are included in the university's quality assurance system. Compound evaluation, grading scale A-E, Beste A, Ikke bestått F Assignment, comprises 30/100 of the grade, grading scale A-E, Beste A, Ikke bestått F. Written examination, 4 hours, comprises 70/100 of the grade, grading scale A-E, Beste A, Ikke bestått F.

GENERAL INFORMATION ABOUT THE COURSE #10		
1.	The name of the course/module	Reproductive Biology and Genetics in Fish
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	1st study year
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The course covers the following main topics: Modes and strategies of reproduction. Genetic sex determination. Sex differentiation. Gonadal development. Gamete maturation and its endocrine control. Gamete anatomy and physiology. Modes of natural reproduction. Controlled maturation and spawning. Handling of gametes. Fertilization and its mechanisms. Embryonic development. Sex reversal. Chromosome set manipulations: polyploidization, gynogenesis and androgenesis. Control of phenotypic sex: Production of monosex stocks. Biotechnology of reproduction: Manipulation of primordial germ cells and transgenesis.
8.	Prerequisites for studying the course/module, connection with other educational components	Bachelor's programme in e.g. Biology, Aquaculture, Seafood Quality. Molecular Cell Biology

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge The student should understand the: • Biology of reproduction with an emphasis on fish species: reproductive modes, strategies and mechanisms • Principles of sex determination • Sex differentiation, gametogenesis, and sexual maturation in fishes • Reproductive biotechnologies in aquaculture, including ploidy manipulations, sex reversal, cryopreservation, induced spawning, and control of germline development • Principles of reproduction of aquaculture fish species with an emphasis on species important in Norway Skills The student should have: • Practical knowledge of evaluation of fish semen quality, including examination of spermatozoa motility and concentration

• Practical knowledge of semen cryopreservation General competence The student should have: • The theoretical and practical background for aquaculture hatchery operations related to fish reproduction • The subject background to apply for higher-level courses in the relevant field • The capability to read scientific literature in the course field

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, laboratory work and group work. Thursday and Fridays - four blocks during the spring. The time schedule will be announced later.	Mid-term oral evaluation with written report, electronic evaluation at the end of the semester.

GENERAL INFORMATION ABOUT THE COURSE #11		
1	The name of the course/module	Aquatic Genomics and Bioinformatics
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	1st study year
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	Topics covered in this course: Fundamentals aspects of programming, basic DNA sequence analysis, multiple sequence alignments, genome annotation, construction of phylogenetic trees, phylogenetic footprinting, synteny analysis, analysis of high-throughput gene expression and epigenomic data, proteomics, and large scale gene perturbation analyses.
8.	Prerequisites for studying the course/module, connection with other educational components	Students enrolled on the MSc programme in Aquaculture. Basic computational skills and some knowledge of molecular biology and biochemistry are advantageous for successful completion of this course.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge The student should: • Have an overview of the main aspects of comparative and functional genomics • Master essential bioinformatics concepts • Have knowledge of the relevant aspects in molecular biology and biochemistry • Be familiar with the appropriate bioinformatics tools • Understand how genomics can be applied to address important aquaculture issues Skills The student should: • Have broad computational skills and be able to use various bioinformatics applications • Know how to analyse large DNA sequence data sets • Be able to predict and characterize eukaryotic genes • Have the expertise to interpret high-throughput functional genomics data • Know how to retrieve data from electronic biological databases General competence The student should: • Understand and apply genomics and bioinformatics concepts to cutting-edge aquaculture research Be able to discuss and present scientific papers in genomics and bioinformatics • Have the competence to participate in bioinformatics and genomics research projects • Be able to access and understand scientific literature pertaining to the field • Possess adquate writing and communication skills

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Block teaching. Lectures, tutorials and computer labs.	Course evaluation: Midterm evaluation (dialogue meeting between lecturer and students). Written, web-based final evaluation.

GENERAL INFORMATION ABOUT THE COURSE #12

1	The name of the course/module	Aquatic Ecophysiology
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	1st study year
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	Osmotic regulation and excretion, food and feeding, digestion and metabolism, nervous and endocrine control, sensory processes, respiration and circulation, temperature regulation, and animal welfare.
8.	Prerequisites for studying the course/module, connection with other educational components	To attend this course you must be qualified for the MSc in Aquaculture/Marine Ecology. Priority for students enrolled at Faculty of Biosciences and Aquaculture, University of Nordland. Other students can join the class if there is free capacity. Necessary previous knowledge in physiology corresponding to BI105F Zoophysiology (10 ECTS) and BI205F Fish Physiology (10 ECTS).

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
The student should:
- Have thorough knowledge of physiological adaption to life in an aquatic environment.
- Understand how an aquatic animal rises to the challenge of an unstable environment by using internal physiological changes

Skills The student should:
- Be able to acquire and apply technical knowledge and relevant information from research and development on practical and/or theoretical issues in aquatic ecophysiology
- Have the ability to analyze textual material from the relevant scientific literature
- Be able to practice the profession in its most important applications by making informed quantitative assessments of published results from aquatic ecophysiology.
- Be able to document the knowledge and work processes involved in the communication of new scientific results

General competence
The student should:
- Master the methods that are necessary to develop experiments to evaluate physiological responses with regard to changes in the environment.
- Be able to communicate about the main issues, challenges and solutions seen within the field of aquatic ecophysiology.
- Be able to exchange views and experiences and present evidence-based opinions with other persons who are involved in aquatic ecophysiology thereby contributing to the continued development of good research practices within the field of expertise

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Lectures and colloquium practice.	Mid-term oral evaluation with written report, electronic evaluation at the end of the semester.

GENERAL INFORMATION ABOUT THE COURSE #12		
1	The name of the course/module	Evolutionary Behavioural Ecology
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	1st study year
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The course covers the following main topics: The history of evolution and behaviour, genetics and evolution, foraging and antipredator behaviour, social behaviour and organisation, sexual behaviour, sexual selection, communication, mating systems parental care, cooperation between individuals, individual differences, and choosing where to live.
8.	Prerequisites for studying the course/module, connection with other educational components	BI122F Genetics and evolution, BI123F Ecology, BI124F Cell biology and Biochemistry, BI125F Biodiversity.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge

- The student should:
- Have broad knowledge of topics and problems in the fields of evolutionary behavioural ecology Have knowledge of the history and different theories in evolutionary behavioural ecology

Skills

The student should:

- Be able to explain the most important theories in the history of evolutionary behavioural ecology
- Explain the behaviour of animals from an evolutionary point of view

General competence

The student should:

- Be able to communicate about evolutionary behavioural ecology with other biologists
- Develop understanding of modern scientific research within evolutionary behavioural ecology

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures and seminars.	Mid-term oral evaluation with written report, electronic evaluation at the end of the semester.

GENERAL INFORMATION ABOUT THE COURSE #13		
1	The name of the course/module	Aquatic Animal Health
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	1st study year
5.	Number of ECTS credits	10
6.	The total number of hours	

7.	General description and purpose of the educational component	The course covers the following main topics: Fish immunology responses and pathogen handling by the host. Fish welfare and stress response in farmed fish. Overview of major bacterial, viral and parasitic diseases of salmonide fish. Disease treatment and control vaccines, prophylaxis and therapy. Tools for pathogen detection and diagnostics.
8.	Prerequisites for studying the course/module, connection with other educational components	AK205F Fish Health and BI217F Microbiology or related subjects.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge

- Knowledge of defence mechanisms in fish including host-pathogen interactions.
- Knowledge of fish welfare, stress responses and how this affect the health.
- A general understanding of the major infectious diseases of farmed aquatic animals, particularly those affecting salmonide fish. Learned ways of detecting, controlling and treating diseases.

Skills

The student should:

- Learned the functions of the different components of the immune system.
- Understand the stress response and how this influences the health and welfare of fish.
- Gained skills in distinguishing different classes of pathogens and assessing both physiological and pathological changes associated with diseases
- Acquired basic knowledge of the importance of controlling diseases to ensure sustainable aquaculture.

General Competence

- The course is a vital component of the Master's programme in Aquaculture.
- The competence acquired will be useful in different sides of the profession ¿ both as a scientist and as an aquaculturist.
- The course helps students to adopt new measures to prevent diseases and maintain the health of farmed fish.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures and laboratory work.	Mid-term oral evaluation with written report, and electronic evaluation at the end of the semester.

GENERAL INFORMATION ABOUT THE COURSE #14

1	The name of the course/module	Marine Biology
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	1st study year
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The course provides an introduction to: the marine environment, important groups of organisms (such as plankton, benthos, invertebrates and vertebrates), ecology of organisms, and use of basic sampling equipment.
8.	Prerequisites for studying the course/module, connection with other educational components	BI123F Ecology, BI125F Biodiversity or similar.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge

The student should:

- Have broad knowledge of basic theories for processes associated with biological production and the flow of energy in the sea
- Be able to identify different ecosystems and give an account of the main ecological processes involved

• Know aboutthe basic methods and research issues in the field Know about central research in the field Skills The student should: • Be able to apply scientific knowledge in field investigations • Be capable of updating his/her knowledge in the field • Be capable of approaching problems based on sound knowledge in the field General competence • The student should: Have insight into the most relevant issues in marine biology • Have a basic level of ecological insight into northern marine ecosystems • Be able to exchange knowledge and viewpoints within the expert community

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
· Talks and seminars (totalt ca 60 h) · Lab- and fieldwork · ca 10 days of field course/excursions.	The study programme is evaluated annually by students by way of course evaluation studies (mid-term evaluation and final evaluation). These evaluations are included in the universitys quality assurance system.

GENERAL INFORMATION ABOUT THE COURSE #15		
1	The name of the course/module	Molecular Ecology
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	1st study year
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The course covers the following topics: 1) organization of animal genomes 2) methods to investigate genetic variation in proteins and DNA 3) molecular markers: mode of inheritance and properties. How to choose the proper marker to study a particular problem 4) population genetics: single populations. Genetic diversity, demography, bottlenecks, inbreeding, and natural selection 5) population genetics: multiple populations. Population structure, gene flow, hybridization, and local adaptations 6) ecologically important traits, phenotype and genotype, adaptive variation 7) using next-generation sequencing technology (deep sequencing) in molecular ecology 8) phylogeography, population histories 9) behavioural ecology, mating systems, sex ratios, predator-prey relationships 10) conservation biology, how to preserve genetic diversity
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge in BI210F Molecular Cell Biology and in BI122F Genetics and Evolution or equivalent.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge The student/candidate should: • have basic knowledge about the recent developments in biological sciences upon which molecular ecology is based have basic knowledge about the theoretical and practical developments of molecular ecology based on the increasing availability and scope of genetic markers have basic knowledge about the molecular markers and techniques applied within molecular ecology and the basic characteristics of these markers Skills The student/candidate should: • be able to apply the basic analytical and practical methods of molecular ecology, including laboratory techniques and bioinformatics tools,

• to specific problems know about the most relevant sources of information and be able to acquire updated knowledge within the field of molecular ecology • be able to assess and discuss relevant research articles within the field General competence The student/candidate should: • be able to identify problems that can be effectively addressed using molecular ecology approaches and the ethical considerations involved • be able to choose the most suitable molecular markers and techniques to study various groups of organisms and ecological problems • be able to convey essential topics, exchange experiences, and keep updated within the field of molecular ecology

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The course includes lectures, seminars, and laboratory exercises. Summaries of lectures and other relevant information will be posted on Fronter. Please note that participation at the seminars is crucial for the proper understanding of contents of the course.	The study programme is evaluated annually by students by way of course evaluation studies (mid-term evaluation and final evaluation). These evaluations are included in the universitys quality assurance system.

GENERAL INFORMATION ABOUT THE COURSE #16		
1	The name of the course/module	Individual Curriculum 5
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	2nd study year
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The course covers the following topics: Literature surveys Extraction of essential information from larger bodies of publications Synthesising this information into a written project report/paper.
8.	Prerequisites for studying the course/module, connection with other educational components	Students enrolled in the MSc at Faculty of Biosciences and Aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge The student should: • Have broad knowledge of theoretical and empirical aspects of a topic at Master¿s level within biology, chemistry or related topics. • Be able to select the appropriate literature in order to understand a specific topic level within biology, chemistry or related topics. Skills The student should: • Be able to explain important theoretical and empirical aspects of a topic at Master's level as described above. • Be able to search for appropriate references General competence The student should: • Be able to communicate orally important theoretical and empirical aspects of a topic at Master's level, • Be able to communicate in writing important theoretical and empirical aspects of a topic at Master's level.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Self-study with supervision	Self-study with supervision

GENERAL INFORMATION ABOUT THE COURSE # 17		
1	The name of the course/module	Individual Curriculum 6
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	2nd study year
5.	Number of ECTS credits	5
6.	The total number of hours	
7.	General description and purpose of the educational component	The course is organised on an individual basis, i.e. the student and his/her supervisor together decide on a curriculum that is related to, though not the very background for, the thesis.
8.	Prerequisites for studying the course/module, connection with other educational components	Compulsory courses included in the study programme. Students enrolled in the MSc at Faculty of Biosciences and Aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge

The student should:

- Have an overview of theory and problems in a topic at Master's level.
- Be able to acquire new knowledge in this topic

Skills

The student should:

- Demonstrate an overview of problems in this topic at Master's level
- Know how to find relevant literature about this topic General competence

The student should:

- Be able to use this knowledge in his or her master thesis
- Be able to communicate with other biologists about this topic at Master's level

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Self-study under supervision	The study programme is evaluated annually by students by way of course evaluation studies (mid-term evaluation and final evaluation). These evaluations are included in the university¿s quality assurance system.

GENERAL INFORMATION ABOUT THE COURSE #18		
1	The name of the course/module	Fish muscle quality and biochemistry
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	2nd study year
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The course will provide fundamental knowledge about the chemical and biochemical composition and functional characteristic of fish muscle. After completed course the student will be able to understand how the quality of fish as raw material can vary, and be able to measure and document this variation. Content: The chemical, biochemical and structural composition of fish muscle, with main focus on muscle

		proteins and lipids. Post mortal changes, ice and freeze storage. Important quality aspects of fish such as colour, texture, fillet gaping, liquid binding capacity and rancidity. Influence of season, maturation, diet, feeding-regimes, photoperiod and slaughter procedures on flesh quality of fish.
8.	Prerequisites for studying the course/module, connection with other educational components	All students accepted as a Master student at University of Nordland or other institutions are qualified to attend the course. Laboratory safety or similar course must be passed prior to the lab.work. Knowledge in chemistry and biochemistry is necessary.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
The student should have:

- Knowledge about the intrinsic quality of fish muscle.
- Knowledge about external and internal factors affecting flesh quality in general
- Good theoretical and practical knowledge of the methods used to evaluate the flesh quality of fish

Skills
Students should be:

- Able to communicate skilled terminology with both academic research and private stakeholders within fisheries and aquaculture
- Be able to perform classic quality assessments of fish using different analytical methods.
- Be able to perform histological and enzymatic analysis of fish muscle

Competence
Students will:

- Have a broad knowledge about fish quality in general Have adequate skills to participate in R & D project within seafood quality
- Have extensive knowledge of the subject and ability to keep abreast of new knowledge within the field.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Five laboratory practices will illustrate important parts of the reading. 1) Analysis of protein, fat and water
2.	2) Histological freezing techniques, histochemical and immunohistochemical staining
3.	3) Proteolytic enzymes
4.	4) Liquid binding capacity
5.	5) Analysis of colour and texture.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Teaching 4 blocks per semester, 2-3 full days on each block (total of 10 days). In each block there will be obligatory laboratory work:	Annual evaluations which are included in the university's quality assurance system.

GENERAL INFORMATION ABOUT THE COURSE #19

1	The name of the course/module	Selected scientific methods
2.	Faculty/department	Faculty of Biosciences and Aquaculture
3.	Status of the educational component	Elective
4.	Semester	2nd study year
5.	Number of ECTS credits	5
6.	The total number of hours	
7.	General description and purpose of the educational component	The course is organized as seminars, with practical exercises preferably within chemical/biological analysis or data analysis. Written submissions and self tuituion must be expected. Syllabus and practical content are determined by the responsible professor. One or more students can participate, and the course should preferable be associated with the students master thesis.
8.	Prerequisites for studying the course/module, connection	All students admittet to the Master in Aquaculture or Master in Marine Ecology at FBA or similar programs at other institutions are eligible.

	with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge and understanding • The student will: • Have a broad knowledge of theoretical and empirical aspects of a topic at the master level. • The topic can be relevant themes within aquaculture, biology, chemistry or statistics. • Ability to acquire new knowledge within this field Skills The student will: • Be able demonstrate important theoretical and empirical aspects of a topic at a master level. • Have practical knowledge about relevant methods for data analyses or chemical/biological analytical methods within the field. General competence The student will: • Be able to communicate important theoretical and empirical aspects of a topic at a master level • Be able to communicate at the master level with other biologists on this issue

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The course is a mix of self-study, seminars and practical exercises.	

JAMES COOK UNIVERSITY

1	Criterion A: University profile		
1.1	Name of the University	**JAMES COOK UNIVERSITY**	
1.2	Classical or applied	Classical	
2	**Criterion B: Profile of the educational program (Curriculum)**		
2.1	Number of Aquaculture disciplines	1	
2.2	The name of the educational program	Master of Aquaculture Science & Technology	
2.3	Type of diploma		
2.4	Total number of credits (ECTS)	120	
3	**Criterion C: Setting the educational program (Curriculum)**		
3.1	Duration of the program	18 month	
3.2	The purpose of the educational program	The Master of Science (Professional) degree is structured such that students take sets of (1) foundational 'knowledge' specific to their major, (2) technical and / or analytical 'skills' subjects, (3) elective subjects and (4) a capstone professional practice module in their final semester. The capstone module is either a research project or an industry internship.	
4	**Criterion D: Characteristics of the educational program (Curriculum)**		
4.1	Subject area (field of knowledge, specialty, specialization (if available))		
5	**Criterion E: Teaching and assessment**		
5.1	Teaching and learning methods	• Block-based lectures and independent assignments. • Lectures, assignments and feedback. • Mandatory participation. Some courses are given as combined lecture and laboratory exercise. • Some courses are a mix of self-study, seminars and practical exercises. • Self-study under supervision.	
5.2	Assessment		
6	**Criterion F: Software competencies**		
6.1	Integral competence		
6.2	General competences		
6.3	Professional competences		
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes		
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support		
8.2	Material and technical support		
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Sustainable Aquaculture	3	Written > Examination (centrally administered) - (50%) - Individual Oral > Presentation 1 - (25%) - Individual Written > Project report - (25%) - Group.
9.1.2	Aquaculture: Feeds and Nutrition	3	Written > Examination (centrally administered) - (45%) - Individual Written > Test/Quiz 1 - (10%) - Individual Oral > Presentation 1 - (15%) - Individual Written > Abstract - (10%) - Group & Individual Written > Lab/Practical report - (20%) - Group & Individual.
9.1.3	Aquaculture: Principles and Practice	3	Written > Examination (centrally administered) - (35%) - Individual Written > Test/Quiz 1 - (30%) - Individual

			Oral > Presentation 1 - (10%) - Individual Written > Lab/Practical report - (25%) - Individual.
9.1.4	Aquaculture: Propagation	3	Written > Examination (centrally administered) - (40%) - Individual Written > Test/Quiz 1 - (10%) - Individual Performance/Practice/Product > Practical assessment/practical skills demonstration - (40%) - Individual Written > Critical Analysis - (10%) - Individual.
9.1.5	Aquaculture: Hatchery Techniques	6	Oral > Presentation 1 - (10%) - Individual Production success measured by output of hatchery operations - (20%) - Group Written > Project report - (30%) - Individual Performance/Practice/Product > Practical assessment/practical skills demonstration - (40%) - Individual.
9.1.6	Human Dimensions of Nature, Environment and Conservation	3	Oral > Presentation 1 - (40%) - Individual Participation > Class participation - (10%) - Individual Written > Journal - (50%) - Individual.
9.1.7	Professional Employability	3	Written > Test/Quiz 1 - (20%) - Individual Written > Action plan - (25%) - Individual Written > Research report - (25%) - Individual Performance/Practice/Product > Portfolio - (30%) - Individual.
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Environmental Chemistry	3	
9.2.2	Economics and Sustainable Resource Management	3	
9.2.3	Human Dimensions of Nature, Environment and Conservation	3	
9.2.4	Marine Reserves as Fisheries Management Tools	3	
9.2.5	International Environmental Policy and Governance	3	
9.2.6	Postgraduate Internship	3	
9.2.7	Research Project (Part 1 of 2)	6	
9.2.8	Research Project (Part 2 of 2)	6	
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Final graduation examinations for the study programme are the Master thesis, trial lecture and oral examination.	

PART III
COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1.	The name of the course/module	Sustainable Aquaculture
2.	Faculty/department	College of Science and Engineering
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	3
6.	The total number of hours	
7.	General description and purpose of the educational component	This subject investigates the sustainability of aquaculture as the industry expands and the world faces critical shortages in food supplies. It addresses contentious issues such as wild resource harvesting, the physical effects of aquaculture, aquaculture wastes, disease and parasites, and the impacts of introductions and escapees. It also addresses how to develop and implement sustainable aquaculture systems. Therefore, as a result of studying this subject, students will be able to critically assess the environmental sustainability and suitability of existing and developing aquaculture industries, as well as quantify the benefits of sustainable aquaculture practices. This subject integrates field and laboratory based learning so that students benefit from varied circumstances, contact and settings. Each day of this intensive is centred around one main sustainability theme which is delivered by experts in that area. The subject coordinator has considerable experience in the aquaculture industry, and aquatic animal health.
8.	Prerequisites for studying the course/module, connection with other educational components	All MSc students at Faculty of Biosciences and Aquaculture, UiN, and students qualified for admission to MSc in Aquaculture. Introductory courses in mathematics, statistics and computer programming.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- determine the sustainability of an aquaculture system;
- define sustainability;
- describe environmental, economic and social aspects of sustainable aquaculture;
- describe challenges to sustainable aquaculture production;
- describe best practise for developing and operating a sustainable aquaculture system;
- describe the benefits of aquaculture in contributing to the UN sustainable development goals.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Block-based lectures and independent assignments. Lectures, assignments and feedback.	Midterm evaluation (dialogue meeting between lecturer and students). Written, web-based final evaluation.

GENERAL INFORMATION ABOUT THE COURSE #2		
1	The name of the course/module	Aquaculture: Feeds and Nutrition
2.	Faculty/department	College of Science and Engineering
3.	Status of the educational component	Mandatory
4.	Semester	1st study year
5.	Number of ECTS credits	3
6.	The total number of hours	

7.	General description and purpose of the educational component	Introduction to the nutrition of aquaculture species and feeding practices used in aquaculture. The nutritional requirements of cultured animals, the metabolic roles of dietary nutrients and the production and properties of the various natural and manufactured foods used in aquaculture. This subject shares lectures, tutorials and practical classes with AQ3002.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- detailed knowledge of the physical and nutritional characteristics of the various live and artificial feeds used in aquaculture;
- understanding of current problems and future research directions for aquaculture feeds development;
- understanding of the principles of nutrition and the nutritional requirements of culture aquatic organisms;
- understanding of the production methods used for live and artificial feeds used in aquaculture.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Mandatory participation. The course is given as combined lecture and laboratory exercise.	

GENERAL INFORMATION ABOUT THE COURSE #3

1	The name of the course/module	Principles and Practice
2.	Faculty/department	College of Science and Engineering
3.	Status of the educational component	Mandatory
4.	Semester	1st study year
5.	Number of ECTS credits	3
6.	The total number of hours	
7.	General description and purpose of the educational component	This subject aims to inspire and motivate students through research-informed teaching in this rapidly developing field. Aquaculture: Principles and Practices discusses the scope and role of aquaculture for increasing food and profit yields of marine, brackish and freshwater organisms. This subject integrates laboratory and field based learning so that students benefit from varied circumstances, contact and settings. Students maintain their own aquaculture organisms (fish or crustaceans, depending on availability) in an intensive aquaculture system. Students will develop practical animal husbandry skills and report writing skills. The subject coordinator/lecturer has considerable experience in the aquaculture industry and associated wild fisheries. The biological principles of aquaculture including species selection, hatchery breeding and rearing and grow-out practices. Aquaculture technology and systems, overseas experience and Australian potential are addressed.
8.	Prerequisites for studying the course/module, connection with other educational components	Students enrolled in the MSc at Faculty of Biosciences and Aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- describe the biological and other principles underlying aquaculture;
- discuss the potential future of aquaculture and factors that will influence it;
- explain the environmental demands, including aspects of pollution and disease, for sustained aquaculture;
- evaluate the different types of aquaculture systems and their appropriateness for various environmental situations.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #4		
1	The name of the course/module	Propagation
2.	Faculty/department	College of Science and Engineering
3.	Status of the educational component	Mondatory
4.	Semester	1st study year
5.	Number of ECTS credits	3
6.	The total number of hours	
7.	General description and purpose of the educational component	This subject discusses husbandry of aquaculture broodstock and larval and juvenile culture techniques of finfish, molluscs, crustaceans and sea cucumbers. Topics include: managed reproduction of broodstock animals using nutritional, environmental, hormonal and chemical manipulation; broodstock nutrition; production of triploids and all-female stocks; factors affecting egg and larval quality; current approaches to larval and juvenile rearing. This subject shares lectures, tutorials and practical classes with AQ3003.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- knowledge of the practical aspects of broodstock management, spawning induction and larval rearing of culture organisms and the current body of science knowledge that underpins these practices;
- understanding of current challenges experienced by the industry in relation to broodstock management and hatchery production, and current research approaches directed at sustainable commercial aquaculture propagation;
- development of effective written and oral communication skills that conform with current scientific conventions for reporting, disseminating and evaluating information;
- development of practical aquaculture skills including: production of slow release pellet implants for delivery of reproductive hormones to finfish broodstock; spawning induction of bivalves; biopsy and histological assessment of spawning condition of finfish broodstock; assessment of larval developmental stage and growth, reproductive status of crustaceans.
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CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #5		
1	The name of the course/module	Aquaculture: Hatchery Techniques
2.	Faculty/department	College of Science and Engineering

3.	Status of the educational component	Mondatory
4.	Semester	1st study year
5.	Number of ECTS credits	6
6.	The total number of hours	
7.	General description and purpose of the educational component	This subject is a hands-on, teamwork based subject. It covers design, operation and evaluation of the success of hatchery culture systems as well as techniques for production and use of various live feeds and larval culture of aquaculture species.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- to develop skills in preparing and presenting major technical reports;
- to develop skills in the critical assessment of methodology and evaluation of success in hatchery production;
- to develop the problem solving and organisational skills required in commercial hatchery production;
- to engage students in realistic aquaculture hatchery and larval rearing production;
- to provide experience in various aspects of aquaculture hatchery protocol;
- to provide practical skills required for larval rearing of aquaculture species;
- to provide the practical skills required for production of various live feeds.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #6

1	The name of the course/module	Human Dimensions of Nature, Environment and Conservation
2.	Faculty/department	College of Science and Engineering
3.	Status of the educational component	Mondatory
4.	Semester	1st study year
5.	Number of ECTS credits	3
6.	The total number of hours	
7.	General description and purpose of the educational component	Knowledge of how ecosystems work that does not include consideration of the integral role of humans in these systems is unlikely to provide a complete understanding required to achieve conservation or sustainable use of natural resources. Successful environmental management requires an interdisciplinary approach that includes information about how humans interact with natural resources, and the complex feedbacks between their values, perceptions, needs, behaviours, and environmental outcomes. This subject draws on a multitude of contemporary theories from the rapidly evolving field of environmental social science; including social-ecological systems, resilience thinking, sustainable livelihoods, commons theory, and the psychology of environmentally significant behaviour. The lectures draw on the current research of the lecturers and guest speakers, exposing students to the latest developments in the field. This class is suitable for students from a multitude of disciplines across the natural and social sciences, and is designed to build the knowledge required to approach environmental problems from an interdisciplinary perspective.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- demonstrate an understanding of the relevance and importance of taking an integrated, social- ecological approach to resolving environmental problems;
- demonstrate knowledge of relevant, contemporary human dimensions theories, concepts, and methods;
- apply environmental social science theory and methods to analysing real-world environmental issues;
- communicate and critically evaluate the relevance and importance of environmental social science to others within an environmental management context.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #7		
1	The name of the course/module	Professional Employability
2.	Faculty/department	College of Science and Engineering
3.	Status of the educational component	Mondatory
4.	Semester	1st study year
5.	Number of ECTS credits	3
6.	The total number of hours	
7.	General description and purpose of the educational component	This subject provides students with targeted career and employability development, anchored in the professional and vocational requirements of their industry. Students will explore their individual career goals and personal motivations, whilst building a deep understanding of current industry requirements and employment trends. The unit takes students through three developmental stages. The first stage is the enhancement of their career clarity, in particular determination of a career path and the development of a personal brand and narrative aligned to that path. Working from contemporary industry insights, participants work with actual job and employment data to enhance their professional knowledge. The second stage focuses on the specific capabilities required in their chosen career path, including both professional and technical skills. Armed with this knowledge students prepare a professional development plan to enable comprehensive career preparation and the development of a differentiated employment narrative. The final stage focusses on strategies to build professional confidence to not only successfully navigate the recruitment process but, importantly, to effectively manage a lifelong career. Strong industry engagement is a characteristic of the Professional Employability program, providing vital networking and knowledge building opportunities with authentic perspectives on career management. This subject is a pre-requisite requirement for SC5009:12 Postgraduate Internship. SC5200 should be taken in the first study period of your degree.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- demonstrate a deep understanding of the professional and technical skills required in their chosen career path through discussion of industry trends and the synthesis of a professional employability plan;
- critically interpret knowledge of industry employment trends and contemporary workforce requirements in the preferred industry sector through the analysis of authentic industry and employment trends and the synthesis of a professional employability plan;
- demonstrate mature self insight into their career motivators, goals and development needs through the workshops, engagement with mentors, and the articulation of a professional employability plan;
- apply the core professional skills of problem solving, professional communication and team work in the consideration and solution of authentic career-oriented problem scenarios;

	• demonstrate understanding of how to effectively transition from higher education to employment, with the skills to effectively manage their chosen career path, through engagement with industry representatives and the formulation of a deliberate and viable professional employability plan.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #8		
1.	The name of the course/module	Aquaculture: Stock Improvement
2.	Faculty/department	College of Science and Engineering
3.	Status of the educational component	Mondatory
4.	Semester	1st study year
5.	Number of ECTS credits	3
6.	The total number of hours	
7.	General description and purpose of the educational component	Consideration of the genetics of breeding programs and how these can be applied to improving desirable traits for aquaculture, such as growth rate, feeding efficiency, disease resistance and market acceptability. Consideration of the techniques available for genetic manipulation in aquaculture breeding programs. Major topics include genetic selection, hybridisation, effective breeding numbers, sex reversal and chromosomal manipulation. This subject shares lectures, tutorials and practical classes with AQ3004.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- appreciation of genetic polymorphism and inter-population and intra-population relationships;
- appreciation of the potential and limitations of breeding programs;
- awareness of the recent advances in biotechnology for genetic studies and genetic manipulation;
- knowledge of the various techniques of genetic selection.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #9		
1.	The name of the course/module	Postgraduate Internship
2.	Faculty/department	College of Science and Engineering

3.	Status of the educational component	Optional
4.	Semester	1st study year
5.	Number of ECTS credits	3
6.	The total number of hours	
7.	General description and purpose of the educational component	The Postgraduate Internship subject is a capstone Work Integrated Learning (WIL) subject for students in the Master of Science (Professional). It gives students first-hand professional work experience in a relevant science discipline combined with employability development activities to produce job and career ready graduates. The subject requires students to further develop, apply and demonstrate their professional competencies in an applied context under the direction of a supervisor from a relevant industry, government or not-for-profit organisation. Students will complete a minimum of 420 hours on the internship project plus an additional 100 hours on skill and employability development workshops, activities and assessment tasks, to a total of 520 hours, across 13 weeks. Students are required to prepare and submit an Internship/Project Plan and a final Internship/Project report. Students will also prepare an e-portfolio of their internship experiences, which will include a job success profile, an internship development plan, reflections on their skill development and learning, assets/artefacts generated during the internship and a post-internship Personal Employability Proposition. On completion of the internship, students will present a summary of their internship experience portfolio to a panel including an HR recruiter/employer, a JCU academic and an employability specialist. They will also receive an Industry Supervisor Evaluation. Enrolment conditions: This subject is intended to be taken in the last semester of the MSc Professional course. Students must complete the pre-requisite unit SC5200 in their preceding semesters. Students undertaking their project overseas, or away from the main JCU campus's are responsible for their own travel and accommodation expenses (unless this is provided by the workplace organisation). JCU student insurance can be used to cover travel and workplace insurance requirements, upon application.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- apply discipline specific knowledge, research skills and technical capabilities to plan and execute a project in a professional workplace environment;
- demonstrate critical thinking and problem solving skills by anticipating and addressing challenges and problems that may arise during project execution;
- professionally communicate, in both written and oral forms, to specialist and non-specialist audiences;
- critically reflect on current skills, knowledge and attitudes to develop and manage professional learning and employability performance within a professional workplace environment;
- demonstrate understanding of the workplace organisation's ways of working and the ability to work effectively, responsibly and safely in diverse contexts;
- demonstrate preparedness for future employment and ongoing career management.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #10

1	The name of the course/module	Research Project (Part 1 of 2)
2.	Faculty/department	College of Science and Engineering

3.	Status of the educational component	Optional
4.	Semester	1st study year
5.	Number of ECTS credits	6
6.	The total number of hours	
7.	General description and purpose of the educational component	Candidates will design and conduct a small discrete research project. The topic will be selected after consultation with the appropriate supervisor(s) and the Course Coordinator. Candidates will be required to write up the results of their research in the form of a scientific paper. In addition, the candidate will give a summative research project seminar to staff, colleagues and peers. The seminar should include critical appraisal of the objectives, methodology, results and future directions of the project. Candidates will prepare a literature review on a topic pertinent to their minor project and selected in consultation with their supervisor(s). The review should be a critical appraisal of the objectives, methodologies and results of previous research relating to the topic. To enrol in this subject, candidates must have achieved a GPA >= 5.5 within their current JCU course, have completed the majority of their other course requirements, attained a supervisor and identified a suitable project in consultation with the supervisor. To request enrolment in this subject, current students need to complete the college's application form at the end of their preceding coursework semester. Once approved students will need to enrol in SC5912 AND SC5913
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- demonstrate a critical and rigorous approach to framing and addressing research questions;
- demonstrate skills required for independent research, especially with respect to sampling design, data collection, data analysis and interpretation relevant to the field of research;
- demonstrate appropriate methodological and analytical approaches relevant to their field of research;
- demonstrate proficiency in literature evaluation, data collection and analysis;
- demonstrate proficiency in preparing and presenting written technical reports;
- demonstrate the practical and/or technical skills required for carrying out a research project;
- demonstrate experience in problem-solving and scientific decision-making.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #11

1	The name of the course/module	Research Project (Part 2 of 2)
2.	Faculty/department	College of Science and Engineering
3.	Status of the educational component	Optionala
4.	Semester	1st study year
5.	Number of ECTS credits	6
6.	The total number of hours	
7.	General description and purpose of the educational component	Candidates will design and conduct a small discrete research project. The topic will be selected after consultation with the appropriate supervisor(s) and the Course Coordinator. Candidates will be required to write up the results of their research in the form of a scientific paper. In addition, the candidate will give a summative research project seminar to staff, colleagues and peers. The seminar should include

		critical appraisal of the objectives, methodology, results and future directions of the project. Candidates will prepare a literature review on a topic pertinent to their minor project and selected in consultation with their supervisor(s). The review should be a critical appraisal of the objectives, methodologies and results of previous research relating to the topic. To enrol in this subject, candidates must have achieved a GPA >= 5.5 within their current JCU course, have completed the majority of their other course requirements, attained a supervisor and identified a suitable project in consultation with the supervisor. To request enrolment in this subject, current students need to complete the college's application form at the end of their preceding coursework semester. Once approved students will need to enrol in SC5912 AND SC5913
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- demonstrate a critical and rigorous approach to framing and addressing research questions;
- demonstrate skills required for independent research, especially with respect to sampling design, data collection, data analysis and interpretation relevant to the field of research;
- demonstrate appropriate methodological and analytical approaches relevant to their field of research;
- demonstrate proficiency in literature evaluation, data collection and analysis;
- demonstrate proficiency in preparing and presenting written technical reports;
- demonstrate the practical and/or technical skills required for carrying out a research project;
- demonstrate experience in problem-solving and scientific decision-making.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

UNIVERSITY OF DUBROVNUK

	Criterion A: University profile	
1.1	Name of the University	**UNIVERSITY OF DUBROVNUK**
1.2	Classical or applied	
2	**Criterion B: Profile of the educational program (Curriculum)**	
2.1	Number of Aquaculture disciplines	1
2.2	The name of the educational program	Mariculture
2.3	Type of diploma	Master of Engineering in Mariculture
2.4	Total number of credits (ECTS)	120
3	**Criterion C: Setting the educational program (Curriculum)**	
3.1	Duration of the program	2 years (4 semester)
3.2	The purpose of the educational program	
4	**Criterion D: Characteristics of the educational program (Curriculum)**	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Career opportunities in mariculture are diverse and primarily include jobs that are directly related to food production such as farming, maintenance, feeding, catching, transport and similar but also include jobs in fish hatcheries and farms management. Smaller production facilities in mariculture are mostly operated by one expert who is responsible for the entire production process as well as for running the company and its financial operations. Experiences throughout the world show that experts who have graduated from a mariculture programme get jobs in ancillary activities that provide services to mariculture production, such as procurement of equipment and food, sales of fish and shellfish for consumption as well as in consulting jobs at the entrepreneurial and state level. Upon graduating from the graduate programme in Mariculture, students will be able to independently work in the jobs mentioned above as well work on introducing new species of marine organisms in the commercial aquaculture production.
5	**Criterion E: Teaching and assessment**	
5.1	Teaching and learning methods	
5.2	Assessment	
6	**Criterion F: Software competencies**	
6.1	Integral competence	
6.2	General competences	
6.3	Professional competences	
7	**Criterion G: Program Learning Outcomes**	
7.1	Program learning outcomes	1. 2. …
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**	
8.1	Staff support	
8.2	Material and technical support	The University of Dubrovnik has chemical, biological and biotechnological laboratories at its disposal as well as experimental research fish and shellfish hatcheries, breeding parks, vessels and a suitable facility for practical student work in the Bistrina cove (part of the Bay of Mali Ston). Also, the University owns the school research ship 'Naše more' ('Our Sea'), which is used to organize field trips for students so that they become acquainted with research methods at sea. From the very beginning of their study, students are included in scientific research projects together with their teachers, they participate in projects, scientific conferences and publish papers with the results of their research both domestic and international journals.
9	**Criterion I: List of components of the educational program and their logic sequence**	

9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Introduction to Ecology		
9.1.2	Applied Malacology		
9.1.3	Reproductive Biology of Marine Organisms		
9.1.4	Diversification of Fish Farming		

9.1.5	Diversification of Shelfish Farming		
9.1.6	Scientific Work Methodology		
9.1.7	Practical Work and Research		
9.1.8	Masteŕs Thesis		
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Mariculture – Status and Perspectives		
9.2.2	Economics for Mangers		
9.2.3	Farming of Larvae and Fry of New Fish Species		
9.2.4	Genetics of Mediterranean Fish and Shelfish		
9.2.5	Physiology of Stress and Adaptation		
9.2.6	New Technologies in Mariculture		
9.2.7	Breeding Technologies in Mariculture		
9.2.8	Entrepreneurship in Mariculture		
9.2.9	Strategic Planning of Mariculture Production Diversification		
9.2.10	Farming of Marine for Biomedical and Pharmacological Purposes		
9.2.11	Diversification of Crustaceans Farming		
9.2.12	Diversification of Echinoderms Farming		
9.2.13	Diversification of Cephalopods Farming		
9.2.14	Public Relations and Lobbying		
10	**Criterion L: Form of attestation**		
10.1	Requirements form	Master Degree Project (thesis)	

COMPARATIVE OF THE EDUCATIONAL PROGRAM (CURRICULUM)

1	**Criterion A: University profile**	
1.1	Name of the University	University of Dubrovnik
1.2	Classical or applied	Classical
2	**Criterion B: Profile of the educational program (Curriculum)**	
2.1	Number of Aquaculture disciplines	1
2.2	The name of the educational program	Master of Engineering in Mariculture (M. Sc. Maricult.)
2.3	Type of diploma	
2.4	Total number of credits (ECTS)	120
3	**Criterion C: Setting the educational program (Curriculum)**	
3.1	Duration of the program	2 years
3.2	The purpose of the educational program	The goal of the graduate university study programme of Mariculture is to educate experts who would contribute to the development of this interdisciplinary sector with their competencies and qualifications. They would do so by working in development research and/or in the management and optimisation of commercial activities, i.e. in the implementation of new production methods and technologies. The aim is to achieve a logically, economically and socially sustainable production of seafood and its trade at the international level..
4	**Criterion D: Characteristics of the educational program (Curriculum)**	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Career opportunities in mariculture are diverse and primarily include jobs that are directly related to food production such as farming, maintenance, feeding, catching, transport and similar but also include jobs in

		fish hatcheries and farms management. Smaller production facilities in mariculture are mostly operated by one expert who is responsible for the entire production process as well as for running the company and its financial operations. Experiences throughout the world show that experts who have graduated from a mariculture programme get jobs in ancillary activities that provide services to mariculture production, such as procurement of equipment and food, sales of fish and shellfish for consumption as well as in consulting jobs at the entrepreneurial and state level. Upon graduating from the graduate programme in Mariculture, students will be able to independently work in the jobs mentioned above as well work on introducing new species of marine organisms in the commercial aquaculture production. The education of experts in this field requires an interdisciplinary approach so that they have sufficient knowledge about the functioning of marine ecosystems, the biology of the farmed organisms, production technologies, the health and welfare of farmed animals, environmental protection, the seafood market and entrepreneurship
5	**Criterion E: Teaching and assessment**	
5.1	Teaching and learning methods	
5.2	Assessment	
6	**Criterion F: Software competencies**	
6.1	Integral competence	
6.2	General competences	
6.3	Professional competences	
7	**Criterion G: Program Learning Outcomes**	
7.1	Program learning outcomes	1. Recognise the position of mariculture and its trends in the country and abroad 2. Identify and analyse the interactions between mariculture and the environment 3. Form and test research hypotheses in mariculture, collect and analyse data and successfully present and interpret results 4. Evaluate the health status of farmed organisms to ensure biosafety 5. Independently organise and manage work processes in farming facilities 6. Manage the production processes in mariculture 7. Understand the ethical issues in the production and handling of farmed organisms 8. Implement the latest farming technologies to reduce the stress on farmed organisms

		9. Ensure high-quality farmed products by implementing GHP and the HACCP plan 10. Advance commercial production by applying genetic methods 11. Plan the feeding regimes so that they positively impact the welfare of farmed organisms 12. Advance production through the selection of new species 13. Ensure farming quality by implementing adequate farming systems 14. Select appropriate farming areas 15. Implement good practices by abiding by all respective laws and regulations	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	Based on the teaching activities, the field of scientific research and the projects that are closely related to the subjects of study programme, it can be concluded that the capacity of the teaching staff is suitable for the implementation of the study program and that the learning outcomes will be acquired.	
8.2	Material and technical support	The University of Dubrovnik has chemical, biological and biotechnological laboratories at its disposal as well as experimental research fish and shellfish hatcheries, breeding parks, vessels and a suitable facility for practical student work in the Bistrina cove (part of the Bay of Mali Ston). Also, the University owns the school research ship 'Naše more' ('Our Sea'), which is used to organize field trips for students so that they become acquainted with research methods at sea. From the very beginning of their study, students are included in scientific research projects together with their teachers, they participate in projects, scientific conferences and publish papers with the results of their research both domestic and international journals.	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Introduction to Mariculture	3	
9.1.2	Mariculture Technology	6	
9.1.3	Sustainable Fish Farming	6	
9.1.4	Sustainable Bivalve Molluscs Farming	6	
9.1.5	Diseases of Cultivated Organisms	6	
9.1.6	Fish Nutrition and Live Feed Culture	6	
9.1.7	Physiology of Stress and Adaptation	6	

9.1.8	Aquaculture Waste Management	3	
9.1.9	Mariculture Genetics	3	
9.1.10	Diversification of Mariculture	6	
9.1.11	Aquaculture Food Safety	3	
9.1.12	Practical Work and Investigation	10	
9.1.13	Master's Thesis	20	
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Multitrophic Mariculture	3	
9.2.2	International Business Negotiations	3	
9.2.3	Innovation Management	3	
9.2.4	Marine Stock Enhancement	3	
9.2.5	Reproductive Biology of Fish	3	
9.2.6	Aquaculture Adaptation to Global Stressors	3	
9.2.7	Marine Biologically Active Natural Products	3	
9.2.8	Ecological Monitoring	3	
9.2.9	Culture of Ornamental Species	3	
9.2.10	Mariculture Marketing	3	
9.2.11	Marine Spatial Planning	3	
9.2.12	Ethical and Socioeconomic Aspects of Aquaculture	3	
9.2.13	Marine and Coastal Ecosystem Services	3	
9.2.14	Safety at Sea	3	
9.2.15	Natural Science Research in the Mediterranean	3	
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Final graduation examinations for the study programme are the Master thesis, trial lecture and oral examination.	

PART III

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Introduction to Mariculture
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	3
6.	The total number of hours	45
7.	General description and purpose of the educational component	To enable students to gain knowledge about the world mariculture, its history and recent trends in the Mediterranean, the EU and the Republic of Croatia, and to acquire advanced knowledge about mariculture for successful follow-up of the graduate study.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Upon successful completion of the course, students will be able to: - explain basic mariculture terms and elaborate on the status in the world, the EU and the Republic of Croatia - describe the features and limitations of traditional fishing and the development aspects of modern mariculture - describe and compare different mariculture industries - know the state of the industry and the characteristics of the production of white sea fish, tuna, oysters and mussels as the main Croatian aquaculture sectors - discuss the perspectives of European and Croatian mariculture.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Definition, objectives and history of mariculture
2.	History and state of marine bioresources; fishery and its recent decline;
3.	Historical development of mariculture and perspective of future development
4.	State of mariculture in the world, the European Union and the Republic of Croatia;
5.	Division of the Mediterranean aquaculture according to the cultivation method and conditions;
6.	Typical types of marine organisms in culture: fish, shellfish, crabs and other marine organisms;
7.	Examples of cultivation of certain types of aquatic organisms: sea bass, sea bream, mussels, European oyster and lobster;
8.	Economics, finance and management in aquaculture
9.	Perspectives of mariculture in the Republic of Croatia and the EU.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Seminars and workshops • Independent assignments • Multimedia and internet • Field work	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures and seminars, as well as in the writing of a seminar paper. Full-

• Work with the mentor • Knowledge tests	time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. Grading. - Class activities (30%) - Quality of seminar work (30%) - Results of the written exam (40%) To pass the exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #2		
1	The name of the course/module	Mariculture Technology
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	6
6.	The total number of hours	75
7.	General description and purpose of the educational component	Course objectives are to explain how to ensure the appropriate conditions for farming of certain organisms in different mariculture systems and for students to gain knowledge to be able to compare the farming of the same organisms in different mariculture systems.
8.	Prerequisites for studying the course/module, connection with other educational components	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
Upon successful completion of the course, students will be able to: - choose the adequate mariculture system to farm the specific species - design the adequate mariculture system to farm the specific species - critically evaluate the current bottlenecks of mariculture production systems - invent technological solutions that fit the specific requirements of mariculture production systems		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1	The course deals with the development and application of various technologies in mariculture. A comparison of algae, bivalve, cephalopods, crustaceans, echinoderms and fish farming systems is given with special respect to hatcheries and grow-out systems. The course includes the assessment of various mariculture farming systems (pond, lagoon, flow-through, cage, recirculation) as well as the classification of the equipment for mariculture facilities. Design, construction, automation and monitoring of mariculture farming systems will be commented.	

	Classes are carried outs through lectures and exercises and seminars that follow the topics of the lectures. Active student participation in the classes is achieved by their independent work during exercises and by their presentation of seminars on the chosen topic.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Seminars and workshops • Exercises • Independent assignments • Multimedia and internet • Laboratory • Field work • Work with the mentor • Knowledge tests	Students should participate in activities during lectures, seminars and exercises. Full-time students are required to attend at least 70% of the total number of lectures and 80% of exercises and seminars in order to achieve the right to take the exam. Part-time students are required to attend at least 80% of the total number of exercises in order to earn the right to take the exam. If student doesn't fulfil all the obligations foreseen in the course, they are obliged to attend the lectures and/or seminars again and fulfil the requirements for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exams or has passed only one of them. To pass the preliminary exams/exam, students must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #3		
1	The name of the course/module	Sustainable Fish Farming
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	6
6.	The total number of hours	75
7.	General description and purpose of the educational component	Familiarize students with fish farming as well as the problems and solutions for its sustainability.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic morphology and biology of teleosts

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Upon successful completion of the course, students will be able to: - analyse the anatomy and morphology of teleost fish - recognise and describe the different reproductive stages of the gonads

- explain early developmental stages - describe all aspects of spawning and breeding of economically important marine fish species - understand the issue of sustainability in marine fish aquaculture - argue the current state and future development of global fish aquaculture

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	The aim of the course is to familiarise students with the anatomy and morphology of teleosts, the methods of sex determination and differentiation. Students will learn about gametogenesis, reproductive endocrinology and the early developmental stages of fish. The course will provide knowledge on the breeding of marine fish species with a special emphasis on traditional Mediterranean species: sea bass and sea bream. Following global aquaculture trends, students will be introduced to the cultivation of new species through the review and analysis of current scientific publications. The issue of sustainability of fish farming in the context of culture and hatchery technology, nutrition and environmental impacts will be discussed. The course will also the analyse economic aspects of farming and current fish markets, as well as the perspectives of global fish aquaculture.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Exercises • Independent assignments • Multimedia and internet • Laboratory • Field work • Work with the mentor • Work with the mentor The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures and exercises. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exams or has passed only one of them. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #4		
1	The name of the course/module	Sustainable Bivalve Molluscs Farming
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	6

<table>
<tr><td>6.</td><td>The total number of hours</td><td colspan="2">75</td></tr>
<tr><td>7.</td><td>General description and purpose of the educational component</td><td colspan="2">The objective of the course is to acquire the theoretical and practical knowledge necessary for the establishment and management of sustainable shellfish farms in accordance with regulations and market requirements.</td></tr>
<tr><td>8.</td><td>Prerequisites for studying the course/module, connection with other educational components</td><td colspan="2">Basic invertebrate biology</td></tr>
<tr><th colspan="4">LEARNING OUTCOMES BY EDUCATIONAL COMPONENT</th></tr>
<tr><td colspan="4">Upon successful completion of the course, students will be able to:
- analyse the anatomy and morphology of teleost fish
- recognise and describe the different reproductive stages of the gonads
- explain early developmental stages
- describe all aspects of spawning and breeding of economically important marine fish species
- understand the issue of sustainability in marine fish aquaculture
- argue the current state and future development of global fish aquaculture</td></tr>
<tr><th colspan="4">CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)</th></tr>
<tr><td>1</td><td colspan="3">Upon successful completion of the course, students will be able to:
- recognise and name the processes associated with bivalve farming
- assess which sites are suitable for farming and collect all relevant data
- select species and categorise available information to establish a breeding area
- assess available data and determine what data and knowledge are missing
- review documents, manage the establishment and operation of the breeding facility.</td></tr>
<tr><th colspan="4">TEACHING AND LEARNING METHODS</th></tr>
<tr><td colspan="3">Teaching methods (work to be carried out by the teacher during classroom classes, consultations)</td><td>Study methods (what types of educational activities should be performed by the student independently)</td></tr>
<tr><td colspan="3">• Lectures
• Exercises
• Independent assignments
• Multimedia and internet
• Field work
• Work with the mentor
• Knowledge tests

The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.</td><td>udents are required to attend classes and participate in activities during lectures, field and laboratory work, and to write a seminar paper. Regular students must attend 70% of lectures and 80% of labs to be eligible to take the exam. Part-time students must attend at least 80% of the labs to be eligible to take the exam. If students have not fulfilled all the obligations specified in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam.
The final grade will be composed of the grades for the following elements in the proportions indicated:
Evaluation of exercises 25%; seminar grade 20%; written exam (or preliminary exam) 30%; oral exam 25%.
To pass the preliminary exam /exam, the student must achieve at least 50%: 49% unsatisfactory (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).</td></tr>
</table>

GENERAL INFORMATION ABOUT THE COURSE #5		
1	The name of the course/module	Diseases of Cultivated Organisms
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	6
6.	The total number of hours	70
7.	General description and purpose of the educational component	The course objectives are to acquaint students with the basics of protecting the health of farmed aquatic organisms and the most significant diseases that occur in aquaculture, with a special emphasis on zoonoses. Also, the objective of the course is to train students to plan and implement preventive measures aimed at preventing disease outbreaks and maintaining farm biosecurity.
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge of the basics of biology and ecology of species in aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Upon successful completion of the course, students will be able to: - define and describe the most common disease symptoms of cultivated organisms - to recognise the healthy vs. diseased state of cultivated organisms - predict and assess the impact of disease on farm operations - integrate the acquired knowledge into the creation of the farm's biosecurity plan - collect appropriate samples in case of suspected disease - manage the breeding system according to all principles of animal welfare.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	The importance of early detection of diseases on farms is of great importance in order to prevent major damages that may occur due to the inability to detect the early symptoms of the disease. Students will learn about the most common diseases of cultivated organisms and the processes of determining the health status of populations in breeding farms and natural habitats, so that the causative agents of diseases can be detected as early and reliably as possible. The procedures for examining sick individuals and taking samples of properly selected organisms will be explained to students. Students will learn about the measures to prevent the spread of disease on breeding farms. The lectures are divided into thematic units: (1) water medium; (2) the immune system; (3) diagnosis; (4) fish diseases; (5) shellfish diseases; (6) crustacean diseases; (7) welfare of cultured organisms; (8) biosecurity.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Seminars and workshops • Exercises • Independent assignments • Multimedia and internet • Laborator • Work with the mentor • Knowledge tests	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take

The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.	the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if students have not passed both preliminary exams or has passed only one of them. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE N6		
1	The name of the course/module	**FISH NUTRITION AND LIVE FEED CULTURE**
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	**Mandatory**
4.	Semester	2nd
5.	Number of ECTS credits	**6**
6.	The total number of hours	75 (45 lecture, 30 practical)
7.	General description and purpose of the educational component	Familiarise students with the nutrition of all life stages of farmed fish
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Learning outcomes at the level of the study programme to which the course contributes:

1. Form and test research hypotheses in mariculture, collect and analyse data and successfully present and interpret results.
2. Manage the production processes in mariculture
3. Plan the feeding regimes so that they positively impact the welfare of farmed organisms.

Expected learning outcomes at the level of the course:

4. Understand which ingredients are used in fish feed formulations and why
5. Describe the production processes of fish feeds
6. Explain the importance of certain nutrients and other compounds that are introduced through feeding
7. Understand the nutritional needs of various life stages of farmed fish
8. Plan feeding regimens for various types of fish
9. Grow different organisms that are used as live feeds and use them to feed early developmental stages of fish

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
2.	The course will enable students to acquire theoretical and practical knowledge in the field of fish nutrition, which will cover ingredients for the preparation of feed mixtures, formulations and feed production processes, an overview of nutrients and other compounds that are introduced through feeding, nutritional needs of various life stages of farmed fish as well as mechanisms of digestion, absorption and metabolism of nutrients and other compounds.
3.	Various feeding regimes for certain economically important farmed species will be discussed
4.	The culture of organisms that serve as live feeds for the early developmental stages of fish, including microalgae, rotifers, Artemia, copepods and others, will be covered.

ASSESSMENT
The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exams or has passed only one of them. To pass the preliminary exam /exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture Laboratory Work with the mentor	Exercises Field work Multimedia and Internet Independent assignments

GENERAL INFORMATION ABOUT THE COURSE N7		
1	The name of the course/module	**PHYSIOLOGY OF STRESS AND ADAPTATION**
2	Faculty/department	Department of Applied Ecology
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**6**
6	The total number of hours	65 (45 lecture, 10 seminar, 10 exercises)
7	General description and purpose of the educational component	The objective of the course is to familiarise students with the basic physiological processes of biologically and commercially important animal organisms living in the aquatic environment and their adaptations and physiological responses to various changes in the living environment. The content of the course covers the physiological processes of cultured organisms and their adaptation to changing culture conditions. In aquaculture, stress control and organism adaptation to new conditions is an important factor affecting production results and animal welfare. In addition to aquaculture, the ability of organisms to adapt to new conditions is also important in the natural environment, especially in light of climate change
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Learning outcomes at the level of the study programme to which the course contributes: upon successful completion of the course, students will be able to: 1. Form and test research hypotheses in mariculture, collect and analyse data and successfully present and interpret results. 2. Implement the latest farming technologies to reduce the stress on farmed organisms. 3. Plan the feeding regimes so that they positively impact the welfare of farmed organisms Expected learning outcomes at the level of the course: 4. Describe physiological processes in the body 5. Explain the neurophysiological mechanisms that control feeding and reproductive behaviour 6. Identify and describe the major types of stressors that affect the body 7. Observe the changes induced by the action of various stressors on organisms in culture, the effects of stressors on the organism 8. Explain the basic mechanisms of the organism's response to the action of harmful factors (stressors) from the environment 9. Explain the mechanism of adaptation (adaptation) of the organism in newly created situations 10. Analyse and present simple physiological results and write a report after completing the laboratory task.
ASSESSMENT
Seminar essay Written exam Independent work Exercises Preliminary exam The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exams or has passed only one of them. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5). **Written exam**

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Physiological processes in organisms
2	Metabolism
3	Nutritional physiology
4	Hormonal regulation
5	Physiology of reproduction
6	Neurophysiological basis of stress
7	Response to stress
8	Adaptive mechanisms
9	Laboratory exercises include comparative anatomy and physiology of cultured organisms and analysis of histological preparations of selected tissues and organs

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture Seminars and Workshops Laboratory Work with mentor Knowledge tests Exercises	Independent assignment Multimedia and internet Field work

GENERAL INFORMATION ABOUT THE COURSE N8		
1	The name of the course/module	**AQUACULTURE WASTE MANAGEMENT**
2	Faculty/department	Department of Applied Ecology
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**3**
6	The total number of hours	60 (30 lecture, 30 exercises)
7	General description and purpose of the educational component	The main objectives are to explain the working principle of the wastewater treatment systems from industries related to aquaculture and to interpret the importance of composting solid waste from aquaculture systems.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Learning outcomes at the level of the study program to which the course contributes: upon successful completion of the course, students will be able to: 1. Identify and analyse the interactions between mariculture and the environment 2. Ensure farming quality by implementing adequate farming systems 3. Select appropriate farming areas 4. Implement good practices by abiding by all respective laws and regulations Expected learning outcomes at the level of the course: 5. Chose the adequate aquaculture system to farm the specific species with special regards to waste reduction 6. Compare wastewater treatment in aquaculture to other technologies 7. Invent new technological solutions for liquid waste management in aquaculture production system 8. Critically judge the current bottlenecks of solid waste management in aquaculture production systems

ASSESSMENT
Written exam Exercises Independent work Preliminary exam The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exams or has passed only one of them. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	The problem of waste in aquaculture and the possibilities of its removal. Classes are carried out through lectures and exercises that follow the topics of lectures
2	Technological solutions for the reduction of wastewater from recirculating aquaculture systems, aquaponics, municipal wastewater treatment and constructed wetlands are compared.

3	The assessment of new processes for nitrogen and phosphorus waste removal, biofloc systems, integrated multitrophic aquaculture and composting of solid waste from aquaculture systems.

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture Laboratory Work with mentor Exercises Knowledge tests	Independent assignment Multimedia and internet Field work

GENERAL INFORMATION ABOUT THE COURSE N9		
1	The name of the course/module	**MARICULTURE GENETICS**
2	Faculty/department	Department of Applied Ecology
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**3**
6	The total number of hours	45(30 lecture, 15 exercises)
7	General description and purpose of the educational component	The aim of the course is to acquire knowledge in the field of genetics of organisms in mariculture, especially marine species cultivated in the EU and Mediterranean. Students will be trained in the application of genetic methods in improving the commercial production of Mediterranean fish and shellfish species.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Learning outcomes at the level of the study program to which the course contributes: upon successful completion of the course, students will be able to: 1. Form and test research hypotheses in mariculture, collect and analyse data and successfully present and interpret results. 2. Advance commercial production by applying genetic methods. Expected learning outcomes at the level of the course: 3. Present the knowledge required for the theoretical development of genetic projects to improve production in mariculture in the field of genetics of farmed organisms 4. Apply genetic methods in the improvement of commercial mariculture production of marine organisms 5. Produce triploid individuals of oysters, sea bass and other marine organisms 6. Distinguish among various ways of improving the culture of aquatic organisms and explain the reasons for their implementation.
ASSESSMENT

Activity in class Written exam Exercises Independent work Preliminary exam

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Qualitative and quantitative genetics
2	Genetic selection and breeding selection programmes
3	Genome manipulation in aquaculture, polyploidy and hybridisation
4	Triploidy in bivalves
5	Production of tetraploid organisms - example lupins and oysters
6	Androgenesis and gynogenesis
7	Gender manipulation in breeding
8	Triploidy in marine fish
9	GMO technology and application of genetically modified organisms in aquaculture
10	Perspectives of genetic improvement in Mediterranean mariculture

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture Work with mentor Exercises Knowledge tests	Independent assignment Multimedia and internet

GENERAL INFORMATION ABOUT THE COURSE #10		
1	The name of the course/module	Diversification of Mariculture
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Mandatory
4.	Semester	3rd
5.	Number of ECTS credits	6
6.	The total number of hours	70
7.	General description and purpose of the educational component	In this course students will get familiar with factors that need to be considered when introducing new species to marine aquaculture production such as market preferences, duration of life cycle, growth rate and minimal technical requirements for successful rearing.
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge of the basics of biology and ecology of species in aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
After successful completion of course, students will be able to: - explain importance and need for diversification of marine aquaculture production - define biological-ecological factors important for selection of new species - recognise difficulties and suggest solutions when introducing new species to production - analyse up-to-date successful examples of diversification for each group of organisms

- suggest potential new species for culturing, recommend suitable aquaculture production system and to evaluate positive and negative aspects of introduction.	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Diversification of marine aquaculture is an important aspect of further development of this growing industry. Global stressors in marine ecosystems, e.g. seawater temperature rise, overfishing, pollution of coastal areas etc., are contributing to the need of culturing new species in marine aquaculture, as well as to the adaptation of marine aquaculture techniques and diversification of market products. In this course students will get familiar with factors that need to be considered when introducing new species to marine aquaculture production such as market preferences, duration of life cycle, growth rate and minimal technical requirements for successful rearing. Potential new species for each group of culturing organisms will be assessed in detail, as well as difficulties that could occur during their introduction to culturing systems. Student will learn about latest trends in aquaculture industry, with emphasize on importance of culturing species on lower trophic level and herbivorous/omnivorous fish species. Thematic units to be covered: Introduction to the diversification of aquaculture production, Diversification of culturing macroalgae, Diversification of culturing bivalves and gastropods, Diversification of culturing cephalopods, Diversification of culturing crustaceans, Diversification of culturing cephalopods, Diversification of culturing fish.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Seminars and workshops • Exercises • Independent assignments • Laborator • Work with the mentor • Knowledge tests The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exam or has passed only one. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #11		
1	The name of the course/module	Aquaculture Food Safety
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Mandatory
4.	Semester	3rd
5.	Number of ECTS credits	3
6.	The total number of hours	60
7.	General description and purpose of the educational component	Course objectives are to explain the purpose of product quality assessment methods and the effect of food preservation procedures. In addition, the objective is that students understand the importance of prerequisite programmes as basis of quality management and recognise the value of certification of aquaculture products.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
After successful mastering of a course, students will be able to: - choose an adequate quality assessment method for aquaculture product - choose an adequate preservation procedure for aquaculture product - organize the implementation of the GHP and HACCP plan in aquaculture production system - design a traceability chain in aquaculture production system - recommend appropriate certification of the aquaculture product

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	The course deals with aquaculture products and their quality and safety. A comparison of product quality assessment methods and food preservation procedures is given. The course includes the assessment of various prerequisite programs (GMP, GHP, SSOP, HACCP) and quality management (ISO 9000, 14000, 22000). Traceability, certification and welfare in production of aquaculture products will also be commented. Classes are carried out through lectures and exercises that follow the topics of lectures. The active participation of the students in the classes is achieved by performing independent exercises on chosen topic.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to

	attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exam or has passed only one. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #12		
1	The name of the course/module	Developmental Biology of Fish
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Elective
4.	Semester	1^{st}
5.	Number of ECTS credits	3
6.	The total number of hours	45
7.	General description and purpose of the educational component	The purpose of this course is to familiarise students with the earliest stages of fish development, from the various types and shapes of eggs and their components to the structure and different types of sperm. Students will be introduced to the process and method of fertilization in fish, as well as the gradual development of organs and organ systems.
8.	Prerequisites for studying the course/module, connection with other educational components	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
After this course, students will be able to: - explain the differences between the various types of fish eggs - explain the structure of fish spermatozoa - describe the process of fish fertilization - discuss the process of embryonic development		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1	During the course, students will learn about different types of fish eggs, their shapes, number, and size in different groups. The parts of the egg will be analysed: yolk, shell, membrane, and	

	micropyle. Students will learn about the different types of sperm in fish and their basic structure. Fertilisation in fish and the developmental processes that follow will be covered, namely blastulation, gastrulation, neurulation, hatching from the egg, and the development of reproductive organs and organ systems.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Exercises • Independent assignments • Multimedia and internet • Laboratory • Knowledge tests	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exam or has passed only one. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #13		
1	The name of the course/module	Developmental Biology of Cultured Invertebrates
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Elective
4.	Semester	1st
5.	Number of ECTS credits	3
6.	The total number of hours	60

7.	General description and purpose of the educational component	Objective of this course is to provide students with knowledge on developmental biology of cultured molluscs (Bivalvia, Gastropoda, Cephalopoda), echinoderms (Echinoidea, Holothuroidea) and Crustacea.
8.	Prerequisites for studying the course/module, connection with other educational components	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
After successful completion of course, students will be able to: - define main concepts in developmental biology - understand and identify processes during embryology and larval development - explain differences in morphogenesis between molluscs and echinoderms - identify important unsolved problems in developmental biology.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
2.	Within the course students will gain knowledge on developmental biology of cultured molluscs (Bivalvia, Gastropoda, Cephalopoda), echinoderms (Echinoidea, Holothuroidea) and Crustacea. Lectures will cover brief introduction on reproduction and reproductive strategies, as well as gametogenesis and fertilisation. Early and late development will be studied in detail. Main processes involved in the embryonic development - cleavages, blastulation, gastrulation, formation of germ layers, coelom formation, organogenesis - will be explained with an emphasis on the differences between protostomia and deuterostomia. For late development, larval development and metamorphosis will be studied, together with regeneration (visceral, nervous system, etc.) for echinoderms. Units to be covered: Introduction to developmental biology, Reproduction and fertilisation, Early development in molluscs and echinoderms, Late development in molluscs and echinoderms. Early and late development of Crustacea.	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)		Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Exercises • Independent assignments • Multimedia and internet • Laboratory • Work with the mentor • Knowledge tests		The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam.

	The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exam or has passed only one. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE N14		
1	The name of the course/module	**MULTITROPIC MARICULTURE**
2	Faculty/department	Department of Applied Ecology
3	Status of the educational component	**Elective**
4	Semester	2nd
5	Number of ECTS credits	**3**
6	The total number of hours	45 (30 lecture, 10 exercises, 5 seminar)
7	General description and purpose of the educational component	To gain competences in interpretation and integration of aquaculture technology knowledge, complementary roles of organisms on different trophic levels and knowledge of sustainable ecological and economic advantages of integrated mariculture. In addition to the general trends in mariculture technology, we will explore the possibilities of integration of complementary species belonging to different trophic levels, where each level achieves multiple benefits. The course aims to facilitate the transfer of knowledge about IMTA, precision, aquaculture technology, sustainable environmental and economic benefits.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Learning outcomes at the level of the study program to which the course contributes: upon successful completion of the course, students will be able to:

1. Recognize mariculture positions and trends in the country and world-wide
2. Identify and analyse interactions between mariculture and the environment
3. Improve production through the selection of new species
4. Ensure the quality of breeding by applying adequate breeding systems.

Expected learning outcomes at the level of the course:

5. Analyse the possibilities and select new species for integration in multitrophic mariculture
6. Underline the different trophic interactions that link nutrient transfer between species groups
7. Discuss the harmonisation of production with the maximal utilization of nutrients
8. Develop economically viable and sustainable strategies in food production

9. Combine all of the above in the selection of new IMTA species with application in food industry and blue-biotechnology research.	
ASSESSMENT	
Seminar essay Written exam Practical training Oral exam Through a written and oral knowledge examination. To pass the preliminary exams/exam, the student must score at least 50%: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Review and selection of potential species, analysis of adaptation to integrated conditions based on their complementary roles in the ecosystem, as well as existing or potential economic value.
2	Furthermore, in addition to addressing new products in the food industry, topics will include cultured species with applications in blue-biotechnology, from the perspective of strategic trends in the world and Europe.
3	All aspects of different life stages will be analysed as a basis for future advanced and specialized knowledge in the field of mariculture.
4	Integral topics include abiotic, biotic and zootechnical factors that correlate with spatial, reproductive and nutritional aspects of breeding, in order to determine and analyse economic perspectives of selected species.

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture Seminars and workshops Laboratory Work with mentor Exercises Knowledge tests	Independent assignment Multimedia and internet Field work

GENERAL INFORMATION ABOUT THE COURSE N15		
1	The name of the course/module	**INTERNATIONAL BUSINESS NEGOTIATIONS**
2	Faculty/department	Department of Applied Ecology
3	Status of the educational component	**Elective**
4	Semester	2nd
5	Number of ECTS credits	**3**
6	The total number of hours	40 (20 lecture, 20 exercises)
7	General description and purpose of the educational component	The aim of the course is to familiarise students with the basic concepts of business negotiation, the specifics of international negotiation, and the basic characteristics of international business negotiation in different parts of the world.
8	Prerequisites for studying the course/module,	N/A

	connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Learning outcomes at the level of the study program to which the course contributes: upon successful completion of the course, students will be able to:

1. Independently organise and control workflows in culture facilities.
2. Manage mariculture production processes.
3. Implement good practice by complying with all laws and regulations.

Expected learning outcomes at the level of the course:

4. Specify and define the basic terms and elements of the business negotiation process
5. Explain, compare, and discern the principles and techniques of business negotiations
6. Determine the basic features of negotiations, identify the negotiation skills, and to classify, discern, and compare the strategies and tactics of international business negotiations
7. Anticipate the challenges of international business negotiations and identify the specific features of international negotiations
8. Discuss the impact of culture on international business negotiation
9. Recognize the importance of communication and communication skills in international business negotiation
10. Present and discuss the specific features of negotiations in different types of businesses
11. Discuss ethical issues in international business negotiations
12. State and explain the specific features of negotiating in different parts of the world, and apply them correctly in the international business negotiation process.

ASSESSMENT

Preparation for exercises
Activity in class
Written exam
Preliminary exam

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Basic business negotiating terms. The nature of business negotiations. Business negotiation process. Principles and techniques of negotiations. Negotiating skills. Negotiating power. Strategies and tactics of negotiation
2	Introduction to international business negotiation. Features of international business negotiation. The challenges of international negotiations
3	The specific features of international negotiations. The context of environment and directness. International business negotiation outcomes
4	The impact of culture on international business negotiations. Culturally sensitive strategies in negotiations. The importance of time in international business negotiations
5	Communication and international business negotiation
6	Negotiating in different types of businesses
7	Ethics in international business negotiations. Ethical issues in international business negotiations. Negotiators' propensity towards unethical methods. Business protocol
8	Specific features of negotiating in different parts of the world. Basic specificities of international business negotiations in Europe, North and South America, Africa, Asia and Australia.
9	Characteristics and examples of international negotiations in Europe. Case studies of selected European countries
10	Characteristics and examples of international negotiations in North and South America. Case studies of selected countries in the Americas
11	Characteristics and examples of international negotiations in Africa. Case studies of selected African countries

12	Characteristics and examples of international negotiations in Asia and Australia. Case studies of Australia and selected Asian countries.

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture Exercises Laboratory Work with mentor Knowledge tests	Independent assignment Multimedia and internet

GENERAL INFORMATION ABOUT THE COURSE N16		
1	The name of the course/module	**INNOVATION MANAGEMENT**
2	Faculty/department	Department of Applied Ecology
3	Status of the educational component	**Elective**
4	Semester	2nd
5	Number of ECTS credits	**3**
6	The total number of hours	30 (20 lecture, 10 exercises)
7	General description and purpose of the educational component	The objective of this module is to broaden student knowledge and understanding of key intellectual property concepts including its creation, management and growth.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Learning outcomes at the level of the study program to which the course contributes: upon successful completion of the course, students will be able to:

1. Independently organise and manage work processes in farming facilities.
2. Implement good practices by abiding by all respective laws and regulations

Expected learning outcomes at the level of the course:

3. Understand and critically judge the concepts related to the use of knowledge and technology in organisational activities
4. Critically evaluate the application of the theoretical framework related to product development in the context of research
5. Critically review different forms of business innovation strategies, think critically about the scope and implementation methods of including companies in global value added chains
6. Understand, interpret and critically judge the influence of factors that affect the financing of intellectual property
7. Evaluate the impact of current trends related to the analysis, planning, procurement, and evaluation of technologies in the context of research
8. Create, present and critically argue a strategic plan for the protection of intellectual property within the company
9. Critically review various factors in the context of digital transformation that may affect the future of intellectual property within companies and institutions

ASSESSMENT
Activity in class Written exam Preliminary exam A student may complete the course during the semester by taking preliminary exam or at the end by taking a final exam. To pass the preliminary exam/exam, the student must score at least 50%: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Basic concepts related to the use of intellectual property in the context of companies and institutions: creativity and learning, intellectual capital, different forms of intellectual property, innovation models;
2	Intellectual capital and innovation management of the company: operation of innovation management, innovative organization and acquisition of technology
3	Intellectual property and product development;; Intellectual property in a global environment: innovation strategies of companies and their participation in global value added chains;
4	Possibilities of financing intellectual capital within an innovative project: global and macro features of innovation financing, innovation project financing and instruments for financing different forms of intellectual property
5	Determinants of innovation policy development as a prerequisite for greater use of intellectual property;
6	Analysis, planning, evaluation and acquisition of technologies: analysis of technology needs, the most important forms of technology - global level, technology acquisition procedure, technology evaluation, and protection of intellectual property;
7	The future of intellectual property in the context of digital transformation of global, national and local communities.

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture Exercises Work with mentor	Independent assignment

GENERAL INFORMATION ABOUT THE COURSE N17		
1	The name of the course/module	**MARINE STOCK INHANCEMENT**
2	Faculty/department	Department of Applied Ecology
3	Status of the educational component	**Elective**
4	Semester	2nd
5	Number of ECTS credits	**3**
6	The total number of hours	45 (30 lecture, 15 seminars)
7	General description and purpose of the educational component	The aim of the course is to familiarize students with the main species subject to fishing and the possibilities of sustainable management and conservation of their stocks, i.e. their improvement or restoration.
8	Prerequisites for studying the course/module, connection with other	N/A

	educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Learning outcomes at the level of the study program to which the course contributes: upon successful completion of the course, students will be able to: 1. Recognize the positions and trends of mariculture in the country and abroad. 2. Identify and analyse the interactions between mariculture and the environment. Expected learning outcomes at the level of the course: 3. Analyse the main groups of fish and invertebrates that are commercially caught in the sea 4. Discuss population structure in space and time 5. Identify and discuss different fishing gears and techniques 6. Analyse the impact on the community 7. Discuss the socio-economic impact of fishing 8. Discuss stock enhancement practices.

ASSESSMENT
Seminar essay Independent work Written exam Preliminary exam A student may complete the course during the semester by taking two preliminary exams or at the end by taking a final exam. To pass the preliminary exam/exam, the student must score at least 50%: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	During the course, students will learn about the main fishing species and their distribution, as well as their population structures in space and time.
2	They will receive basic information on fishing gear and fishing techniques, as well as the impact of fishing on natural communities and on socio economics
3	Students will become familiar with ways to sustainably manage marine stocks and restore shellfish, crustaceans, echinoderms and fish stocks.

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture Seminars and workshops Work with mentor Knowledge tests	Independent assignment Multimedia and internet

GENERAL INFORMATION ABOUT THE COURSE N18		
1	The name of the course/module	**REPRODUCTIVE BIOLOGY OF FISH**
2	Faculty/department	Department of Applied Ecology
3	Status of the educational component	**Elective**
4	Semester	2nd
5	Number of ECTS credits	**3**

6	The total number of hours	45 (30 lecture, 10 seminars, 5 exercises)
7	General description and purpose of the educational component	The objective of this course is to familiarise students with fish reproduction, including their sex determination and differentiation, general patterns of oogenesis, and spermatogenesis. Students will become familiar with the endocrinological mechanism of control of gamete formation and the possibilities of its disruption. Students will also become familiar with the environmental control of reproduction and the various types of sexual behaviour in fish.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Learning outcomes at the level of the study program to which the course contributes: upon successful completion of the course, students will be able to:

1. Identify and analyse the interactions between mariculture and the environment

Expected learning outcomes at the level of the course:

2. Explain the stages of gametogenesis
3. Describe the endocrine control of reproduction
4. Discuss the causes of disorders of gametogenesis
5. Analyse the sexual behaviour of different groups of fish.

ASSESSMENT

Seminar essay
Exercises
Written exam
Preliminary exam
A student may complete the course during the semester by taking two preliminary exams or at the end by taking a final exam. To pass the preliminary exams/exam, the student must score at least 50%: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	During the course, students will learn about the different ways teleosts reproduce and how to determine their sex.
2	Ovarian structure will be analysed and oogenesis, testicular structure, and spermatogenesis will be described
3	Students will become familiar with the endocrine and environmental control of reproduction. Fish behaviour, including migration, territoriality, and spawning site selection, will be explained
4	The social interaction among individuals will be analysed, including sexual selection and care of off spring
5	Unusual forms of reproduction and reproduction in fisheries and aquaculture will also be covered

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Lecture Seminars and workshops Exercises Laboratory Work with mentor Knowledge tests	Independent assignment Multimedia and internet

GENERAL INFORMATION ABOUT THE COURSE #19		
1	The name of the course/module	Aquaculture Adaptation to Global Stressors
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Elective
4.	Semester	3rd
5.	Number of ECTS credits	3
6.	The total number of hours	45
7.	General description and purpose of the educational component	Objective of this course is to teach students about global stressors, impacts they have on marine aquaculture and learn adaptation and mitigation strategies.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successfully completing the course, the students will be able to:
- define global stressors, explain the cause of occurrence and understand the impacts on the marine ecosystem
- understand and explain the difference between global stressors and their impact on aquaculture at global and regional scale
- asses and analyse the impact of target stressors on aquaculture production
- identify suitable strategies for aquaculture adaptation to global stressors
- recommend and apply the optimal adaptation or mitigation strategy on a regional example
- design and conduct research and/or monitoring in a particular area.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Within this course, students will gain knowledge about global stressors, impacts they have on marine aquaculture, and learn adaptation and mitigation strategies. Climate change, global warming, local extreme weather events like heatwaves, ocean acidification, sea level rise and potential effect of multiple stressors will be lectured in detail. Students will get to know aquaculture adaptation strategies to now-and future projections of changes in the ecosystem, including change of fish feed, relocation, diversification of production, applying genetic methods based on epigenetic adaptation mechanisms. Local mitigation possibilities and methods will be explained with a case-study method. Thematic units to be covered: Global changes and stressors, Impact of global changes on aquaculture, Adaptation and mitigation strategies, Research, monitoring and policies.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

• Lectures • Exercises • Seminars and workshops • Independent assignments • Multimedia and internet • Laboratory • Knowledge tests The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exam or has passed only one. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #20		
1	The name of the course/module	Marine Biologically Active Natural Products
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Elective
4.	Semester	3rd
5.	Number of ECTS credits	3
6.	The total number of hours	45
7.	General description and purpose of the educational component	To gain competences in interpretation of natural organic compounds produced by marine organisms and gain knowledge about their potential application in the pharmaceutical, cosmetic and food industries.
8.	Prerequisites for studying the course/module, connection with other	

	educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Following a successfully completion of the course student will be able to:
- interpret and investigate the role of chemical interactions between living organisms and their environment
- compare chemically mediated interactions in the marine environment and how they affect the abundance and distribution of organisms and metabolites
- recognize the evolutionary course of development in individual interactions and predict processes of biosynthesis that mediate interactions
- distinguish the main groups of producers of metabolites
- distinguish chemical classes (groups) that are most often the source of new biomaterials
- analyse detection and screening methods
- contribute to better understanding of the marine environment as a rich source of NP's.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	The course provides a detailed introduction to biologically active compounds from the sea (marine natural products - MNP). Integral themes include natural organic compounds produced by marine organisms as a source of new drugs, the origins of modern drugs and traditional medicines with great potential in modern medicine. Furthermore, the focus is on the biochemistry of specific molecules or compounds that function as signals to initiate, modulate, or terminate various biological processes. The aim of the course is to provide students with a broad knowledge of the classes of secondary metabolites originating from marine macro- and microorganisms, and their potential application in the pharmaceutical, cosmetic and food industries. Classes are organized according to thematic units that include an overview of marine organisms that produce bioactive components, methods of collecting, processing and screening their biological activities. Furthermore, interdisciplinary (biology-ecology-chemistry) analysis of interactions in communities and their application in, ecology, biology, biotechnology, biomedicine and various industries will be discussed.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Exercises • Seminars and workshops • Independent assignments • Multimedia and internet • Laboratory • Knowledge tests • Field work • Work with the mentor The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam.

	The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exam or has passed only one. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #21		
1	The name of the course/module	Ecological Monitoring
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Elective
4.	Semester	3rd
5.	Number of ECTS credits	3
6.	The total number of hours	45
7.	General description and purpose of the educational component	The goal of the course is to familiarise students with the basics of ecosystem protection, monitoring methods, and the most common negative impacts of maricultural operations on surrounding habitats and biodiversity, as well as methods of preventing and reducing negative impacts.
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge of basic ecological principles and ecosystem functioning is required.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
Upon successful completion of the course, students will be able to: - identify the impact of mariculture on the environment - understand the importance of sustainable use of the ecosystem - analyse approaches and methods for environmental impact assessment and environmental monitoring - propose the necessary measures to reduce the negative impact of mariculture on the environment - design and implement research and/or environmental monitoring in the field of aquaculture - discuss the advantages and disadvantages of different approaches to environmental monitoring.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1	Mariculture is an activity that has numerous negative impacts on the environment, and planned and necessary growth includes the expansion of cultivation areas, more facilities both on land and at sea, and increased use of food, drugs, and other substances used in mariculture that directly enter the marine environment. Students will become familiar with environmental monitoring and assessment methods through a combination of lectures and analysis of existing programmes and practices. They will understand the importance of quality environmental monitoring programs for the sustainable development of this sector and the reduction of negative impacts. Students will learn theoretically and practically the methods of sampling and analysis of samples and draw conclusions from the data obtained. By analysing practical examples, they will be encouraged to identify advantages and disadvantages of existing programmes and measures for environmental protection in areas of aquaculture and to propose new solutions.	
TEACHING AND LEARNING METHODS		

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Exercises • Seminars and workshops • Independent assignments • Multimedia and internet • Laboratory • Knowledge tests • Field work • Work with the mentor The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exam or has passed only one. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #22		
1	The name of the course/module	Culture of Ornamental Species
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Elective
4.	Semester	3rd
5.	Number of ECTS credits	3
6.	The total number of hours	60
7.	General description and purpose of the educational component	Familiarise students with fish farming as well as the problems and solutions for its sustainability
8.	Prerequisites for studying the course/module, connection with other	Basic morphology and biology of teleosts

	educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
After successfully completing the course, students will be able to: - list the equipment necessary for the successful operation of freshwater and marine home and public aquariums - describe the process and importance of spawning organisms in captivity for the purposes of sale on the ornamental species market or for conservation - understand the world market of ornamental species - apply the acquired knowledge to design, establish and maintain their own aquarium
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Lectures will cover types of aquariums, methods of setup and technological solutions both for private and public aquaria as well the reproduction of species in captivity for sale or conservation purposes and the market for ornamental aquatic vertebrates, invertebrates and plants. Practical classes will allow students to learn first-hand about the design, establishment, stocking, start-up and maintenance of their own aquarium within the University's Aquaculture Laboratory. Furthermore, they will have the opportunity to visit and participate in the daily tasks of a public aquarium, where they will get to know more about the equipment and processes involved in its successful operation.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Exercises • Seminars and workshops • Independent assignments • Multimedia and internet • Laboratory • Knowledge tests • Field work • Work with the mentor The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exam or has passed only one. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-

	79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #23		
1	The name of the course/module	Mariculture Marketing
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Elective
4.	Semester	3rd
5.	Number of ECTS credits	3
6.	The total number of hours	45
7.	General description and purpose of the educational component	The aim of the course is to acquire basic theoretical and practical knowledge in the field of marketing and its application in mariculture. Through lectures, exercises and other forms of education, students will try to train themselves after completing their studies to independently approach and solve problems in economic and social practice.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic morphology and biology of teleosts
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
After successfully completing the course, students will be able to: - define and understand the basic concepts of marketing, - recognise the criteria for market segmentation and selection of target segments, - analyse and compare market products/services, distribution, prices and promotions, - anticipate processes related to decision-making on marketing strategy, - distinguish between ethical and socially responsible aspects of marketing activities and - evaluate the latest scientific and professional knowledge.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1	Through examples of the latest trends in the application of marketing in mariculture, students will cover the following topics through lectures and exercises: concept and definition of marketing, market research, market segmentation, consumer behaviour, target audience, marketing information system (MIS), marketing mix (4P), strategic planning and SWOT analysis, product management, product positioning, brand creation strategy, application of marketing to specific mariculture products, internet marketing, 21st century global marketing and social responsibility and marketing ethics.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Exercises • Seminars and workshops • Independent assignments	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the

• Multimedia and internet • Laboratory • Knowledge tests • Field work • Work with the mentor The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.	knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exam or has passed only one. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #24		
1	The name of the course/module	Marine Spatial Planning
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Elective
4.	Semester	3rd
5.	Number of ECTS credits	3
6.	The total number of hours	45
7.	General description and purpose of the educational component	Course objectives: to acquaint students with the basics of spatial planning of the marine area, with special reference to spatial plans of the area with special features. Also, the goal is to train students on the obligations of nature and environmental protection in the spatial development and protection of space.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic morphology and biology of teleosts
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
After successfully completing the course, students will be able to: - valorise the goals and principles of spatial planning		

- assess which spatial plans are valid in a particular geographical area - assess which institutions are responsible for preparation and adoption of spatial plans - represent an opinion during participation in the public debate on the proposal of the spatial plan - analyse spatial plans - envisage the necessary legal procedures during the preparation of the spatial plan

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
2.	Through teaching materials and processed topics, students are introduced to goals and principles of the spatial planning and institutional framework. Knowledge of the procedures for the preparation and verification of spatial plans is acquired and links with European practices are analysed. Some topics are elaborated in more detail: spatial planning in a protected coastal area, interventions in restricted areas, marine area planning, etc. The subject-matter and content of spatial plans and their levels (state, regional, local) with special reference to spatial plans of the area with special features such as the spatial plans of the national park and nature park are also analysed. The manner of stakeholders involvement and participation in public debates is discussed. Students are informed about the competencies for adoption of spatial planning documents. Legislation related to physical planning, nature conservation and environmental protection is being processed, which additionally emphasizes the obligations of nature and environmental protection in the planning development and protection of space. Classes are organised in the form of lectures and seminars presented by students, and follow the topics of the lecture. Active participation of students in the curriculum is achieved through interactive lectures and processing current examples in spatial planning and following the scientific literature in this field.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Seminars and workshops • Knowledge tests • Work with the mentor The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exam or has passed only one. To

	pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #25		
1	The name of the course/module	Ethical and Socioeconomic Aspects of Aquaculture
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Elective
4.	Semester	3rd
5.	Number of ECTS credits	3
6.	The total number of hours	45
7.	General description and purpose of the educational component	Objective of this course is to teach students to categorize and analyse various ethical aspects of aquaculture industry, with an emphasis on four major involved groups – producers, consumers, environment and cultured organism.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic morphology and biology of teleosts

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successfully completing the course, the students will be able to:
- define the main ethical principles in food production
- explain and analyse current ethical issues in aquaculture industry
- distinguish between societal and economic impacts on local and global community
- identify positive aspects and plan production accordingly
- estimate negative issues and propose management plan to mitigate risks
- use present-day guidelines and legislative to ensure good practice.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	With increased aquaculture contribution to the global food production there is a number of ethical concerns as well as a range of socio-economic impacts that need to be addressed. Within this course, students will learn to categorise and analyse various ethical aspects of aquaculture industry, with an emphasis on four major involved groups – producers, consumers, environment and cultured organism. In addition, latest ethical issues considering genetically modified organisms and lack of food security will be described and discussed over case-studies. Positive (job opportunities, food security reduction in fish price, improved infrastructure etc.) and negative (social conflict, loss of jobs due to lack of proper management, health hazards etc.) socio-economic aspects of aquaculture on local communities will be explained. Students will get to know how to find and apply latest guidelines and legislative on aquaculture production. Topics to be covered: Introduction to ethical issues in food production, Food Ethics Council and major ethical principles, Ethical issues of aquaculture, Genetically modified food, Positive and negative socio-economic issues in aquaculture, Aquaculture guidelines and legislation.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

• Lectures • Seminars and workshops • Knowledge tests • Work with the mentor The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exam or has passed only one. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #26		
1	The name of the course/module	Marine and Coastal Ecosystem Services
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Elective
4.	Semester	3rd
5.	Number of ECTS credits	3
6.	The total number of hours	45
7.	General description and purpose of the educational component	The goal of the course is to acquire the knowledge necessary to recognise, evaluate, and utilise the services provided by marine and coastal ecosystems.
8.	Prerequisites for studying the course/module, connection with other	Knowledge of ecosystem concepts and functions.

	educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After the completion of the course students will be able to:
- identify coastal and marine processes in a range of habitats
- evaluate fisheries and aquaculture biology and management for a range of marine animals
- reflect on issues associated with cultural use of coastal and marine systems
- synthesise, evaluate and interpret marine and coastal biological and ecological data
- effectively communicate scientific information through writing reports, online and verbal discussions and poster presentation.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	With increased aquaculture contribution to the global food production there is a number of ethical concerns as well as a range of socio-economic impacts that need to be addressed. Within this course, students will learn to categorise and analyse various ethical aspects of aquaculture industry, with an emphasis on four major involved groups – producers, consumers, environment and cultured organism. In addition, latest ethical issues considering genetically modified organisms and lack of food security will be described and discussed over case-studies. Positive (job opportunities, food security reduction in fish price, improved infrastructure etc.) and negative (social conflict, loss of jobs due to lack of proper management, health hazards etc.) socio-economic aspects of aquaculture on local communities will be explained. Students will get to know how to find and apply latest guidelines and legislative on aquaculture production. Topics to be covered: Introduction to ethical issues in food production, Food Ethics Council and major ethical principles, Ethical issues of aquaculture, Genetically modified food, Positive and negative socio-economic issues in aquaculture, Aquaculture guidelines and legislation.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Seminars and workshops • Knowledge tests • Work with the mentor The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both

	preliminary exam or has passed only one. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #27		
1	The name of the course/module	Safety at Sea
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Elective
4.	Semester	3rd
5.	Number of ECTS credits	3
6.	The total number of hours	60
7.	General description and purpose of the educational component	Theory and practical knowledge of safety at sea. Knowledge of using equipment for survival, life-saving and firefighting.
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge of ecosystem concepts and functions.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
After the completion of the course students will be able to: - describe and interpret the international and national laws relevant to maritime safety, security and pollution prevention - discuss the importance of safety and security for ship management - define search and rescue operations and procedures - illustrate distress communication procedures - summarise operational conditions and maintenance of survival equipment on ships - describe the survival equipment available on merchant ships - explain the operational conditions and maintenance of fire-fighting equipment on ships - identify and describe the fire-fighting equipment available on merchant ships.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1	Learning objectives are to develop an understanding of the international system of safety of navigation, including the most important maritime conventions. Furthermore, the objective is also to pass to students a working knowledge and give them basic training in safety at sea. International maritime safety, security and pollution prevention system, search and rescue, maritime casualties, safety equipment and appliances, distress communication, abandoning ship and survival at sea, firefighting procedures.	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)	

• Lectures • Independent assignments • Multimedia and internet • Knowledge tests • Work with the mentor The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam. The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exam or has passed only one. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

GENERAL INFORMATION ABOUT THE COURSE #28		
1	The name of the course/module	Natural Science Research in the Mediterranean
2.	Faculty/department	Department of Applied Ecology
3.	Status of the educational component	Elective
4.	Semester	3rd
5.	Number of ECTS credits	3
6.	The total number of hours	45
7.	General description and purpose of the educational component	The aim of the course is to familiarise students with the development of natural science research in the Mediterranean and the Adriatic Sea, the most important researchers and scientists who initiated, designed and carried out oceanographic research, as well as the institutions that were responsible for scientific research projects. Also, the goal of the course for students is to understand the importance of sea and ocean research, as well as well-designed and prepared modern

		projects with the aim of getting to know marine ecosystems as well as possible and sustainable development in the Blue Sector.
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge of ecosystem concepts and functions.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
After successfully completing the course, students will be able to: - present knowledge about the history of oceanographic research in the seas and oceans - distinguish the importance of certain periods in the development of natural science research in the Mediterranean - notice the importance of the role of researchers and institutions in the scientific research process - understand the importance of scientific and biotechnological projects in modern research on marine ecosystems - critically assess the possibility and importance of applying the results of scientific research in marine ecosystems.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
2.	The course presents an overview of natural science research in the Mediterranean from the beginnings of monitoring the natural and environmental features of the Mediterranean area in ancient times to modern research and projects. Lectures include a brief overview of the history of world seas and oceans with special emphasis on research periods in the Mediterranean, physical, chemical, and biological oceanographic research of marine ecosystems, scientific research expeditions, marine research institutions, prominent researchers, a brief overview of fisheries and biological research as and an overview of the history of the cultivation of marine organisms and a special review of natural science research in the Adriatic Sea.	

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures • Independent assignments • Multimedia and internet • Knowledge tests • Work with the mentor The quality of the programme, teaching process, teaching skills and curriculum mastering level will be determined by conducting a written evaluation based on questionnaires and other standardised methods that are in accordance with the general acts of the University of Dubrovnik (student survey on the quality of teaching activities, teacher self-analysis, etc.) and guidelines for quality assurance in the European Higher Education Area as well as the requirements of the ISO 9001 standard.	The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and The final grade is based primarily on the knowledge that students demonstrate during teaching activities and on the written part of the exam. Students should participate in activities during lectures, exercises and seminars, as well as the writing of a seminar paper. Full-time students are required to attend at least 70% of the total number of lecture hours and 80% of exercises and/or seminars in order to exercise the right to take the exam. Part-time students are required to attend at least 80% of the total number of hours of exercises in order to exercise the right to take the exam. If students have not fulfilled all the obligations stipulated in the course, they are obliged to attend the lectures again and fulfil the conditions for taking the exam.

	The final grade is formed as follows: 50% preliminary exam 1, 50% preliminary exam 2 or 100% final exam. The written exam is taken if the student has not passed both preliminary exam or has passed only one. To pass the preliminary exams/exam, the student must obtain at least 50% points: 49% insufficient (1); 50-64% - sufficient (2); 65-79% - good (3); 80-89% - very good (4); 90-100% - excellent (5).

POLYTECHNIC UNIVERSITY OF VALENCIA

N	Criterion A: University profile	
1.1	Name of the University	**POLYTECHNIC UNIVERSITY OF VALENCIA**
1.2	Classical or applied	Applied
2	**Criterion B: Profile of the educational program (Curriculum)**	
2.1	Number of Aquaculture disciplines	18
2.2	The name of the educational program	Master's degree in Aquaculture
2.3	Type of diploma	
2.4	Total number of credits (ECTS)	**60** Compulsory courses-min. 36 Optional – 18 Internship-0 Thesis -6
3	**Criterion C: Setting the educational program (Curriculum)**	
3.1	Duration of the program	1 year (2 semesters)
3.2	The purpose of the educational program	The objective is to provide students with knowledge, skills and approaches that enable them to carry the following tasks. ✓ Design of aquaculture facilities for marine and inland species, and assessment of their environmental impact. ✓ Control of the production process, reproduction, feeding, growth, product transformation, etc. ✓ Health and environmental management. ✓ Drawing up and development of research projects and integrated management plans. ✓ Information and scientific dissemination in the aquaculture sector, especially regarding issues of sustainable development, consumption and food safety.
4	**Criterion D: Characteristics of the educational program (Curriculum)**	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	✓ Aquaculture ✓ Health and environmental management and impact ✓ Production, reproduction, product transformation
5	**Criterion E: Teaching and assessment**	
5.1	Teaching and learning methods	**Teaching methods** ✓ Lecture theory ✓ Laboratory practical ✓ Seminar ✓ Computer practice **Learning methods** ✓ Project development ✓ Practical observations ✓ Case study ✓ Classroom Troubleshooting ✓ Field work
5.2	Assessment	✓ Written exam ✓ Oral exam ✓ Open answer written test (multiple choice) ✓ Academic work: Project development ✓ Practical observation ✓ Portfolio ✓ Case study ✓ Self-evaluation
6	**Criterion F: Software competencies**	
6.1	Integral competence	
6.2	General competences	
6.3	Professional competences	Software competencies are merged with the outcomes
	Criterion G: Program Learning Outcomes	
	These are the outcomes that students acquire through this program: the UPV **generic student outcomes** (common to all UPV graduates), **the general and specific outcomes of the degree**.	

7.1	Program learning outcomes	**Generic Outcomes** **1. Comprehension & Integration** Demonstrate an understanding and integration in both the students' own specialization and other wider contexts **2. Application & practical thinking** An ability to put theoretical knowledge into practice and plan the process to be followed, develop and conduct appropriate experimentation, analyze, interpret data to draw conclusions **3. Analyzing & solving problems** Analyze & solve problems effectively by identifying and defining the significant elements of which they are composed **4. Innovation, creativity & entrepreneurship** Innovation & entrepreneurship in the form of satisfactory and original response to personal, organizational & social needs and demands **5. Teamwork & leadership** Work with and lead a team effectively in order to achieve common objectives while contributing to the personal and professional development of its members **6. Designs & projects** Effective design, control and evaluation of an idea until it becomes a specific project **7. Ethical, environmental and professional responsibility** Show ethical, environmental and professional responsibility towards oneself and others **8. Effective communication** Effective oral and written communication with proper use of the appropriate means and bearing in mind the requirements of the situation and the person receiving the message **9. Critical thinking** Develop the ability to think critically and to consider the fundamental concepts behind h e students' and others' ideas, action and judgements **10. Awareness of contemporary issues** Identify and interpret contemporary issues both in students' own field and other fields of knowledge **11. Life-long learning** Strategic, independent & flexible use of knowledge in accordance with the desired objectives throughout students' professional career **12. Planning & time management** Appropriate planning to make the best use of the time available, programming the required activities to reach the desired academic, professional and personal objectives **13. Specific tools** Select and apply as appropriate tools, technologies and general instruments available in any operations related to design and projects in students' professional field **General Outcomes** 1. To possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous

		2. Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context 3. That students know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within broader (or multidisciplinary) contexts related to their area of study 4. That students are able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments 5. To know how to communicate their conclusions and the ultimate knowledge and reasons that support them to specialized and non-specialized audiences in a clear and unambiguous way 6. Possess basic knowledge of the physiology, production, reproduction and nutrition of key species in aquaculture, as well as the function and manipulation of biological and physicochemical cycles in tanks. 7. Possess basic knowledge in the identification and control of pathologies in aquaculture farms 8. Possess basic knowledge in the design of facilities, as well as the evaluation of their environmental impact. 9. Possess basic knowledge for the design and analysis of experiments, the management and organization of the sector; and scientific dissemination and communication strategies 10. Acquire the ability to perform tasks such as: (a) analyze water quality; (b) develop auxiliary and production crops; (c) control and diagnose diseases; (d) carry out quality controls and traceability; (e) analyze and prevent risks in the production chain; and (f) design facilities 11. Acquire the basic skills necessary to: (a) identify relevant research objectives and realistically plan their achievement; (b) designing experimental analyzes that allow increasing knowledge about production, reproduction, maintenance and pathology of key species and potential species in aquaculture, as well as helping to solve newly emerging problems; and, (c) produce communicable knowledge, that is, be able to elaborate the information 12. Acquire the basic skills necessary to: (a) anticipate R+D+i needs (for example, those derived from the introduction of new species or prophylaxis against emerging pathogens); (b) prevent potential environmental impact; and (c) organize production ensuring its viability **Specific Outcomes** 1. Design control, management and prevention plans for infectious and non-infectious pathologies of relevance in aquaculture. 2. Analyze the potential impact of crops on the environment and surrounding biodiversity. 3. Possess the essential basic knowledge on the pathology of farmed fish, molluscs and crustaceans. 4. Understand the operation of production systems and specialized facilities. 5. Know the crops of marine and continental species that are developed today. 6. Plan and/or propose experimental assumptions for the study of the control of the reproduction of fish and mollusk cultures. 7. Identify new trends and relevant research fields on fish and mollusc reproduction. 8. Apply knowledge about the reproductive process of fish, or mollusc cultures, proposing the relevant tools to solve problems raised by the industry in the short and medium term 9. Possess skills for handling and using live prey as larval food. 10. Understand the physiological functioning of animals of interest in aquaculture and the basic mechanisms underlying these mechanisms

		11. Understand the role of coordination and integration systems in the functioning of animals of interest in aquaculture. 12. CE2 - Apply the basic treatments used to control and prevent the most relevant infectious diseases in aquaculture 13. Correctly handle scientific terminology and become familiar with the methodologies and sources of information in the Physiology of animals of interest in aquaculture. 14. Familiarize yourself with the elaboration of analysis bulletins. 15. Acquire skills to recognize the importance of the different groups of contaminants present in water. 16. Relate the results of the different water quality control parameters. 17. Recognize the importance of analytical chemistry to make technical decisions about operation, choice and promotion of types of water for certain crops 18. Design inland and marine aquaculture facilities (tanks and floating cages) 19. Assess the environmental impact of facilities 20. Manage and control continental and marine facilities. 21. Promote entrepreneurial vision on farms 22. Propose new tools and studies with applicability in the medium and short term in aquaculture. 23. Possess the necessary manual skills for the correct handling of materials and instruments. 24. CE4 - Detect the errors of approach or procedure committed during the work in the laboratory, and discern their scope on the results obtained 25. Use taxonomic nomenclature correctly 26. Recognize the anatomy of the different groups of animals used in aquaculture. 27. Identify taxa of interest in aquaculture through specific bibliography (keys, identification guides, etc.). 28. Understand the functional morphology, physiology and life strategies of farmed or potentially farmable species, with special emphasis on the impact of biological constraints on aquaculture practice. 29. Use physiological and ethological information to assess the welfare of farmed species.	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	8 teaching staff that teaches in the degree program	
8.2	Material and technical support	N/A	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Applied physiology (1st sem.) .	3	N/A
9.1.2	Applied zoology (1st sem.)	3	N/A
9.1.3	Nutrition and Food (1st sem.)	5	✓ Written exam ✓ Written test ✓ Observation ✓ Project development
9.1.4	Pathology and immunology (1st sem.)	6	N/A
9.1.5	Reproduction (1st sem.)	5	✓ Written exam ✓ Academic work
9.1.6	Water quality (1st sem.) The study guide is not available	3	N/A
9.1.7	Facilities design and management (2nd sem.)	4	✓ Oral exam ✓ Written test ✓ Project development
9.1.8	Product quality (2nd sem.)	3	✓ Written exam ✓ Project development
9.1.9.	Systems engineering applied to Aquaculture (2nd sem.)	4	✓ Written exam ✓ Practical observation

9.1.10	Master's degree final Project (Thesis, 2nd sem.)	6	Thesis defence
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Introduction to aquaculture (1st sem.)	2	N/A
9.2.2	Disease diagnosis and control (2nd sem.)	4	N/A
9.2.3	Introduction to research in aquaculture (research orientation) (2nd sem.)	6	✓ Academic work: Project ✓ Observation ✓ Self-evaluation
9.2.4	Latest advances in aquaculture (2nd sem.)	3	N/A
9.2.5	Production systems: auxiliary crops (2nd sem.)	2	N/A
9.2.6	Production systems: continental and tropical fish (2nd sem.)	3	✓ Written exam ✓ Written test ✓ Portfolio
9.2.7	Production systems: marine fish (2nd sem.)	3	✓ Written exam ✓ Portfolio
9.2.8	Production systems: molluscs (2nd sem.)	2	N/A
9.2.9	Sustainable aquaculture (2nd sem.)	3	✓ Written test ✓ Case study ✓ Observation
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Master degree Project (thesis)	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE N1		
1.	The name of the course/module	**Nutrition and Food**
2.	Faculty/department	Animal Science
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	**5**
6.	The total number of hours	Contact hours: **50** (35 lecture, 15 practical laboratory) Non contact hours**: 80**
7.	General description and purpose of the educational component	The optimal growth, the maintenance of an adequate sanitary state and the final quality of the product of the aquaculture species depends on a correct feeding. In addition, the cost of feed is the highest percentage of farms aquaculture, so that its proper planning and management depends on profitability business. The technicians of the aquaculture companies must know, both the physiological bases of the nutrition of different species, such as digestion and metabolism processes and their nutritional needs, such as the practical aspects relating to the composition of the food and the evaluation of nutritional efficacy.
8.	Prerequisites for studying the course/module, connection with other educational components	There is not identified Recommended Prior Knowledge.
ASSESSMENT		
	Type: Open answer written test Amount: 1 Weight: 40 %	
	Type: Achievement test multiple choice (written exam) Amount: 1 Weight: 30%	
	Type: Academic work: Project development Amount: 1 Weight: 20%	
	Type: Observation	

	Amount: 1 Weight: 10%

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General and specific outcomes.

1. Possess basic knowledge of the physiology, production, reproduction and nutrition of key species in aquaculture, as well as the function and manipulation of biological and physicochemical cycles in tanks.
2. Understand the physiological functioning of animals of interest in aquaculture and the basic mechanisms underlying these mechanisms
3. Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
4. To possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous
5. To know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within broader (or multidisciplinary) contexts related to their area of study
6. Acquire the basic skills necessary to: (a) identify relevant research objectives and realistically plan their achievement; (b) designing experimental analyzes that allow increasing knowledge about production, reproduction, maintenance and pathology of key species and potential species in aquaculture, as well as helping to solve newly emerging problems; and, (c) produce communicable knowledge, that is, be able to elaborate the information
7. Understand the functional morphology, physiology and life strategies of farmed or potentially farmable species, with special emphasis on the impact of biological constraints on aquaculture practice
8. Analyzing and solving problem: Design and conduct experiments, interpret data, and draw conclusions.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	**Introduction to aquacultural species** ✓ Feeding of aquaculture species
2.	**Introduction feeding to aquaculture**
3.	**Digestive Physiology** ✓ Digestive physiology of mollusks ✓ Digestive physiology of crustaceans ✓ Digestive physiology of fish
4.	**Metabolism and nutritional needs** ✓ Proteins and amino-acids ✓ Lipids and fatty acids ✓ Carbohydrates ✓ Energy and protein/energy ratio
5.	**Raw materials for use in aquaculture** ✓ Introduction ✓ Protein concentrates ✓ Energy concentrates
6.	**Formulation and manufacturing** ✓ Feed design and formulation ✓ Feed manufacturing systems
7.	**Feeding of different species of aquacultural interest**

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
✓ Lecture theory ✓ Practical laboratory	✓ Project development: Development of a project that can extend from brief and simple essays to project ✓ Observations: Strategy based on the systematic collection of data in the learning context itself: execution of tasks, practices

GENERAL INFORMATION ABOUT THE COURSE N2

1.	The name of the course/module	**Reproduction**
2.	Faculty/department	Animal Science
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	**5**
6.	The total number of hours	Contact hour: **50** (35 lecture, 10 lab sessions, 5 seminar)

		Non contact hour**: 95**
7.	General description and purpose of the educational component	The course tries to address some of the many and very different aspects (see list of topics) that have to do with the fish reproduction. Basically as the first step in fish farming, but mentions of species will also be included model that can be interesting, for example, from the point of basic research in biomedicine or physiology.
8.	Prerequisites for studying the course/module, connection with other educational components	There is no identified requirements
ASSESSMENT		
	Type: Academic work Amount: 1 Weight: 30%	
	Type: Open answer written test (exam) Amount: 2 Weight: 70%	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		

General and specific outcomes.

1. Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
2. To know how to communicate their conclusions and the knowledge and reasons the latter that support them to specialized and non-specialized audiences in a clear way and without ambiguities
3. Plan and/or propose experimental assumptions for the study of the control of the reproduction of fish and shellfish culture
4. Possess basic knowledge for the design and analysis of experiments, the management and sector management; and scientific dissemination and communication strategies
5. Apply knowledge on the reproductive process of fish, or crops of molluscs, proposing the pertinent tools in the solution of problems raised by the industry in the short and medium term
6. Understand the functional morphology, physiology and vital strategies of the species cultivated or potentially cultivable, with special emphasis on the impact of constrictions information on the practice of aquaculture
7. Possess basic knowledge in the physiology, production, reproduction and nutrition of key species in aquaculture, as well as the function and manipulation of biological cycles and physico-chemicals in tanks.
8. Identify new trends and relevant research fields on reproduction of fish and shellfish

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Introduction ✓ General information on the biology of the reproduction of molluscs and crustaceans. Types of reproduction. Sexual dimorphism. Fertilization mechanisms. Reproductive behaviors. Types of oocytes and larvae. ✓ General information on the biology of fish reproduction. Types of reproduction. Sexual dimorphism in fish. Fertilization mechanisms. Reproductive behaviors. Types of oocytes and larvae.
2.	Anatomy and physiology of reproduction ✓ Anatomy. Nervous system. Endocrine system. Reproductive organs. Aspect of the gonad. Types of gonads. Gonadosomatic index ✓ Phases of the reproductive cycle. Oogenesis. Spermatogenesis. Types of ovarian development.
3.	Playback control ✓ Environmental control of the reproduction of molluscs, crustaceans and fish. Environmental factors involved in the development of the reproductive process. Modification of the laying season by means of environmental manipulation. ✓ Hormonal control of the reproduction of molluscs, crustaceans and fish. Endogenous regulation of reproduction. Hormonal treatments to induce gonadal development. Hormonal laying induction treatments.
4.	Practical aspects ✓ Management of reproducers. Food. Anesthesia. Sampling (biopsies, blood extraction, intra-ovarian cannulations, etc.). Administration of hormonal treatments Synchronization of layings. Installations (hatcheries, auxiliary crops, transport, fattening). ✓ Manipulation of gametes and larvae. Obtaining gametes by filtering or stripping. Evaluation of the laying quality. Sperm handling. Evaluation of sperm quality. Use of vital stains. In vitro fertilization. Incubation. Embryonic development. Larval feeding. Gamete cryopreservation
5.	**Sexual differentiation and sex control**

	✓ Differentiation and sexual determination. Differences according to species. Labile period. ✓ Sex control techniques. Genetic techniques: polyploidy and gynogenesis. Physiological techniques: direct methods and indirect methods ✓ Endocrine disruption. Disruptors. Effects and consequences
6.	Genetic improvement and gene transfer ✓ Genetic improvement and gene transfer. General information about characters of commercial interest. Selection of players. Selection programs (Norwegian salmon, tilapia). Establishment of crossings. Hybridization. Markers and genetic improvement. ✓ Transgenesis: types, scientific, commercial and biomedical interest. Germ cell transplantation.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
✓ Lecture ✓ Seminar ✓ Laboratory sessions	Project development

GENERAL INFORMATION ABOUT THE COURSE N3		
1.	The name of the course/module	**Facilities Design and Management**
2.	Faculty/department	Animal Science
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	**4**
6.	The total number of hours	Contact hour**: 40** (14 lecture, 20 computer mediated practice, 6 practical session) Non contact hour**: 67**
7.	General description and purpose of the educational component	The planning of an aquaculture farm should be carried out prior to the start of production by means of an appropriate design of the facilities. This course develops the bases and methodology needed to size a fish farm, including determining the number of production units and calculating the flow of water required. Once these aspects are dealt with, the procedure is developed to evaluate the initial investment cost and the production cost, considering the different production factors - fry, fodder, personnel, etc. needed in a fish farm according to the production volume. Finally, the concepts and methodologies for the design of fish farming facilities will be put into practice and the different production alternatives will be evaluated.
8.	Prerequisites for studying the course/module, connection with other educational components	Sustainable aquaculture Production systems: continental and tropical fish Production systems: marine fish Systems engineering applied to Aquaculture Nutrition and food

ASSESSMENT

	Type: Exam oral Amount: 1 Weight: 15%
	Type: Open answer written test Amount: 1 Weight: 45%
	Type: Project Amount: 1 Weight: 40%

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Acquire the basic skills necessary to: (a) anticipate R+D+i needs (for example, those derived from the introduction of new species or prophylaxis against emerging pathogens); (b) prevent potential environmental impact; and (c) organize production ensuring its viability
2. Understand the operation of production systems and specialized facilities.
3. Assess the environmental impact of facilities
4. Promote entrepreneurial vision on farms
5. To possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.
6. To know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within broader (or multidisciplinary) contexts related to their area of study
7. To possess basic knowledge in the design of facilities, as well as the evaluation of their environmental impact.
8. Design inland and marine aquaculture facilities (tanks and floating cages)

9. Manage and control continental and marine facilities. General outcome: ✓ Designs and projects ✓ Teamwork and leadership	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Production systems and biological bases for the zootechnical design of farms 1.1 Introduction to fish farm management and planning 1.2 Biological basis for fish farm design 1.3 Growth models, oxygen consumption, maximum loads
2.	Dimensioning the installation and planning of production 2.1. Establish the number of annual lots 2.2. Production Units 2.3. Determination of flow rates 2.4. Calculation of daily feed and waste estimation 2. 5. Planning of the growth of the lots, classifications, unfoldings and sales
3.	Equipment and staffing needs 3.1 Equipment needs 3.2 Personnel requirements
4.	Economic evaluation of design and management alternatives 4.1 Budget and economic study 4. 2. Management of the aquaculture company

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
✓ Lecture practice ✓ Seminar theory ✓ Computer practice	Project: During the development of the course the design of an aquaculture farm will be developed

GENERAL INFORMATION ABOUT THE COURSE N4		
1.	The name of the course/module	**Systems engineering applied to Aquaculture**
2.	Faculty/department	Animal Science
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	**4**
6.	The total number of hours	Contact hour**: 40** (23 theory, 10 seminar, 7 practical) Non contact hour**: 67**
7.	General description and purpose of the educational component	The aim of the course is for students to know the different facilities and equipment that make up the different types of aquaculture farms and the bases for the design and calculation of these facilities
8.	Prerequisites for studying the course/module, connection with other educational components	It is convenient to review the units of measurement in order to develop the class exercises
ASSESSMENT		
	Type: Open Answer Written Test (Exam) Outline: Controlled test against the clock where the students must draw up their answers Amount: 3 Weight: 80%	
	Practical observation: 20%	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
1. To possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous 2. To know how to apply the knowledge acquired and their ability to solving problems in new or unfamiliar environments within larger contexts (or multidisciplinary) related to their area of study 3. Understand the operation of production systems and facilities specialized 4. Design inland and marine aquaculture facilities (tanks and floating cages)		

5. Acquire the basic skills necessary to: (a) anticipate R+D+i needs (e.g., those derived from the introduction of new species or prophylaxis against pathogens emerging); (b) prevent potential environmental impact; and (c) organize production ensuring its feasibility 6. Manage and control continental and marine facilities 7. Promote entrepreneurial vision on farms 8. Possess basic knowledge in the design of facilities, as well as the evaluation of the their environmental impact. 9. Assess the environmental impact of facilities. General outcome: ✓ Analyzing and solving problem

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Location of an aquaculture facility
2.	Elements that make up an installation on land and in the open sea
3.	Water collection and pumping systems
4.	Filtration systems. Recirculation
5.	Aeration and oxygenation methods
6.	Water distribution systems
7.	Types of production enclosures
8.	Floating and submerged structures for molluscs and fish
9.	Auxiliary structures for open sea
10.	Marine corrals and anchoring systems.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
✓ Lecture theory (LE) ✓ Seminar theory (Se) ✓ Lecture practice (LP)	1. Classroom troubleshooting 2. Practical observation

GENERAL INFORMATION ABOUT THE COURSE N5		
1.	The name of the course/module	**Product Quality**
2.	Faculty/department	Dept. of Food Technology
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	3
6.	The total number of hours	Contact hours: 30 (17 theory/13 lab) Non contact hours: 55
7.	General description and purpose of the educational component	Quality in Aquaculture Products is a compulsory subject of the Master in Aquaculture of 3 ECTS credits that is taught in the second semester of the course. This subject is justified based on the close link between Aquaculture and Food Technology due to the need to achieve safe and high-quality aquaculture products. It is also intended to cover objectives related to food safety and the quality of aquaculture products. Aspects related to the aquaculture products transformation industry will be dealt with, as well as the implementation of the HACCP system and other quality management systems. It is expected that after completing the course, students have acquired basic knowledge of the quality of aquaculture products, know the fundamental principles of hazard analysis and critical control points, and have a satisfactory command of the most relevant production and industrial transformation techniques. for your professional development.
8.	Prerequisites for studying the course/module, connection with other educational components	No specific knowledge is required to study the subject, except for thosegeneral knowledge that are established to access the master's degree

ASSESSMENT	
	Type: Achievements tests multiple choice (written exam) Amount: 2 Weight: 60%
	Type: Project: Amount: 1 Weight: 25%

	Practical observation: Amount: 1 Weight: 15%

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Possess the necessary manual skills for the correct handling of materials and instruments
2. Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
3. To know how to communicate their conclusions and the ultimate knowledge and reasons that support them to specialized and non-specialized audiences in a clear and unambiguous way
4. To know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within broader (or multidisciplinary) contexts related to their area of study
5. Capacity to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments
6. Familiarize yourself with the elaboration of analysis bulletins.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Theory

1.	Chemical composition, nutritional value and post-mortem changes in aquaculture products ✓ Chemical composition and nutritional value. Main constituents: lipids, proteins and minerals. Fish in the Mediterranean Diet ✓ Post-mortem and storage changes in aquaculture products. Sensory, autolytic, bacteriological changes, oxidation and hydrolysis of lipids. Effect of temperature, hygiene, anaerobic conditions and carbon dioxide. Evaluation of product quality
2	Processing and preservation of aquaculture products ✓ Refrigeration, freezing and deep-freezing. Conservation by cold and associated changes. Fresh or chilled fish. Freezing in aquaculture products. Installations for freezing and refrigeration. Cold storage. Defrosting ✓ Other conservation systems. Drying, salting, smoking, preserves ✓ Restructured products. Minced fish, surimi, protein concentrates ✓ Cooked and pre-cooked food. Industrial production processes. Cooking. Packaged in modified atmospheres
3	Food safety systems and normatives ✓ Mandatory food safety systems: The HACCP system (Hazard Analysis and Critical Control Points) and guides to good hygiene practices ✓ System of normative: Norma ISO-9001 y GLOBALG.A.P.

Laboratory practicies

1	Evaluation of freshness in fish
2	Production of products I
3.	Elaboration of products II
4.	Elaboration of products III

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
✓ Lecture theory (LE) ✓ Laboratory session (LS)	✓ Practical observation

GENERAL INFORMATION ABOUT THE COURSE N6

1.	The name of the course/module	**Production Systems: Continental and Tropical Fish**
2.	Faculty/department	Dept. of Animal Science
3.	Status of the educational component	Elective
4.	Semester	2nd
5.	Number of ECTS credits	3
6.	The total number of hours	Contact hours: 30 (10 Lecture theory, 10 Seminar, 10 Practical) Non contact hours: 45
7.	General description and purpose of the educational component	Knowledge of the production system of the main species of inland waters, their current situation, problems and future prospects. For each of the species considered,

		its biological cycle, its reproduction in captivity, larval breeding, pre-fattening and fattening, breeding facilities, its commercialization and its profitability will be studied.
8.	Prerequisites for studying the course/module, connection with other educational components	1. Water quality 2. Nutrition and Food 3. Reproduction 4. Sustainable aquaculture
ASSESSMENT		
	Type: Open answer written test Amount: 1 Weight: 35 %	
	Type: Achievement test multiple choice (written exam) Amount: 1 Weight: 40%	
	Type: Portfolio (Document drawn up by a student that contains the tasks carried out in a certain subject during the course) Amount: 3 Weight: 25%	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
	1. To know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within broader (or multidisciplinary) contexts related to their area of study 2. To be able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
Theory		
1.	Trout fishing and restocking	
2	Trout production	
3	Eel production	
4	Production of tents and tench	
5	Sturgeon production	
6	Other continental species of interest	
7	Production of tropical species (tilapia, bagre, cachama etc)	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
✓ Lecture theory (LE) ✓ Seminar (LS)	✓ Field Work

GENERAL INFORMATION ABOUT THE COURSE N7		
1.	The name of the course/module	**Production Systems: marine fish**
2.	Faculty/department	Dept. of Animal Science
3.	Status of the educational component	Elective
4.	Semester	2nd
5.	Number of ECTS credits	3
6.	The total number of hours	Contact hours: 30 (10 lecture theory, 10 seminar, 10 practical) Non contact hours: 45
7.	General description and purpose of the educational component	Knowledge of the production system and of the particular problems of each marine species, its current situation, problems and future prospects. For each of the species considered, their biological cycle, reproduction in captivity, larval breeding, pre-fattening and fattening, appropriate facilities, marketing and profitability will be studied.
8.	Prerequisites for studying the course/module, connection with other educational components	1. Reproduction 2. Nutrition and food
ASSESSMENT		
	Type: Open answer written test (written exam) Amount: 1	

	Weight: 35%
	Type: Achievement test multiple choice (written exam) Amount: 1 Weight: 40%
	Type: Portfolio (Document drawn up by a student that contains the tasks carried out in a certain subject during the course) Amount: 2 Weight: 25%

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. That students know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within broader (or multidisciplinary) contexts related to their area of study
2. That students are able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments
3. Awareness of contemporary problems issues: knowledge of contemporary problems affecting the production of marine fish from aquaculture

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Theory

1.	Production of sea bream and sea bass ✓ Reproduction and frying ✓ Pre-engorde ✓ Engorde ✓ Current problem
2	Corvina production
3	Seriola production
4	Tuna production
5	Economic aspects

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
✓ Lecture theory ✓ Seminar ✓ Practical	N/A

GENERAL INFORMATION ABOUT THE COURSE N7

1.	The name of the course/module	**Sustainable aquaculture**
2.	Faculty/department	Dept. of Hydraulic Engineering and Environment
3.	Status of the educational component	Elective
4.	Semester	2nd
5.	Number of ECTS credits	3
6.	The total number of hours	Contact hours: 30 (14 lecture theory, 16 practical laboratory) Non contact hours: 56
7.	General description and purpose of the educational component	The subject Sustainable Aquaculture has been raised to meet the training needs that the future MSc. in Aquaculture will have in environmental aspects. Aquaculture is highly dependent on environmental quality and must be safeguarded to ensure long-term viability. On the other hand, it is a question of demystifying certain accusations and myths about the environmental effects of aquaculture production activities.
8.	Prerequisites for studying the course/module, connection with other educational components	There is not identified prerequisites

ASSESSMENT

	Type: Open answer written test Amount: 2 Weight: 40 %
	Type: Case study Amount: 2 Weight: 40%
	Type: Observation Amount: 1 Weight: 20%

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. Acquire the basic skills necessary to: (a) anticipate R+D+i needs (for example, those derived from the introduction of new species or prophylaxis against emerging pathogens); (b) prevent potential environmental impact; and (c) organize production ensuring its viability 2. To possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous. 3. To know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within broader (or multidisciplinary) contexts related to their area of study 4. Possess basic knowledge in the design of facilities, as well as the evaluation of their environmental impact. 5. Acquire the ability to perform tasks such as: (a) analyze water quality; (b) develop auxiliary and production crops; (c) control and diagnose diseases; (d) carry out quality controls and traceability; (e) analyze and prevent risks in the production chain; and (f) design facilities General outcomes. ✓ Ethical, environmental and professional responsibility ✓ Awareness of contemporary problems issues

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
Theory	
1.	**Sustainability and Aquaculture** ✓ Aquaculture and conflicts of use in the marine environment, coastline and banks. ✓ Principles of Sustainability. Application to the case of aquaculture. Environmental Management Tools in Aquaculture.
2	**Environmental Impacts** ✓ Impacts of Aquaculture: organic enrichment ✓ Impacts of Aquaculture: nutrients and eutrophy ✓ Impacts of aquaculture: active chemical substances ✓ Impacts of Aquaculture: leaks and genetic problems
3	**Sustainable management** ✓ Sustainable aquaculture feed production and food security ✓ Low impact systems in carcinoculture ✓ Development of integrated systems ✓ Planning and management issues
4	**Environmental Monitoring Programs** ✓ Environmental monitoring programs: Monitoring techniques ✓ Environmental monitoring: planning and execution of environmental monitoring

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
✓ Lecture theory ✓ Practical laboratory	**Case study:** It involves analysis and resolution of a suggested situation that arises multiple solution problems through thought and dialogue for an integrated and significant group learning **Observation:** Strategy based on the systematic collection of data in the learning context itself: execution of tasks, practices.

GENERAL INFORMATION ABOUT THE COURSE N9		
1.	The name of the course/module	**Introduction to research in aquaculture (research oriented)**
2.	Faculty/department	Dept. of Animal Science
3.	Status of the educational component	Elective
4.	Semester	2nd
5.	Number of ECTS credits	6
6.	The total number of hours	Contact hours: 60 (60 practical laboratory) Non contact hours: 114
7.	General description and purpose of the educational component	The subject Introduction to Aquaculture Research must be chosen by students who follow the research option. It is intended that the students who choose it begin in the development of a research activity in one of the various facets of this field. For this, the student must be integrated into a research group through which they will learn

		the basic lines of research in Aquaculture and the methodologies and work systems that are applied in a research center. the student will be involved in research tasks, always under the supervision of a tutor. The objectives of the course are that the student: - Learn about the basic lines of research in Aquaculture and the methodologies and work systems that are applied in a research center. - Handle the bibliographical sources related to the research topic and acquire the ability to deepen knowledge on a specific topic. - Know and understand specific terminology. - Learn to interact with the members of a research team.
8.	Prerequisites for studying the course/module, connection with other educational components	✓ Pathology and Immunology ✓ Water quality ✓ Product quality ✓ Nutrition and food ✓ Facilities design and management ✓ Systems engineering applied to Aquaculture ✓ Applied zoology ✓ Reproduction
ASSESSMENT		
	Type: Academic work: Development of project that can extend from brief and simple essays to complicated project Amount: 2 Weight: 60%	
	Type: Observation: Strategy based on the systematic collection of data in the learning context itself: execution of tasks, practices Amount: 1 Weight: 25 %	
	Type: Self-evaluation Amount: 1 Weight: 15 %	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
Professional outcomes: There is not mentioned General outcomes: ✓ Comprehension and Integration: State of the art of a specific topic		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	Investigation development	
2	Report writing	

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
✓ Laboratory session	✓ Project development ✓ Observation

SUBJECTS FOR WHICH STUDY GUIDE IS NOT AVAILABLE

Title	Type	Semester	ECTS
Applied Physiology	Mandatory	1st	3
Applied Zoology	Mandatory	1st	3
Pathology and Immunology	Mandatory	1st	6
Water Quality	Mandatory	1st	3
Introduction to Aquaculture	Optional	1st	2
Latest advances in Aquaculture	Optional	2nd	3
Production Systems: Molluscs	Optional	2nd	2
Disease diagnosis and control	Optional	2nd	4
Production Systems: Auxilliary Crops	Optional	2nd	2

UNIVERSITY OF ALGARVE

1	Criterion A: University profile	
1.1	Name of the University	**UNIVERSITY OF ALGARVE**
1.2	Classical or applied	Applied
2	**Criterion B: Profile of the educational program (Curriculum)**	
2.1	Number of Aquaculture disciplines	20
2.2	The name of the educational program	Master in Aquaculture and Fisheries: Specializations: Fisheries
2.3	Type of diploma	
2.4	Total number of credits (ECTS)	Theory: 78 (42 mandatory courses +36 optional) Dissertation Report: 48 ECTS (1st sem) Thesis Dissertation (TD): 12 ECTS
3	**Criterion C: Setting the educational program (Curriculum)**	
3.1	Duration of the program	1.5 year (3 semesters)
3.2	The purpose of the educational program	Provide students with the knowledge and training required for the assessment, management, conservation and sustainable exploitation of living resources. Provide students with the knowledge and training required for the production of species in different aquaculture production systems. Training of professionals for aquaculture and fisheries. Provide skills that enable lifelong learning in a self-oriented or autonomous manner. Create the competencies during the Masters to enable progress to a higher level of specialization at the PhD level. To train professionals able to communicate their knowledge to the scientific as well as non-scientific public. Students shall write a report and present the proposed research in a public session.
4	**Criterion D: Characteristics of the educational program (Curriculum)**	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Exact and Natural Sciences
5	**Criterion E: Teaching and assessment**	
5.1	Teaching and learning methods	Teaching. Theory lecture (T) Theoretical and Practical (TP) Theory and Laboratory (TL) Seminar (S) Learning. Field work, Practical work, Experiment Diving Underwater practice Collection analyzing socio-economic data Experiment, Scientific paper Research Project Case study
5.2	Assessment	✓ Theoretical final exam ✓ Practical evaluation report on lab classes ✓ Written test ✓ Participation in the discussion forum ✓ Individual work ✓ Multiple choice quizzes ✓ Final written exam ✓ Project performance: written and oral presentation ✓ Water performance ✓ Practical component with a report ✓ Written and practice exercise ✓ Quality of work performance ✓ Quality of written and oral presentations
6	**Criterion F: Software competencies**	
6.1	Integral competence	1. Provide the students with skills that allow them to structure a project. 2. Students will learn to delineate experiences, interpret the best methodologies for answering the question of interest, and develop critical skills by designing a research project through: problem identification (including state of the art review),

		definition of the hypothesis to be tested and experimental planning. 3. Students will learn the conception and planning of the thesis	
6.2	General competences	Not divided	
6.3	Professional competences		
7	**Criterion G: Program Learning Outcomes**		
7.	Program learning outcomes	This course involves an original and individual work that should be carried out in one of the scientific areas of MAF. 1. Students have to learn how to develop a research project, to elaborate a written report about the experiments performed (thesis report) and defend it in a public session. 2. The students will learn how to design and execute experimental work, to develop specific methodologies and to understand and discuss the obtained results. 3. The main competences are: ability to execute an experimental plan, treat the appropriately and present it in writing and orally 4. Ability to integrate concepts that from different areas of knowledge; 5. Ability to plan and implement scientific and technical activities associated with the proposed work 6. Ability to write a thesis report and defend it in public.	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	24 Teaching Staff is involved in Program	
8.2	Material and technical support	N/A	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components Specialization: Aquaculture**	**Number of credits**	**Final control form**
9.1.1	Experimental Planning(1st sem)	3	Written test or/Final exam
9.1.2	Fisheries Biology and Ecology (1st sem)	6	Exams: 2 Practical evaluation: Reports on lab classes
9.1.3	Basic in Statistic (1st sem)	3	Written test or Final exam
9.1.4	Techniques in Molecular and Cellular Biology (1st sem)	6	Theoretical exam Practical report
9.1.5	Topics in Aquaculture, Fisheries and Conservation (1st sem)	6	Seminar on the topic chosen Written work Participation in the discussion forums
9.1.6	Fisheries Economics (2nd sem)	3	Final exam Papers/Case study
9.1.7	Fisheries Technology and Evaluation of Resources (2nd sem)	6	Reports/paper and seminar account Final exam
9.1.8	Management and Conservation (2nd sem)	6	Final exam
9.1.9	Socio-Economic Demension of Fisheries (2nd sem)	3	Report and presentation
9.2	**Selective components Specialization: Aquaculture**	**Number of credits**	**Final control form**
9.2.1	Advanced SCUBA Skills for Scientific Diving (1st, 2nd sem)	3	Written exam Water performance Practical component with a report
9.2.2	Biocustics (1st sem)	3	Individual work Final exam
9.2.3	Introduction to Management in Aquaculture (1st, sem)	3	Multiple choice quizzes: 3 Final written exam: 1
9.2.4	Level 1 Diver (1st, ,2nd sem)	3	Written exam Water performance

			Practical component with a report
9.2.5	Field Methods in Fisheries (1st, 2nd sem)	3	Written report Practical work performance
9.2.6	Laboratory Methods in Fisheries (1st, 2nd sem.)	3	Written report Project practical performance
9.2.7	Practical Work in Fisheries (1st, 2nd sem.)	6	Quality of the written and oral presentation Quality of the work performance
9.2.8	Scientific Diving in Marine Ecology (1st, 2nd sem.)	3	Written exam 20 Water performance Practical component with a report
9.2.9	Scientific Writing (1st, 2nd sem.)	3	Written Exercise (equivalent to an Exam) Practical exercises
9.2.10	Marine Ecological Modeling and Global Climate Change (semester is not available)	3	N/A
9.2.11	Protected Marine Areas (2nd sem.)	3	Student's presentation and/or group report Written exam
10	**Criterion L: Form of attestation**		
10.1	Requirements form	Thesis Report Project Dissertation	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE N1 **Specialization: Fisheries**		
1	The name of the course/module	**EXPERIMENTAL PLANNING**
2.	Faculty/department	Faculty of Sciences & Technology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	3
6.	The total number of hours	Contact hours: 21 (theoretical and practical) Not contact hours: 57 Total working hours: 78
7.	General description and purpose of the educational component	The course unit aims to prepare the student for the planning and development of a statistical study
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge in the area of descriptive statistics and statistical inference.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The student should be able to.

1. distinguish between analysis of variance models and regression models
2. identify the appropriate model for his study
3. know the assumptions of the model and evaluate the fit
4. use multiple comparison methods
5. use the regression model to obtain forecasts
6. develop computer skills in data analysis with the statistical software R.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Analyses of Variance with one factor
2.	Analyses of Variance with blocks
3.	Factorial Experiments
4.	Simple and Multiple Linear Regression

ASSESSMENT

Written test and/or Final exam

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Theoretical and Practical (TP) Slides support Theoretical-practical classes. The theoretical concepts are followed by solving problems with the R program. Slides and other relevant information are made available on the e-tutoring platform	N/A

GENERAL INFORMATION ABOUT THE COURSE N2 Specialization: Fisheries		
	The name of the course/module	**FISHERIES BIOLOGY AND ECOLOGY**
	Faculty/department	Faculty of Sciences & Technology
	Status of the educational component	Mandatory
	Semester	1st
	Number of ECTS credits	6
	The total number of hours	Contact hours: 45 (15-theory, 21-practical and laboratorial, 9-theoretical and practical) Not contact hours: 111 Total working hours: 156
	General description and purpose of the educational component	Knowledge of the essential biological bases for the evaluation of fishery resources. Meet me all sampling, from evaluates the age of fish and invertebrates and estimates of growth rates. Understand the gametogenesis process and the dynamics of maturation in sexual. To know me all from the point of view of fertility, from the study of the diet, studying the strata from the point of view of life cycle and food ecology. The course identifies the main environmental factors affecting the abundance and distribution of resources. Indicates the main hiccups which explain the fluctuation of resources. Acknowledges the relative importance of different anthropogenic impacts general in the marine ecosystem, including fishing. It indicates factors causing direct and indirect mortality in fishing activity. It discusses the implications of the overall changes in fishing activity and the interaction between the two.
	Prerequisites for studying the course/module, connection with other educational components	Biology Ecology Statistics

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. To know the biological basis for living resources management.
2. To know the sampling and age determination methods for fish and invertebrates and how this information is used to estimate growth rates.
3. To understand the process of gametogenesis and the dynamics of sexual maturation.
4. To learn the methods for studying the diet of fish and invertebrates.
5. To identify the main environmental and biotic factors that regulate the abundance and the distribution of living resources: currents, wind, nutrients, pollutants and mortality (recruitment and changes in predation and competition rates
6. To understand the relative importance of the anthropogenic impacts on marine ecosystems and to identify the main factors determining direct or indirect fishing mortality.
7. To discuss the consequences of climatic changes on fisheries and on how these two factors might interact.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	The importance of fisheries biology in fisheries sciences. The renovation of living resources and fisheries management.
2.	Age and growth
3.	Indirect methods for age determination. Modal progression analysis.
4.	Direct methods for age determination: calcified structures (CS) used in age determination. Sampling, conservation and processing of CS. Age rings and how they are deposited.
5.	Validation and verification of ageing results.
6.	Age-length keys, mean length-at-age
7.	Age models and fitting of von Bertalanffy growth model.
8.	Reproduction

9.	The organization of ovaries and testes: anatomical and cytological description. Oogenesis and spermatogenesis
10.	Gonadosomatic and hepatosomatic indexes. Dynamics of sexual maturation.
11.	Spawning behaviour: total spawnars and partial spawnars.
12.	Fecundity and methods for fecundity estimation.

ASSESSMENT

Exams: 2 (40 + 50%)
Practical evaluation: Reports on lab classes

The evaluation of the practical part (lab classes) will be based on two reports, one on the subjects addressed by J. Pedro Andrade and the other on the subjects addressed by F. Leitão. This part (practical evaluation) will contribute 40% to the final grade.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical (T) Theoretical and Practical (TP) Practical laboratory (PL)	N/A

GENERAL INFORMATION ABOUT THE COURSE N3
Specialization: Fisheries

9.	The name of the course/module	**BASIC IN STATISTIC**
10.	Faculty/department	Faculty of Sciences & Technology
11.	Status of the educational component	Mandatory
12.	Semester	1st
13.	Number of ECTS credits	3
14.	The total number of hours	Contact hours: 24 (Theoretical and Practical) Not contact hours: 54 Total working hours: 78
15.	General description and purpose of the educational component	The objective of the curricular unit is to prepare and motivate the student for data analysis.
16.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge of mathematics

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The students must be able to.

1. Understand the importance of statistics in scientific studies
2. Plan and develop a statistical study
3. Use appropriate statistical methodology, interpret results, and obtain valid conclusions for the study at hand
4. Develop computer skills in data analysis with the statistical program R.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Introduction to R software. Fundamental concepts in statistics
2	Exploratory data analysis
3	Main probability distributions
5	Topics in statistical interfence
4	Hypothesis testing

ASSESSMENT

Written test and/or Final exam

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and Practical (TP) Slides support Theoretical-practical classes. The theoretical concepts are followed by solving problems with the R software.	N/A

GENERAL INFORMATION ABOUT THE COURSE N4 Specialization: Fisheries		
1	The name of the course/module	**TECHNIQUES IN MOLECULAR AND CELLULAR BIOLOGY**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Mandatory**
4	Semester	1st
5	Number of ECTS credits	**6**
5	The total number of hours	Contact hours: 47 (15-theory; 24-practical laboratory; 5-seminar; 3-tutorial) Not contact hours: 109 Total working hours: 156
7	General description and purpose of the educational component	The main objective of course is to provide knowledge and skills related to the animal cells sampling and the main techniques in molecular and cellular biology for implementation in Marine Biology
8	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge on the structure and function of biological molecules, especially proteins and nucleic acids.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The student should be able to.

1. To know of molecular principles underlying the main techniques in Molecular and Cellular Biology.
2. To understand simple techniques related to DNA (DNA electrophoresis and amplification) and to proteins (expression, purification and electrophoresis).
3. To have competences of transfection of animal cells and expression of heterologous proteins (yellow fluorescent protein).
4. To implement application of these techniques in Marine Biology.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Unit organization, classification, program, literature
2	Expression of recombinant proteins in E. coli
3	Chromatography
4	Flow Cytometry
5	Electrophoresis and Immunoassays
6	Nucleic acids and PCR technique
7	Cell culture and transfection
8	Light Microscopy and fluorescent proteins

ASSESSMENT

Theoretical exam 50%
Practical report 50% or 30% (depending on the presentation of a seminar)
The facultative presentation of a seminar based on a scientific paper chosen by the students where one of the techniques studied should be part of the methodology

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Practical Laboratory (PL) Seminar (S) The methodology comprises theoretical classes used to explain the fundamentals of each experimental technique executed in the laboratory classes	Scientific paper targeted at one of the technique with methodology

GENERAL INFORMATION ABOUT THE COURSE N5
Specialization: Aquaculture

1	The name of the course/module	**TOPICS IN AQUACULTURE, FISHERIES AND CONSERVATION**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Mandatory**
4	Semester	1st
5	Number of ECTS credits	**6**
6	The total number of hours	Contact hours: 45 (30- theory; 10-field work; 5-seminar) Not contact hours: 111 Total working hours: 156
7	General description and purpose of the educational component	General objectives: Taking general knowledge and competences of several areas within the Aquaculture, Fisheries and Conservation
8	Prerequisites for studying the course/module, connection with other educational components	Knowledge in Biology and related areas.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The student should be able to.

1. To have an integrated knowledge on the biology of cultivated species (fish, cephalopods and bivalves);
2. To understand the basic principles of production of farmed species;
3. To gain an integrated knowledge in the areas of larviculture, nutrition in fish, reproduction, genetics and selection, pathology, biotechnology;
4. To have an integrated knowledge on specialization of fisheries: fisheries biology and technology, legislation and evaluation of marine resources;
5. To gain an integrated knowledge in marine protected areas, marine conservation, artificial reefs, and marine biodiversity.
6. Competencies to be developed: critical capacity through the discussion of the proposed topics during the seminars; develop of writing skills, interpretation and exposition through the elaboration of projects and seminars on different themes; take note of research areas and production units in Portugal.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Introduction to topics
2	Farming for the future
3	Offshore Aquaculture in Portugal
4	Integrated Multitrophic Aquaculture
5	Principal pathologies in Portuguese marine farming
6	Skeletal evaluation in aquaculture
7	Nutritional imbalances: the case of vitamin A and K
8	Puberty in fish production: problems and solutions
9	Biotechnological tools in reproductive management in aquaculture and conservation
10	Genetic selection in Dicentrarchus labrax
11	Accoustic telemetry to study fish daily patterns and habitat use in ria Formosa
12	Habitat mapping and marine spatial planning.
13	Squid production and research
14	Bivalve production: potentiality and sustainability
15	Future challenges in Aquaculture: impact for fish digestive physiology
16	Sustainability challenges for aquaculture fish feed
17	Nutrition and quality of fish larvae
18	Amino-acids in fish nutrition

ASSESSMENT

Seminar on the topic chosen: 50%
Written work about one of the topics covered in class: 25%
Participation in the discussion forums (seminars given by experts): 25%

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory (T) Seminar (S) Field work (TC) The UC is organized in two parts: a set of lectures given by experts in the various topics discussed, in which students have to step in and debate the subject in order to enhance the ability of intervention and critical spirit; visits to production facilities and research institutes. This approach allows students to have real	Field work

knowledge of the different production systems and provides an overview of the various possibilities that exist within the theme analysed. In addition students will have to deliver a written work (project design, state-of-the-art review) about one of the topics discussed or within the program of the UC and present it at a seminar. A jury composed by the teacher and by a group of students will be responsible for the discussion and evaluation of the theme presented.	

GENERAL INFORMATION ABOUT THE COURSE N6 Specialization: Fisheries		
1	The name of the course/module	**BIOACUSTICS**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st, 2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: **28** (12-theoretical; 12- practical and laboratorial; 4- theoretical and practical) Not contact hours: 50 Total working hours: 78
7	General description and purpose of the educational component	N/A
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. To be aware of ocean sound of biological origin: sound sources, characteristics, space-time distribution and sound propagation. Ocean sound imaging and usage for remote passive monitoring.
2. To have competences work with the technics for measure and analysis.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Ocean noise components.
2	Ambient noise and ocean soundscape
3	Coastal and pristine areas
4	Fauna and flora characterization through sound imaging
5	How to measure sound and units
6	Notions of sound propagation in the ocean
7	Notion of frequency, amplitude, duration, periodicity and spatial distribution.
8	Noise sources: Environmental noise. Anthropogenic noise. Fish noise
9	Marine mammal vocalizations.
10	Invertebrates. Flora.

ASSESSMENT

Individual work
Final exam

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory (T) Theoretical and Practical (TP) Practical and Laboratorial (PL) A series of descriptive theoretical classes with the support of the text books of the bibliography, with images, movies and sound tracks of a variety of animals, from various areas and various underwater chorus. The experimental component is restricted to the role of user of equipment and applications for underwater sound analysis both, in tank and at Ria Formosa park.	Experiment

GENERAL INFORMATION ABOUT THE COURSE N7 Specialization: Fisheries

1	The name of the course/module	**INTRODUCTION TO MANAGEMENT IN AQUACULTURE**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: 25 (10-theory; 15-theory and practical) Not contact hours: 53 Total working hours: 78
7	General description and purpose of the educational component	N/A
8	Prerequisites for studying the course/module, connection with other educational components	Basic Mathematics

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

At the end of the course, students should be able to grasp the following concepts, in the context of an aquaculture business

1. Management, organization and the roles of managers and the importance for management in an organization.
2. Components of human resource planning, tools for employee motivation and importance of team work.
3. Value of strategy definition and implementation of a strategic plan. Be familiar with tools such as the Blue Ocean Strategy for strategy creation and the Balanced Scorecard for strategy implementation.
4. Steps of the decision-making process.
5. Importance of communication and information technology as well as the role of the data analyst.
6. Basic concepts in Supply Chain Management (SCM) and its relevance in planning and logistics.
7. Basic issues in managerial accounting and the use of ABC (activity-based-costing) as a tool for better understanding of cost drivers
8. Importance of innovation and the challenges in change management.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Introduction to Management in Aquaculture businesses
2	People - Human Resource Management and Teams
3	Strategy and implementation
4	Data, information and decision-making
5	A basic understanding of costs, cost-drivers and optimization of operations
6	Supply Chain Management and the Bullwhip effect in the aquaculture market
7	Change management and innovation in aquaculture companies

ASSESSMENT

Multiple choice quizzes: 3
Final written exam: 1

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory (T) Theoretical and Practical (TP) Each class has three parts: ✓ Presentation of the units subject ✓ Business case studies: students divided in groups will read and analyse a case written in the context of an aquaculture business ✓ Discussion of the case study	Case study

GENERAL INFORMATION ABOUT THE COURSE N8
Specialization: Fisheries

1	The name of the course/module	**FIELD METHODS IN FISHERIES**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st, 2nd

5	Number of ECTS credits	**3**
6	The total number of hours	Total working hours: Practical 78
7	General description and purpose of the educational component	The objective of this course is to gain experience in field methods in the area of Fisheries Science, by means of practical participation in research projects.
8	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
To gain capacities of methods in Fisheries		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1	The tasks and objectives of this course will be defined to fit the interests of individual students or small groups of students. The students will get practical training in field methods under the supervision of researchers and teachers	
ASSESSMENT		
Written report 60% Practical work performance 40% The student´s final grade will be based on a written report, evaluated by the supervisor and the course coordinator and the students performance during the practical work, evaluated by the supervisor. An evaluation form will be filled in by each evaluator including scores and their justification.		

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Practical participation in the Research Project Each student will be assigned a supervisor (professor or researcher with a PhD degree) that will coordinate the work during the training period. The schedule will be agreed between the student and the supervisor, according to the type of work, with no changes in the total number of hours.	Practical work

GENERAL INFORMATION ABOUT THE COURSE N9 Specialization: Fisheries		
1	The name of the course/module	**LABORATORY METHODS IN FISHERIES**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1^{st}, 2^{nd}
5	Number of ECTS credits	**3**
6	The total number of hours	Total working hours: Practical 78
7	General description and purpose of the educational component	The objective of this course is to gain experience in field methods in Fisheries Science, by means of practical participation in research projects.
8	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
To gain capacities in laboratory methods in Fisheries		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1	The tasks and objectives of this course will be defined to fit the interests of individual students or small groups of students. The students will get practical training in laboratory methods under the supervision of researchers and professors.	
ASSESSMENT		
Written report 60%		

Project practical performance 40% The student´s final grade will be based on a written report, evaluated by the supervisor and the course coordinator and the student performance during the practical work, evaluated by the supervisor. An evaluation form will be filled in by each evaluator including scores and their justification.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Research Project Each student will be assigned a supervisor (professor or researcher with a PhD degree) that will coordinate the work during the training period. The schedule will be agreed between the student and the supervisor, according to the type of work, with no changes in the total number of hours.	Practical participation in Research Project

GENERAL INFORMATION ABOUT THE COURSE N10 Specialization: Fisheries		
1	The name of the course/module	**PRACTICAL WORK IN FISHERIES**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st, 2nd
5	Number of ECTS credits	**6**
6	The total number of hours	Contact hours: Not contact hours: 156 Total hours:
7	General description and purpose of the educational component	The aim of the course is to allow the student to implement and consolidate the knowledge in scientific and technological areas of Fisheries, in order to provide the student with practical knowledge to their future professional activity. The student will need to write a synthesis report of the tasks. During this practical work the students are encourage to learn several practical activities related to the topic chosen. They will be integrated in research groups and in running experiments.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. To gain laboratory skills in certain techniques and methodologies. 2. To acquire skills in sampling, data analysis and reporting.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Depends on the experiment where the students are involved but the main steps will be: Bibliography research. The students are encouraged to search for papers on the area to know more about the work they are involved.
2	Laboratory or field analysis. They will be responsible for maintaining organisms, participate in samplings, perform analysis in the laboratory
3	Data analysis and reporting: The students will learn how to process data, such as statistic methods and will write a report on the main activities developed in the lab.

ASSESSMENT
1. Quality of the written and oral presentation 60 % ✓ Report structure 5% ✓ Depth and details of the methodologies description 10% ✓ Clear and concise writing style 5% ✓ Depth and details of the literature review 10% ✓ Oral presentation 20% ✓ Scientific correctness 10% 2. Quality of the work performance 40% ✓ Commitment and responsibility, including time keeping 5% ✓ Capacity to understand the concepts explained 10% ✓ Capacity to plan the practical work 10%

✓ Critical sense, independence in problem solving 10% ✓ Scientific correctness 5%

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The topics of practical work in Aquaculture may involve fieldwork, laboratory, scientific research and data treatment and will always be guided by a PhD from UAlg or by a qualified researcher from other institution where the work is developed. The learning steps will follow the scheme explained in the detailed program. The teaching methods will depend on the work performed but there will be a constant contact with the supervisor of the work that will guarantee that the student understands all the steps he/she is performing. In this sense, periodic meetings will be scheduled to follow the work performed. The supervisor will transmit to the student as much information as possible about the proposal and on the methodologies to be used, encouraging the student to find additional specific information. The supervisor will give support in all tasks/samplings in the laboratory, so students understand the processes involved in the proposed work	Field work Scientific research

GENERAL INFORMATION ABOUT THE COURSE N11 Specialization: Fisheries		
1	The name of the course/module	**SCIENTIFIC WRITTING**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st, 2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: 30 (10-theory; 20-theory and practical) Not contact hours: 48 Total hours: 78
7	General description and purpose of the educational component	This course aims to train the planning, writing and critical analysis of scientific papers. The graduate students will understand the principles of writing scientific papers, submitting the, dealing with reviewers comments. Training in critically assessing papers and grant proposals will develop skills to act as scientific referee.
8	Prerequisites for studying the course/module, connection with other educational components	English language skills

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
To gain scientific writing skills

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	The planning of a paper outline
2	Focus on the question
3	The language style: the title, the abstract, the introduction, the materials and method,. the results and discussion.
4	Review papers, book chapters
5	Scientific English issues.
6	The submission. Addressing reviewers comments

ASSESSMENT
Written Exercise (equivalent to an Exam) Practical exercises

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Theory and Practical (TP) Lectures, practical writing assignments and critical analyses. Students work on scientific papers available as published literature.	Work on scientific papers

GENERAL INFORMATION ABOUT THE COURSE N12 Specialization: Fisheries		
1	The name of the course/module	**ADVANCED SCUBA SKILLS FOR SCIENTIFIC DIVING**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st, 2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: 30 (10-theory; 20-theory and practical) Not contact hours: 54 Total hours: 84
7	General description and purpose of the educational component	This course is designed to train students in to advanced SCUBA dive skills, such as stability, team work, problem solving and situational awareness, thru a well structure dive planning, and strong academic knowledge on gas properties and hazards, gas strategies and management, decompression and adequate equipment use for scientific diving activities. **An international certification, according to norm NP EM 14153-02, may be awarded through an additional training module.**
8	Prerequisites for studying the course/module, connection with other educational components	**This course has an entry level prerequisite for students which is to have an Open Water Diver certificate or equivalent.**

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. To gain the SCUBA dive skills 2. To have strong knowledge on gas properties and hazards, gas strategies and management, decompression and adequate equipment use for scientific diving activities

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	**Theory** Physics and physiology
2	Gas management
3	Decompression theory
4	Scientific diving planning
5	Scientific Diving SCUBA equipment
6	**Practical** Underwater stability (buoyancy mastery, trim, balance)
7	Propulsion methods adequate for silty and fragile environments (frog, flutter, modified frog, modified flutter, helicopter turn, backward)
8	Basic manipulation and operation of regulators (including back up) and masks
9	Underwater tank valve manipulation
10	Use of safety buoys
11	Team position and problem solving
12	Managing out of gas situations
13	Managing adequate ascend profiles, including minimum decompression while sharing gas to an out of gas diver.
14	Underwater data acquisition on a pre-set monitoring site.

ASSESSMENT
Written exam 20% Water performance 60% Practical component with a report 20%

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Theory and Practical (TP) The methodology will be theory classes with power point. Theoretical exercises focusing advanced dive planning will be done with all students in an interactive manner. Out of the water practice of the future in water skills. Underwater practice after teacher demonstration. Repetition until mastery is obtain .	Underwater practice and repetition

GENERAL INFORMATION ABOUT THE COURSE N13 Specialization: Fisheries

1	The name of the course/module	**LEVEL I DIVER**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st, 2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: 30 (10-theory; 20- practical and laboratorial) Not contact hours: 54 Total hours: 84
7	General description and purpose of the educational component	This course as the objective to teach the students to scuba dive. Students will participate in a pool dive day where they will do basic exercises: regulator retrieval, free flow regulators, gas sharing procedures, mask clearing underwater, use of the buoyancy compensator device, basic buoyancy adjustments, underwater swimming. **This class may confer an international diving certification (level 1 according to the norm NP EN 14153-1) after completing additional dive**
8	Prerequisites for studying the course/module, connection with other educational components	No pre-requisites

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Know the basic safety rules (including physic laws applicable to diving and human physiology
2. Get familiar with dive equipment, basic emergency dive procedures, underwater communication signals, techniques to get in and out of the water
3. To have competences of gas sharing procedures, mask clearing underwater, use of the buoyancy compensator device, basic buoyancy adjustments, underwater swimming.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	**Theoretical component** Physics and physiology - Boyle law and its application to human physiology - Gas expantion problems and how to avoid - How to equalize the air spaces.
2	Decompression - Dive computers - Decompression profiles - Decompression emergencies
3	Dive planning - Teams - Profiles - Exposure - Risk analysis
4	Dive equipment - Regulators (first and second stages) - Buoyancy compensator device (BCD) - Suit - Fins - Mask - Computer - Tanks
5	Practical application Equipment assemblages (regulator, BCD, tanks)
6	Regulator retrieval
7	Mask clearing, Gas sharing, Use of the BCD
8	Underwater swimming
9	Ascend with safety stop

ASSESSMENT

Written exam 20%
Water performance 60%
Practical component with a report 20%

For water performance.
Unsafe (fail); Cannot complete the task (need to repeat); Complete the task well (pass); Excellent performance (pass)

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Theory and Practical (TP) The methodology will be theory classes with power point. Out of the water practice of the future in water skills. Underwater practice after teacher demonstration. Repetition until mastery is obtain.	Underwater practice

GENERAL INFORMATION ABOUT THE COURSE N14 Specialization: Fisheries		
1	The name of the course/module	**SCIENTIFIC DIVING IN MARINE ECOLOGY**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st, 2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: 30 (10-theory; 20- practical and laboratorial) Not contact hours: 54 Total hours: 84
7	General description and purpose of the educational component	This course is designed to train students in to underwater sampling techniques applied to Marine Ecology. Advanced SCUBA dive planning, focusing on safety and efficiency will also be exercised.
8	Prerequisites for studying the course/module, connection with other educational components	This course has an entry level prerequisite for students which is to have an Advanced Diving certificate such as GUE Fundamentals or equivalent

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT	
1.Knowledge in advanced SCUBA dive planning 2. To gain operating skills on the techniques of underwater sampling	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	**Theory** Distinguish scientific diving from other diving activities and understand the applications and limitations of scientific diving
2	Sampling strategies: random, hap hazard and systematic. Error vs Bias
3	Develop a scientific perspective and respect to the underwater world
4	Develop knowledge and familiarity with scientific diving practices applied to marine ecology: ✓ Band transects to access organism density ✓ Point intersect transects for genetic sampling ✓ Use of underwater sampling grids for spatial distribution of species ✓ Underwater sample collection ✓ Underwater video documentation of marine habitats ✓ Underwater photomosaics ✓ Introduction to data processing for the above sampling techniques, such as software for photomosaic and underwater mapping.
5	Advanced SCUBA Dive planning
6	**Practical** Develop knowledge and familiarity with scientific diving practices applied to marine ecology
ASSESSMENT	
Written exam 20% Water performance 60% Practical component with a report 20% Additionally, a scale from 1 to 4 will be used to evaluate student in water performance (60%) where: Unsafe (fail) - Cannot complete the task (need to repeat) - Complete tasks well (pass) - Excellent performance (pass)	
TEACHING AND LEARNING METHODS	

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Theory and Practical (TP) Theory classes are mandatory. Students will learn the methods used in marine ecology, how to plan a dive were those skills will be applied. Prior to the dives all students will participate test the dive plan out of the water, for a better understanding of the methodology to apply. Each dive will have a specific skill to be developed were all students will have the opportunity to use and practice the skill (i.e. Photomosaic). Complexity of skills will be increasing gradually. Post dive, data will be processed and analysed to point areas of improvement so that the error and bias of future sampling can be reduced (therefore increasing data quality).	Diving

GENERAL INFORMATION ABOUT THE COURSE N15 Specialization: Fisheries		
17.	The name of the course/module	**FISHERIES ECONOMIC**
18.	Faculty/department	Faculty of Sciences & Technology
19.	Status of the educational component	**Mandatory**
20.	Semester	2nd
21.	Number of ECTS credits	**3**
22.	The total number of hours	Contact hours: **25** (15-theoretical and practical, 10- seminar) Not contact hours: 53 Total working hours:78
23.	General description and purpose of the educational component	Introduce students to fundamental concepts in economics and finance
24.	Prerequisites for studying the course/module, connection with other educational components	Basic concepts in Population Dynamics and Mathematics

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. To understand: (i) the functioning of markets (ii) the firm decision problem (iii) the basic economic underpinnings of fishery management policies.
2. Expose students to: (i) the methodological approach used by fishery economists, (ii) the main insights provided by that scientific field, (iii) the main challenges concerning the integration of economics into fisheries policies.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	**A brief course on Economics** Markets and Welfare
2	Inside the firm
3	The firm in the competitive market
4	Investing and discounting
5	**Fishery Economics** A brief review on the contribution of fishery economics
6	Property rights
7	Biological models vs bioeconomic models

ASSESSMENT

Final exam
Papers/Case study

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and Practical (TP) Seminar (S) For the first section several practical exercises will be held in a classroom context. Depending on the number of enrolled students, problem sets, to be solved individually or in group, will be	Case study

evaluated. For the second section, students will be asked to present papers/case studies.	

GENERAL INFORMATION ABOUT THE COURSE N16 Specialization: Fisheries		
1	The name of the course/module	**FISHERIES TECHNOLOGY AND EVALUATION OF RESOURCES**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**6**
6	The total number of hours	Contact hours: **50** (15-theory, 20- theory and practical, 5-seminar, 10-TC) Not contact hours: 106 Total working hours: 156
7	General description and purpose of the educational component	The course program includes theoretical and practical aspects on the design, construction and use of fishing gear. The second part of the course covers quantitative methods for the assessment of living resources that serve as the scientific basis for management actions and decisions.
8	Prerequisites for studying the course/module, connection with other educational components	Biology, ecology, population dynamics, mathematics, computer skills (EXCEL).

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Knowledge of the main fishing gears: characteristics, métiers, catch mechanisms, selectivity, impacts on target species, impacts in terms of by-catch and discards, impacts on the marine environment, and methods to mitigate negative impacts of fishing.
2. Knowledge of the most important aspects of the behavior of harvested species in relation to fishing gear.
3. Understanding the basics of fish detection using acoustic methods (e.g. sonar).
4. Knowledge of the main methods and models used in the assessment of living resources, their limitations, assumptions and requirements in terms of data and parameters.
5. Competency analysis and interpretation of data and the use of models for assessing the status of a stock.
6. Ability to propose management measures and conservation.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Selectivity, bycatch and discards, as well as the implementation of measures to mitigate negative impacts, such as the use of by-catch reduction devices
2	The study of fish behavior with respect to different fishing gears will also be studied.
3	Quantitative methods for the assessment of living resources that serve as the scientific basis for management actions and decisions.
4	The most appropriate models and methods depending on the quality and quantity of available data, the type of fishery and the biological and ecological characteristics of the species.
5	Production models, models with age structure, length-based models, yield per recruit models, cohort analysis, reference points, multi-species models and risk analysis

ASSESSMENT

Reports/paper and seminar account for 50%
Final exam 50%

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Theory and Practical (TP) Seminar (S) Field Work (TC) Lectures take place in classrooms equipped with power point projectors. Practical application and learning will take place in computer classrooms through data analysis and exercises (e.g. selectivity parameter estimation for different gears, fitting of production models, risk analysis). Fieldwork will include visit(s) or field trips to observe different types of fishing vessels and fishing gears. Students will give oral presentations on different topics and works in seminars.	Field Work

GENERAL INFORMATION ABOUT THE COURSE N17 Specialization: Fisheries		
1	The name of the course/module	**Management and Conservation**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**6**
6	The total number of hours	Contact hours: 45 (30-theory, 15-seminar) Not contact hours: 111 Total working hours: 156
7	General description and purpose of the educational component	Expose the students to the problems associated with the exploitation, management and conservation of living marine resources. Promote critical evaluation of solutions presently available for management and conservation. Stress the importance of a multidisciplinary approach to management and conservation; although issues in the areas of biology dominate, topics related with social, economic, historical and ethical aspects will also be covered.
8	Prerequisites for studying the course/module, connection with other educational components	Basic concepts in Ecology and Population Dynamics

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. To have a knowledge on exploitation, management and conservation of living marine resources
2. Knowledge related to the issues in the areas of biology dominate, topics related with social, economic, historical and ethical aspects
3. To gain skills on critical evaluation of solutions presently available for management and conservation

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	The syllabus of this course is reviewed every year, depending on the evolution of the situation of marine resources, management and conservation solutions:
2	The situation of the world fisheries resources
3	Historical evolution of fisheries management. Changing objectives and methodologies.
4	Stock assessment and fisheries management: tools available and the decision-making process
5	Impacts of fishing on the genetic and population structure. Fishing and evolutionary pressures
6	Changes in ecological balance.
7	Fisheries and marine biodiversity
8	Marine Protected areas in the context of fisheries management
9	Artificial Reefs
10	Conservation of marine exploited resources in the face of ongoing climate change
11	Ecosystem-based management
12	Integrated coastal management
13	The socio-economic dimension of fisheries
14	Illegal, Unreported and Unregulated Fishing.
15	Consumer needs/demands and interaction with resource management
16	Ethical issues in fisheries
17	Conciliating exploitation and conservation of marine resources

ASSESSMENT

Final exam

The evaluation of the course is done in a final exam, composed of several questions of extended answers, about the themes discussed in the class and requiring the in-depth reading of the list of papers that constitute the bibliography of the course.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Seminar (S) Each class includes a presentation and an associated study case, for one and half hours. Part of the time is intentionally allocated to debating ideas and students are encouraged to share experiences. A list of readings (one per class) and in some cases lectures available on-line are used as a complement to the class debate.	Case study

GENERAL INFORMATION ABOUT THE COURSE N18 Specialization: Fisheries	
The name of the course/module	**SOCIO-ECONOMIC DIMENSION OF FISHERIES**
Faculty/department	Faculty of Sciences & Technology
Status of the educational component	**Mandatory**
Semester	2nd
Number of ECTS credits	**3**
The total number of hours	Contact hours: **25** (10-theory, 10- theoretical and practical, 5-seminar) Not contact hours: 53 Total working hours: 78
General description and purpose of the educational component	Expose the students to the problems associated with social and economic aspects of fisheries and management of living marine resources. Stress the importance of a multidisciplinary approach and including the socioeconomic dimension of fisheries in management and conservation. Understand socioeconomic data collection and analysis, its use and importance.
Prerequisites for studying the course/module, connection with other educational components	General knowledge in fisheries

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. To know the social and economic aspects of fisheries and management of living marine resources.
2. To know the socioeconomic dimension of fisheries in management and conservation
3. Understand socioeconomic data collection and analysis, its use and importance

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	The syllabus of this course is reviewed every year, depending on the evolution of the situation of socioeconomics of fisheries management: The situation of the world fisheries resources
2	The socioeconomics dimension of fisheries in the world
3	The socioeconomics dimension of fisheries in Europe
4	The importance of small-scale fisheries
5	Importance of including the social dimension in fisheries management
6	Governance of fisheries and participation in the decision-making process
7	Gender dimension (women) in fisheries
8	Access rights in fisheries
9	The human dimension of marine protected areas
10	Fisheries trade, seafood consumption, the sustainable seafood movement, labelling and certification
11	Marketing tool and initiatives to add-value to fishery products
12	Collecting and analyzing socioeconomic fisheries data

ASSESSMENT

Report and presentation

The evaluation of the course is done through a report and presentation, where students will collect and analyze socioeconomic data on a topic of their choice (from the themes discussed in classes, or other relevant themes) and requiring an in-depth reading of the list of papers that constitute the bibliography of the course.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Seminar (S) Each class includes a presentation and associated study cases, for 1,5 hours. Part of the time is intentionally allocated to debating ideas and students are encouraged to share experiences.	Collection and analyzing socioeconomic data on a topic of the students choice

GENERAL INFORMATION ABOUT THE COURSE N19 Specialization: Fisheries	
The name of the course/module	**MARINE ECOLOGICAL MODELING AND CLIMATE CHANGE** **Not available**
Faculty/department	Faculty of Sciences & Technology

Status of the educational component	**Optional**
Semester	2nd
Number of ECTS credits	**3**
The total number of hours	Contact hours: Not contact hours: Total working hours:
General description and purpose of the educational component	
Prerequisites for studying the course/module, connection with other educational components	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	
ASSESSMENT	
TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE N20 **Specialization: Fisheries**	
The name of the course/module	**PROTECTED MARINE AREAS**
Faculty/department	Faculty of Sciences & Technology
Status of the educational component	**Optional**
Semester	2nd
Number of ECTS credits	**3**
The total number of hours	Contact hours: 28 (10-theory, 10- field work, 6- theoretical and practical, 2-seminar) Not contact hours: 50 Total working hours: 78
General description and purpose of the educational component	The main objective is to learn about ocean conservation through marine protected areas (MPAs); Definition of MPAs, types of MPAs and steps for their implementation; Effectiveness of MPAs; Science of MPAs and networks of MPAs. Integrating social, economic and ecological aspects of marine protected areas.
Prerequisites for studying the course/module, connection with other educational components	There is not any pre-requisites
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT	
Students are expected to: 1. learn what are marine protected areas, the different types and how have they been used; understand why MPAs have been advocated by global agreements; 2. learn the main guiding principles and criteria for selection, design and management of marine protected areas; 3. understand the concept of connectivity and its central importance for the design of networks of marine protected areas; 4. understand the role of marine protected areas in the context of global ocean management	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	What are marine protected areas (MPA is)? • Types and definitions of MPA
2	Selection of marine protected areas • Guiding principles and criteria for the selection and design of MPA • Management plans for MPA
3	Networks of marine protected areas
4	Monitoring procedures, indicators and long-term objectives

5	Effectiveness of MPAs, science of MPAs
6	Global agreements for MPAs and current situation
7	Future prospects for ocean conservation and sustainable development

ASSESSMENT

Student's presentation and/or group report
Written exam

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory (T) Seminar (S) Theoretical and Practical (TP) Field Work (TC) Theoretical topics will be presented in lectures and seminars (theoretical lectures will include students talks); some theoretical-practical exercises will help to improve some specific concepts related to MPAs; the course will also include a visit to a marine park.	Field Work

UNIVERSITY OF ALGARVE (UAlg)

1	Criterion A: University profile	
1.1	Name of the University	**UNIVERSITY OF ALGARVE (UAlg)**
1.2	Classical or applied	Applied
2	**Criterion B: Profile of the educational program (Curriculum)**	
2.1	Number of Aquaculture disciplines	**18 (10 mandatory, 8 optional)**
2.2	The name of the educational program	**Master in Aquaculture and Fisheries:** **Specializations: Aquaculture**
2.3	Type of diploma	
2.4	Total number of credits (ECTS)	Theory: **42 mandatory**+ 27 optional Thesis: **48** Project dissertation: **12**
3	**Criterion C: Setting the educational program (Curriculum)**	
3.1	Duration of the program	1.5 year (3 semesters)
3.2	The purpose of the educational program	Provide students with the knowledge and training required for the assessment, management, conservation and sustainable exploitation of living resources. Provide students with the knowledge and training required for the production of species in different aquaculture production systems. Training of professionals for aquaculture and fisheries. Provide skills that enable lifelong learning in a self-oriented or autonomous manner. Create the competencies during the Masters to enable progress to a higher level of specialization at the PhD level. To train professionals able to communicate their knowledge to the scientific as well as non-scientific public.
4	**Criterion D: Characteristics of the educational program (Curriculum)**	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Exact and Natural Sciences
5	**Criterion E: Teaching and assessment**	
5.1	Teaching and learning methods	Teaching. Theory lecture (T) Theoretical and Practical (TP) Theory and Laboratory (TL) Seminar (S) Learning. Field work Experiment, Scientific paper Research Project Case study
5.2	Assessment	✓ Theoretical exam ✓ Practical evaluation report on lab classes ✓ Written test ✓ Participation in the discussion forum ✓ Individual work ✓ Multiple choice quizzes ✓ Final written exam ✓ Project performance: written and oral presentation
6	**Criterion F: Software competencies**	
6.1	Integral competence	N/A
6.2	General competences	N/A
6.3	Professional competences	1. Develop kills that allow them to structure a project. Students will learn to delineate experiences, interpret the best methodologies for answering the question of interest 2. Develop critical skills by designing a research project through: problem identification (including state of the art review), definition of the hypothesis to be tested and experimental planning.
7	**Criterion G: Program Learning Outcomes**	
7.1	Program learning outcomes	Students have to learn. 1. To develop a research project, to elaborate a written report about the experiments performed (thesis report) and defend it in a public session.

		2. The students will learn how to design and execute experimental work, to develop specific methodologies and to understand and discuss the obtained results. 3. The main competences to be acquired are: ability to execute an experimental plan, treat the appropriately and present it in writing and orally; 4. Ability to integrate concepts that from different areas of knowledge; 5. Ability to plan and implement scientific and technical activities associated with the proposed work; 6. Ability to write a thesis report and defend it in public.	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	24 Teaching Staff is involved in Program	
8.2	Material and technical support	N/A	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components Specialization: Aquaculture**	**Number of credits**	**Final control form**
9.1.1	Experimental planning (1st sem)	3	Written test or/Final exam
9.1.2	Fisheries biology and ecology (1st sem)	6	Exams: 2 Practical evaluation: Reports on lab classes
9.1.3	Basic in Statistic (1st sem)	3	Written test or Final exam
9.1.4	Techniques in Molecular and Celullar Biology (1st sem)	6	Theoretical exam Practical report
9.1.5	Topics in Aquaculture, Fisheries and Conservation (1st sem)	6	Seminar on the topic chosen Written work Participation in the discussion forums
9.1.6	Culture of Live feed and Larviculture (2nd sem)	6	Practical classes reports Paper discussion, seminars Project Exame
9.1.7	Genetics and selection (2nd sem)	3	Written exam Theoretical practical assignments Individual presentation
9.1.8	Pathology in Aquaculture (2nd sem)	3	participation in e-activities (online) individual presentation, oral and written individual written test
9.1.9	Reproduction in Aquaculture (2nd sem)	3	Extended abstract of article and oral presentation Written exam
9.1.10	Transformation of Aquatic Products (2 nd sem)	3	Final test 20 point Analysis of practical work
9.2	**Selective components Specialization: Aquaculture**	**Number of credits**	**Final control form**
9.2.1	Biocustics (1st sem)	3	Individual work Final exam
9.2.2	Introduction to management in Aquaculture (1st sem)	3	Multiple choice quizzes Final written exam
9.2.3	Methods in the field of Aquaculture (1st, , 2nd sem)	3	Written report Project performance
9.2.4	Laboratory methods in Aquaculture (1st, ,2nd sem)	3	Written report Project practical performance
9.2.5	Practical work in Aquaculture (1st , 2nd sem)	6	Quality of the written and oral presentation Quality of work performance
9.2.6	Scientific writing (1st sem)	3	Written Exercise (equivalent to an Exam) Practical exercises

9.2.7	Techniques in reproductive biology (2nd sem)	3	Participation in seminars in class Reports from practical classes Written Exam
9.2.8	Wastewater treatment (2nd sem)	3	Group work with written and oral presentation Final exam/or Individual written work
10	**Criterion L: Form of attestation**		
10.1	Requirements form	Thesis Report Project Dissertation	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE N1 Specialization: Aquaculture		
1	The name of the course/module	**EXPERIMENTAL PLANNING**
2.	Faculty/department	Faculty of Sciences & Technology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	3
6.	The total number of hours	Contact hours: 21(Theoretical-Practical) Non contact hours: 57 Total working hours 78
7.	General description and purpose of the educational component	The course unit aims to prepare the student for the planning and development of a statistical study
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge in the area of descriptive statistics and statistical inference.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The student should be able to.

1. Distinguish between analysis of variance models and regression models
2. Identify the appropriate model for his study
3. Know the assumptions of the model and evaluate the fit
4. Use multiple comparison methods
5. Use the regression model to obtain forecasts
6. Develop computer skills in data analysis with the statistical software R

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
8.	Analyses of Variance with one factor
9.	Analyses of Variance with blocks
10.	Factorial Experiments
11.	Simple and Multiple Linear Regression

ASSESSMENT

Written test and/or Final exam

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical-Practical classes (TP) Slides support Theoretical-practical classes. The theoretical concepts are followed by solving problems with the R program	N/A

GENERAL INFORMATION ABOUT THE COURSE N2 Specialization: Aquaculture		
	The name of the course/module	**FISHERIES BIOLOGY AND ECOLOGY**
	Faculty/department	Faculty of Sciences & Technology
	Status of the educational component	Mandatory
	Semester	1st
	Number of ECTS credits	6

	The total number of hours	Contact hours: 45 (15- theoretical; 9-theoretical and practical; 21-practical laboratory) Non contact hours: 111 Total working hours: 156
	General description and purpose of the educational component	In this curricular unit, students will have the opportunity to learn important biological issues in the evaluation and modeling of springs. These aspects include morphometric variation, age and growth, reproduction, sexual maturation, strategies from the point of view of the life cycle and food ecology. The curricular unit will focus on issues related to methods sampling methods for fisheries biology studies, methods for determining age in fish and invertebrates, estimating maturation age parameters, fertility estimation, qualitative and quantitative analysis of diets and appropriate methods for comparing curves and testing hypotheses. Although the emphasis of the curricular unit essentially addresses the study of animal living resources, students will be confronted with the most important characteristics of commercially important algae and methods for study.
	Prerequisites for studying the course/module, connection with other educational components	No specific pre-requisites Prior knowledge and skills ✓ Biology ✓ Ecology ✓ Statistics

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. To know the biological basis for living resources management
2. To know the sampling and age determination methods for fish and invertebrates and how this information is used to estimate growth rates
3. To understand the process of gametogenesis and the dynamics of sexual maturation
4. To learn the methods for studying the diet of fish and invertebrates
5. To identify the main environmental and biotic factors that regulate the abundance and the distribution of living resources: currents, wind, nutrients, pollutants and mortality (recruitment and changes in predation and competition rates.
6. To understand the relative importance of the anthropogenic impacts on marine ecosystems and to identify the main factors determining direct or indirect fishing mortality.
7. To discuss the consequences of climatic changes on fisheries and on how these two factors might interact

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	The importance of fisheries biology in fisheries sciences. The renovation of living resources and fisheries management
2.	Age and growth
3.	Indirect methods for age determination. Modal progression analysis
4.	Direct methods for age determination: calcified structures (CS) used in age determination. Sampling, conservation and processing of CS. Age rings and how they are deposited.
5.	Validation and verification of ageing results
6.	Age-length keys, mean length-at-age
7.	Age models and fitting of von Bertalanffy growth model
8.	Reproduction
9.	The organization of ovaries and testes: anatomical and cytological description. Oogenesis and spermatogenesis
10.	Gonadosomatic and hepatosomatic indexes. Dynamics of sexual maturation
11.	Spawning behaviour: total spawnars and partial spawnars.
12.	Fecundity and methods for fecundity estimation.

ASSESSMENT

Exams: 2 (60%)
Practical evaluation: Reports on lab classes (40%)

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical (T) Theoretical and Practical (TP) Practical laboratory (PL)	N/A

GENERAL INFORMATION ABOUT THE COURSE N3
Specialization: Aquaculture

1	The name of the course/module	**BASIC IN STATISTIC**
2.	Faculty/department	Faculty of Sciences & Technology

3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	3
6.	The total number of hours	Contact hours: 24 (Theoretical and Practical) Not contact hours: 54 Total working hours: 78
7.	General description and purpose of the educational component	The main objective of the course is understand the fundamental concepts, data analysis and hypotesys in statistics.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge of mathematics

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The students must be able to.

1. Understand the importance of statistics in scientific studies
2. Plan and develop a statistical study
3. Use appropriate statistical methodology, interpret results, and obtain valid conclusions for the study at hand
4. Develop computer skills in data analysis with the statistical program R.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Introduction to R software. Fundamental concepts in statistics
2	Exploratory data analysis
3	Topics in statistical inference
4	Hypothesis testing

ASSESSMENT

Written test and/or Final exam

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and Practical (TP) Slides support Theoretical-practical classes. The theoretical concepts are followed by solving problems with the R software.	N/A

GENERAL INFORMATION ABOUT THE COURSE N4
Specialization: Aquaculture

1	The name of the course/module	**TECHNIQUES IN MOLECULAR AND CELLULAR BIOLOGY**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Mandatory**
4	Semester	1st
5	Number of ECTS credits	**6**
5	The total number of hours	Contact hours: 47 (15-theory; 24-practical laboratory; 5-seminar; 3-tutorial) Not contact hours: 109 Total working hours: 156
7	General description and purpose of the educational component	The main objective of course is to provide knowledge and skills related to the animal cells sampling and the main techniques in molecular and cellular biology for implementation in Marine Biology
8	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge on the structure and function of biological molecules, especially proteins and nucleic acids.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The student should be able to.

1. To know of molecular principles underlying the main techniques in Molecular and Cellular Biology.
2. To understand simple techniques related to DNA (DNA electrophoresis and amplification) and to proteins (expression, purification and electrophoresis).

	3. To have competences of transfection of animal cells and expression of heterologous proteins (yellow fluorescent protein). 4. To implement application of these techniques in Marine Biology.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Unit organization, classification, program, literature
2	Expression of recombinant proteins in E. coli
3	Chromatography
4	Flow Cytometry
5	Electrophoresis and Immunoassays
6	Nucleic acids and PCR technique
7	Cell culture and transfection
8	Light Microscopy and fluorescent proteins
ASSESSMENT	
Theoretical exam 50% Practical report 50% or 30% (depending on the presentation of a seminar) The facultative presentation of a seminar based on a scientific paper chosen by the students where one of the techniques studied should be part of the methodology	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Practical Laboratory (PL) Seminar (S) The methodology comprises theoretical classes used to explain the fundamentals of each experimental technique executed in the laboratory classes	Scientific paper targeted at one of the technique with methodology

GENERAL INFORMATION ABOUT THE COURSE N5 Specialization: Aquaculture		
1	The name of the course/module	**TOPICS IN AQUACULTURE, FISHERIES AND CONSERVATION**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Mandatory**
4	Semester	1st
5	Number of ECTS credits	**6**
6	The total number of hours	Contact hours: 45 (30- theory; 10-field work; 5-seminar) Not contact hours: 111 Total working hours: 156
7	General description and purpose of the educational component	General objectives: Taking general knowledge and competences of several areas within the Aquaculture, Fisheries and Conservation
8	Prerequisites for studying the course/module, connection with other educational components	Knowledge in Biology and related areas.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The student should be able to.

1. To have an integrated knowledge on the biology of cultivated species (fish, cephalopods and bivalves);
2. To understand the basic principles of production of farmed species;
3. To gain an integrated knowledge in the areas of larviculture, nutrition in fish, reproduction, genetics and selection, pathology, biotechnology;
4. To have an integrated knowledge on specialization of fisheries: fisheries biology and technology, legislation and evaluation of marine resources;
5. To gain an integrated knowledge in marine protected areas, marine conservation, artificial reefs, and marine biodiversity.
6. Competencies to be developed: critical capacity through the discussion of the proposed topics during the seminars; develop of writing skills, interpretation and exposition through the elaboration of projects and seminars on different themes; take note of research areas and production units in Portugal.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Introduction to topics
2	Farming for the future

3	Offshore Aquaculture in Portugal
4	Integrated Multitrophic Aquaculture
5	Principal pathologies in Portuguese marine farming
6	Skeletal evaluation in aquaculture
7	Nutritional imbalances: the case of vitamin A and K
8	Puberty in fish production: problems and solutions
9	Biotechnological tools in reproductive management in aquaculture and conservation
10	Genetic selection in Dicentrarchus labrax
11	Accoustic telemetry to study fish daily patterns and habitat use in ria Formosa
12	Habitat mapping and marine spatial planning.
13	Squid production and research
14	Bivalve production: potentiality and sustainability
15	Future challenges in Aquaculture: impact for fish digestive physiology
16	Sustainability challenges for aquaculture fish feed
17	Nutrition and quality of fish larvae
18	Aminoacids in fish nutrition

ASSESSMENT

Seminar on the topic chosen: 50%
Written work about one of the topics covered in class: 25%
Participation in the discussion forums (seminars given by experts): 25%

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory (T) Seminar (S) Field work (TC) The UC is organized in two parts: a set of lectures given by experts in the various topics discussed, in which students have to step in and debate the subject in order to enhance the ability of intervention and critical spirit; visits to production facilities and research institutes. This approach allows students to have real knowledge of the different production systems and provides an overview of the various possibilities that exist within the theme analysed. In addition students will have to deliver a written work (project design, state-of-the-art review) about one of the topics discussed or within the program of the UC and present it at a seminar. A jury composed by the teacher and by a group of students will be responsible for the discussion and evaluation of the theme presented.	Field work

GENERAL INFORMATION ABOUT THE COURSE N6
Specialization: Aquaculture

1	The name of the course/module	**BIOACUSTICS**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st, 2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: **28** (12-theoretical; 12- practical and laboratorial; 4- theoretical and practical) Not contact hours: 50 Total working hours: 78
7	General description and purpose of the educational component	N/A
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. To be aware of ocean sound of biological origin: sound sources, characteristics, space-time distribution and sound propagation. Ocean sound imaging and usage for remote passive monitoring. 2. To have competences work with the technics for measure and analysis.	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Ocean noise components.
2	Ambient noise and ocean soundscape
3	Coastal and pristine areas
4	Fauna and flora characterization through sound imaging
5	How to measure sound and units
6	Notions of sound propagation in the ocean
7	Notion of frequency, amplitude, duration, periodicity and spatial distribution.
8	Noise sources: Environmental noise. Anthropogenic noise. Fish noise
9	Marine mammal vocalizations.
10	Invertebrates. Flora.
ASSESSMENT	
Individual work Final exam	
TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory (T) Theoretical and Practical (TP) Practical and Laboratorial (PL) A series of descriptive theoretical classes with the support of the text books of the bibliography, with images, movies and sound tracks of a variety of animals, from various areas and various underwater chorus. The experimental component is restricted to the role of user of equipment and applications for underwater sound analysis both, in tank and at Ria Formosa park.	Experiment

GENERAL INFORMATION ABOUT THE COURSE N7 **Specialization: Aquaculture**		
1	The name of the course/module	**INTRODUCTION TO MANAGEMENT IN AQUACULTURE**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st, 2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: 25 (10-theory; 15-theory and practical) Not contact hours: 53 Total working hours: 78
7	General description and purpose of the educational component	N/A
8	Prerequisites for studying the course/module, connection with other educational components	Basic Mathematics
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
At the end of the course, students should be able to grasp the following concepts, in the context of an aquaculture business 1. Management, organization and the roles of managers and the importance for management in an organization. 2. Components of human resource planning, tools for employee motivation and importance of team work. 3. Value of strategy definition and implementation of a strategic plan. Be familiar with tools such as the Blue Ocean Strategy for strategy creation and the Balanced Scorecard for strategy implementation. 4. Steps of the decision-making process. 5. Importance of communication and information technology as well as the role of the data analyst. 6. Basic concepts in Supply Chain Management (SCM) and its relevance in planning and logistics. 7. Basic issues in managerial accounting and the use of ABC (activity-based-costing) as a tool for better understanding of cost drivers 8. Importance of innovation and the challenges in change management.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1	Introduction to Management in Aquaculture businesses	

2	People - Human Resource Management and Teams
3	Strategy and implementation
4	Data, information and decision-making
5	A basic understanding of costs, cost-drivers and optimization of operations
6	Supply Chain Management and the Bullwhip effect in the aquaculture market
7	Change management and innovation in aquaculture companies

ASSESSMENT

Multiple choice quizzes: 3
Final written exam: 1

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory (T) Theoretical and Practical (TP) Each class has three parts: ✓ Presentation of the units subject ✓ Business case studies: students divided in groups will read and analyse a case written in the context of an aquaculture business ✓ Discussion of the case study	Case study

GENERAL INFORMATION ABOUT THE COURSE N8 Specialization: Aquaculture		
1	The name of the course/module	**METHODS IN THE FIELD OF AQUACULTURE**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st, 2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Total working hours: Practical 78
7	General description and purpose of the educational component	The objective of this course is to gain experience in field methods in Aquaculture, by means of practical participation in research projects
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

To gain capacities of methods in Aquaculture

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	The tasks and objectives of this course will be defined to fit the interests of individual students or small groups of students. The students will get practical training in field methods under the supervision of researchers and professors

ASSESSMENT

Written report 60%
Project performance 40%

The student´s final grade will be based on a written report, evaluated by the supervisor and the course coordinator and the students performance during the practical work, evaluated by the supervisor. An evaluation form will be filled in by each evaluator including scores and their justification.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Practical participation in the Research Project Each student will be assigned a supervisor (professor or researcher with a PhD degree) that will coordinate the work during the training period. The schedule will be agreed between	Research Project

the student and the supervisor, according to the type of work, with no changes in the total number of hours.	

GENERAL INFORMATION ABOUT THE COURSE N9 Specialization: Aquaculture		
1	The name of the course/module	**LABORATORY METHODS IN AQUACULTURE**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st, 2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Total working hours: Practical 78
7	General description and purpose of the educational component	The objective of this course is to gain experience in laboratory methods in Aquaculture, by means of practical participation in research projects.
8	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
To gain capacities in laboratory methods in Aquaculture		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1	The tasks and objectives of this course will be defined to fit the interests of individual students or small groups of students. The students will get practical training in laboratory methods under the supervision of researchers and professors.	
ASSESSMENT		
Written report 60% Project practical performance 40% The student´s final grade will be based on a written report, evaluated by the supervisor and the course coordinator and the student performance during the practical work, evaluated by the supervisor. An evaluation form will be filled in by each evaluator including scores and their justification.		

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Research Project Each student will be assigned a supervisor (professor or researcher with a PhD degree) that will coordinate the work during the training period. The schedule will be agreed between the student and the supervisor, according to the type of work, with no changes in the total number of hours.	Practical participation in Research Project

GENERAL INFORMATION ABOUT THE COURSE N10 Specialization: Aquaculture		
1	The name of the course/module	**PRACTICAL WORK IN AQUACULTURE**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st, 2nd
5	Number of ECTS credits	**6**
6	The total number of hours	Contact hours: 35 Not contact hours: 121

		Total hours: 156
7	General description and purpose of the educational component	The aim of this course is to allow the student to implement and consolidate the knowledge in scientific and technological areas of Aquaculture, in order to provide the student with practical knowledge essential to their future professional activity. The student will need to write a synthesis report of the tasks. During this practical work the students are encourage to learn several practical activities related to the topic chosen. They will be integrated in research groups and in running experiments.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. To gain laboratory skills in certain techniques and methodologies.
2. To acquire skills in sampling, data analysis and reporting.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Depends on the experiment where the students are involved but the main steps will be. Bibliography research. The students are encouraged to search for papers on the area to know more about the work they are involved.
2	Laboratory or field analysis. They will be responsible for maintaining organisms, participate in samplings, perform analysis in the laboratory
3	Data analysis and reporting: The students will learn how to process data, such as statistic methods and will write a report on the main activities developed in the lab.

ASSESSMENT

1. Quality of the written and oral presentation 60 %
   - ✓ Report structure 5%
   - ✓ Depth and details of the methodologies description 10%
   - ✓ Clear and concise writing style 5%
   - ✓ Depth and details of the literature review 10%
   - ✓ Oral presentation 20%
   - ✓ Scientific correctness 10%
2. Quality of the work performance 40%
   - ✓ Commitment and responsibility, including time keeping 5%
   - ✓ Capacity to understand the concepts explained 10%
   - ✓ Capacity to plan the practical work 10%
   - ✓ Critical sense, independence in problem solving 10%
   - ✓ Scientific correctness 5%

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The topics of practical work in Aquaculture may involve fieldwork, laboratory, scientific research and data treatment and will always be guided by a PhD from UAlg or by a qualified researcher from other institution where the work is developed. The learning steps will follow the scheme explained in the detailed program. The teaching methods will depend on the work performed but there will be a constant contact with the supervisor of the work that will guarantee that the student understands all the steps he/she is performing. In this sense, periodic meetings will be scheduled to follow the work performed. The supervisor will transmit to the student as much information as possible about the proposal and on the methodologies to be used, encouraging the student to find additional specific information. The supervisor will give support in all tasks/samplings in the laboratory, so students understand the processes involved in the proposed work	Field work Scientific research

GENERAL INFORMATION ABOUT THE COURSE N11
Specialization: Aquaculture

1	The name of the course/module	**SCIENTIFIC WRITTING**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	1st, 2nd
5	Number of ECTS credits	**3**

6	The total number of hours	Contact hours: 30 (20-theory; 10-theory and practical) Not contact hours: 48 Total hours: 78
7	General description and purpose of the educational component	This course aims to train the planning, writing and critical analysis of scientific papers. The graduate students will understand the principles of writing scientific papers, submitting the, dealing with reviewers comments. Training in critically assessing papers and grant proposals will develop skills to act as scientific referee.
8	Prerequisites for studying the course/module, connection with other educational components	English language skills

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

To gain scientific writing skills

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	The planning of a paper outline
2	Focus on the question
3	The language style: the title, the abstract, the introduction, the materials and method,. the results and discussion.
4	Review papers, book chapters
5	Scientific English issues.
6	The submission. Addressing reviewers comments

ASSESSMENT

Written Exercise (equivalent to an Exam)
Practical exercises

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Theory and Practical (TP) Lectures, practical writing assignments and critical analyses. Students work on scientific papers available as published literature.	Work on Scientific papers

GENERAL INFORMATION ABOUT THE COURSE N12
Specialization: Aquaculture

1	The name of the course/module	**CULTURE OF LIVE FEED AND LARVICULTURE**
2.	Faculty/department	Faculty of Sciences & Technology
3.	Status of the educational component	**Mandatory**
4.	Semester	2nd
5.	Number of ECTS credits	**6**
6.	The total number of hours	Contact hours: **50** (30 theory, 15-practical and laboratorial, 5- field work) Non contact hours: 106 Total working hours:156
7.	General description and purpose of the educational component	In Live feeds and Larviculture we pretend to transmit practical and scientific knowledge on several aspects of larval rearing from live food production (microalgae, rotifers and Artemia) to larval development. The content of this course is design to prepare students to practical aspect of the aquaculture sector and to explore new research related areas and species. The target species will be the produced marine fish species: gilthead seabream, European seabass, sole and turbot. Bivalves and crustaceans will be also mentioned, as well as some fresh water species such as salmonids and cyprinids
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge in Biology or related areas

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The students will gather.
1. Theoretical knowledge and practical skills in the principal techniques of live feeding production and on larvae culture
2. Practical and scientific knowledge on several aspects of larval rearing from live food production (microalgae, rotifers and Artemia) to larval development
3. Practical skills of aquaculture sector

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Introduction: Importance of life food at early life stages and criteria for selection
2	Microalgae, Rotifers and Artemia ✓ Biological and morphological characteristics ✓ Nutritional value ✓ Production and use in aquaculture ✓ Factors affecting production ✓ Enrichment strategies
3	Fish Larvae ✓ Biological bases ✓ Functional demands for feeding ✓ Metamorphosis and swim bladder ✓ How to cultivate larvae from different species
4	Bivalve and Crustacean larval rearing ✓ Biological bases ✓ Fertilization and Embryonic developmental stages ✓ Larval stages ✓ Examples in different species ✓ Cultivation aspects: egg incubation, larval rearing and protocols ✓ Daily routines ✓ Larval feeding ✓ Metamorphosis process ✓ Settlement

ASSESSMENT
Practical classes reports: 40% Paper discussion, seminars, Project, 10% Exame: 50% (minimum grade: 9.5 values)

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Practical and Laboratorial (PL) Field Work (TC) The different topics will be presented in lectures by the teacher. Some topics will be explored further in seminars given by expert researchers in a certain topic. These seminars will transmit case studies to students, creating a discussion line in class. In these cases the students will have a first contact with the topic in theoretical classes. Therefore they will have the opportunity to profound in the topic and participate actively in discussion. Associated with the topics developed in seminars, the students will write a project proposal that will be presented as poster or orally. The practical classes are divided in 2 parts: in the 1st one the students will learn how to produce microalgae, rotifers and artemia, performing experiments and reporting data. In the 2nd one, the students will use this information to produce fish and bivalve larvae.	Field Work

GENERAL INFORMATION ABOUT THE COURSE N13 Specialization: Aquaculture		
1	The name of the course/module	**GENETICS AND SELECTION**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: 25 (10-theory, 15- theory and practical) Not contact hours: 53 Total working hours: 78
7	General description and purpose of the educational component	N/A

8	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge of biology and genetics, equivalent to those normally taught in undergraduate life sciences degrees

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. To the main challenges and trends in the field of genetics and selection in aquaculture 2. To know the tools to plan, implement and evaluate genetic selection programs in aquaculture 3. To know the power and relevance of genetics and selection for the development of the aquaculture industry.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Introduction to the principles of genetic and selection ✓ Population genetics ✓ Heritability and selection ✓ Selection in aquaculture
2	Genome technologies and biotechnologies ✓ Whole genome sequencing ✓ Genetic marker development ✓ Genome Wide Association Studies (GWAS) ✓ Chromosome manipulations
3	Phenotyping and selection traits
4	Quantitative genetics and selective breeding ✓ Breeding schemes in aquaculture ✓ Quantitative Trait Loci (QTL) ✓ Marker-Assisted Selection (MAS) ✓ Genomic Selection (GS)
5	Practical aspects of the application of genetic/genomic in aquaculture
6	Present status and future trends in the industry

ASSESSMENT
Written exam 40% Theoretical practical assignments 30% Individual presentation 30%

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Theory and Practical (TP) The theoretical classes consist in the presentation of key concepts of genetics and selection through the support of PowerPoint, online material and the whiteboard. At the end of each theme presented, whole-class discussion of the respective theme will be done in practical classes, before moving to the next theoretical subject. Besides discussions of fundamental concepts, the practical part will consist in hands-on in genetic/genomic methodologies. In addition, the students will prepare group reports about case-studies of implemented genetic methodologies in aquaculture.	Case study

GENERAL INFORMATION ABOUT THE COURSE N14 Specialization: Aquaculture		
1	The name of the course/module	**PATHOLOGY IN AQUACULTURE**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: 25 (15-theory, 10-theoretical and practical) Not contact hours: 53 Total working hours: 78
7	General description and purpose of the educational component	The main purpose of course is to provide ecological importance of disease outbreaks and the different infection processes, pathologies in aquaculture (water quality, bacteria, parasites, viruses and fungi), the main prevention methods of pathologies such as handling and hygiene, as well as on the immune system and the use of vaccines and immunostimulants.

		In the TP section students should be able to perform necropsies on fish, collect bacteriological and parasitological samples, and perform general and specific diagnostic techniques. This knowledge will enable students to understand the process of diagnosing a disease.
8	Prerequisites for studying the course/module, connection with other educational components	Knowledge of biology and physiology of the aquatic organisms

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

It is intended to equip students with knowledge that will allow them:

1. To understand the ecological / economic importance of disease outbreaks and the different infection processes;
2. To recognize the most relevant pathologies in aquaculture (water quality, bacteria, parasites, viruses and fungi);
3. To understand how to prevent and combat pathologies by acquiring knowledge about the main prevention methods, such as handling and hygiene, as well as on the immune system and the use of vaccines and immunostimulants

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	**Theoretical component** Most common factors that lead to the onset of diseases.
2	Review of anatomy and physiology of fish
3	Epizootology - definitions.
4	Water quality and diseases
5	Disease-causing bacteria in fish, examples.
6	Fish parasites, examples of different organisms.
7	Viruses causing diseases in fish, examples.
8	Pathogenic organisms in the cultivation of crustaceans and molluscs. Like differences with fish.
9	Diseases and non-pathogenic origin.
14	Vaccination and immunostimulation.
Practical component	
1	Standards for sending and collecting fish
2	Analysis of the water quality of the experimental circuit.
3	Necropsy performed on fish: aseptic collection of material for bacteriological and virological diagnosis.
4	Isolation and identification of pathogenic bacteria in fish.
5	Identification of parasitic fish organisms.
6	Collection and identification of bacteria and parasites in bivalves (extra)

ASSESSMENT

Continuous evaluation with three mandatory components: -

- ✓ participation in e-activities (online) 10%
- ✓ individual presentation, oral and written 45%
- ✓ individual written test 45%

Final examination exemption, for those with a grade of 9.5 or above, in the written test. Final exam has the same weight (45%) as written test. A grade below 9,5 on any of the three components, means Fail. Extra work can be foreseen in such case

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Theory and Practical (TP)	N/A

GENERAL INFORMATION ABOUT THE COURSE N15 Specialization: Aquaculture		
1	The name of the course/module	**REPRODUCTION IN AQUACULTURE**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: 22.5 (7.5-theory, 10- practical and laboratorial, 5-theoretical and practical) Not contact hours: 55.5 Total working hours: 78

7	General description and purpose of the educational component	N/A
8	Prerequisites for studying the course/module, connection with other educational components	General biology

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Provide basic concepts of reproductive biology
2. Provide the scientific and reasoning for the application of reproductive biology to aquaculture
3. Provide the tools for the students to explore recent advances in reproductive biology and related subjects both for basic science and applications of science.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Introduction: Variability of reproductive strategies in teleost fishes
2	Origin and morphology of gonads and ducts
3	Sex determination and differentiation in fish
4	Gametogenesis
5	Neuroendocrine control of gametogenesis
6	The cycle of gametogenesis and endocrine cycle in salmonids and non-salmonids
7	Hormonal pheromones
8	The endocrine regulation of puberty in male fish: implications for ongoing problems in aquaculture
9	Hormonal spawning induction in fish farming
14	Environmental control of fish reproduction

ASSESSMENT

Students will be examined by.
1) Extended abstract of article and oral presentation 25%
2) written exam 75%

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Theory and Laboratorial (TL) Theoretical and Practical (TP) Topics will be presented in lectures which the students explore further in bibliography provided from books and scientific papers, generally reviews. A few practical hands on or demonstration classes will deal with basic topics such as gametogenesis. Students are encouraged to further explore particular topics by writing a review in the style of a scientific paper, which will be subject to peer review and will be presented orally.	Writing review in the style of scientific paper

GENERAL INFORMATION ABOUT THE COURSE N16
Specialization: Aquaculture

1	The name of the course/module	**TRANSFORMATION OF AQATIC PRODUCTS**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: **25** (15-theory, 5-theoretical and practical, 5-practical and laboratorial) Not contact hours: 53 Total working hours: 78
7	General description and purpose of the educational component	N/A
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Specifically, at completion of this course (UC) it is intended that students know:

	1. the importance of the seafood network (in terms of food use and a in the perspective of sustainable use of resources), the main species captured/produced and the current state of the resources/stocks 2. he main methods of catching/fishing and producing seafood; 3. the relevant/emerging indicator parameters to assess fish freshness and study the dynamics of the spoilage processes; 4. the methods and technologies for the transformation, processing and conservation (storage) of fishery and aquaculture products; 5. the methodologies and/or procedures, both formal and operational, contributing to the implementation of programs of quality assurance applied in the fishery and aquaculture industry.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Aquatic (living) resources and their use as food: global trends and national estimates of landings of fishery and production of aquaculture products; biology of major exploited species; technologies used in fisheries and aquaculture
2	Characteristics of quality/freshness of fish and dynamics of deterioration/spoilage.
3	Preservation and processing of fishery and aquaculture products: in ice, refrigeration and modified/controlled atmospheres; freezing and frozen storage; canning and other processing techniques; hygiene during processing and storage of fishery and aquaculture products
4	Quality assurance of fishery and aquaculture products: quality control; regulations, standards bodies and international standards; accreditation and quality systems.
ASSESSMENT	
Final test 20 point Analysis of practical work 10 point	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Practical and Laboratorial (PL) Theoretical and Practical (TP) The course is divided into (i) a series of theoretical classes/lectures, during which the topics referred to above are to be presented and discussed; and (ii) lab classes, where in (up to) 2 experiments/practical laboratory activities - involving the transformation/processing of fishery and aquaculture products and current analyses - shall be carried out by the students in order to practice the topics talked about in the lectures.	Analysis of experiment

GENERAL INFORMATION ABOUT THE COURSE N17 Specialization: Aquaculture		
1	The name of the course/module	**TECHNIQUES IN REPRODUCTIVE BIOLOGY**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: 35 **(**20-theory, 10-practical and laboratorial, 5- seminar) Not contact hours: N/A Total working hours: N/A
7	General description and purpose of the educational component	In Techniques in Reproductive Biology we pretend to transmit practical and scientific knowledge on the characterization and management of gametes and breeders in aquaculture and in the conservation of genetic resources. The contents of this discipline are based on methods and techniques focused on practical aspect for the aquaculture sector and on innovative techniques for research. The target species will be: gilthead seabream, European seabass, sole, turbot, grouper, some salmonids and bivalves.
8	Prerequisites for studying the course/module, connection with other educational components	No pre-requisites
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Introduction to gamete management and manipulation
2	Methods for gamete emission. Methods for gamete extraction
3	Characterization of gametes: cellular and molecular aspects
4	Techniques in sperm quality assay: practical and research aspects
5	Techniques in oocyte quality
6	Fertilization techniques in fish, bivalves and crustacean
7	Germ cell management
8	Practical aspects in preservation and cryopreservation
9	Analysis of damage: biomarkers and techniques used
10	Applications to aquaculture and genetic resources conservation
11	Gamete manipulation
12	Introduction to breedeŕs management
13	Reproductive strategies in European cultured species
14	Factores determining breeder´s quality
15	Strategies for sex manipulation in cultured species: methods and applications
16	Crossbreeding and hybridization. Triploidization
17	Nuclear transfer technique: principals and applications in fish (somatic and germ cells)
18	Techniques in primordial and spermatogonial germ cells: surrogate production

ASSESSMENT
Participation in seminars in class (discussion, comments, questions)- 10% Reports from practical classes, protocols or presentations-40% Written Exam- 50%

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Practical and Laboratorial (PL) Theoretical and Practical (TP) The course will have practical and theorectical classes with power point demonstrations. In practical classes students will follow the protocols provided by the teacher to develop an experimental work and they will also have the opportunity to develop their own project and execute it.	Experimental work Own scientific project

GENERAL INFORMATION ABOUT THE COURSE N18 Specialization: Aquaculture		
1	The name of the course/module	**WASTEWATER TREATMENT**
2	Faculty/department	Faculty of Sciences & Technology
3	Status of the educational component	**Optional**
4	Semester	2nd
5	Number of ECTS credits	**3**
6	The total number of hours	Contact hours: **30** (theoretical and practical) Not contact hours: 48 Total working hours: 78
7	General description and purpose of the educational component	The objective of Wastewater Treatment in Aquaculture course is the development of the students' skills to solve technical problems associated with wastewater treatment in aquaculture systems
8	Prerequisites for studying the course/module, connection with other educational components	No pre-requisites

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Students must acquire skills on: 1. Understanding the treatment processes in aquaculture 2. Treatment options vs. water quality.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	An introduction to water quality and water treatment in aquaculture ✓ Aquaculture classification

	✓ Technical components of the system ✓ Inlet and outlet water quality ✓ Fish metabolism and water quality
2	Traditional one-way water flow units
3	Recirculation and water re-use systems (RAS) ✓ Model for construction of the re-use systems ✓ Mass flow system o Water requirements of the system (oxygenation / dilution of waste) ✓ Outlet concentration Components of the system o Aeration/ oxygenation ✓ pH adjustment ✓ Solids removal (filtration, protein skimmer, settling) ✓ Ammonia removal (biofilters, nitrification/denitrification, chemical removal) ✓ Phosphorus removal ✓ Disinfection (UV, O)

ASSESSMENT
Group work with written and oral presentation 25% Final exam/or Individual written work 75% Both assessment components are mandatory. The classification of the individual work or the final exam must always be higher than 9.5 for approval at the UC. Other evaluation criteria can be added at the beginning of classes, presented in the 1st class and placed in electronic tutoring. The themes of the works will also be presented and placed in the electronic tutoring

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture theory (T) Practical and Laboratorial (PL) Theoretical and Practical (TP) TP: in a classroom with a multimedia projector. Content exposure using case studies and guided discussion. Design calculations. Practice in decision making.	Group work

UNIVERSITY OF PATRAS

1	Criterion A: University profile	
1.1	Name of the University	**UNIVERSITY OF PATRAS**
1.2	Classical or applied	Classical
2	**Criterion B: Profile of the educational program (Curriculum)**	
2.1	Number of Aquaculture disciplines	**10 (mandatory)**
2.2	The name of the educational program	**Master in Sustainable Fisheries, Aquaculture**
2.3	Type of diploma	
2.4	Total number of credits (ECTS)	**90** (30 corresponds to thesis)
3	**Criterion C: Setting the educational program (Curriculum)**	
3.1	Duration of the program	**1.5 year (3 semesters)**
3.2	The purpose of the educational program	The objective of the Program is to provide postgraduate level education to Life Science with a view to let them achieve a strong scientific background and to expand their experience and know-how on the sustainable production of aquatic organisms while emphasizing on the protection of the environment. This general topic comprises the search and provision of scientifically sound knowledge concerning sustainable production, the research for the advancement of theoretical knowledge and the development of innovative technological applications. **Apart from the techniques of production, the emphasis is on the environmental aspects.** The particular subjects covered in the Program of Sustainable fisheries, aquaculture refer to the aquatic ecosystems, the organisms under commercial exploitation, the production systems, the current trends with environment-friendly technologies and to other methodologies for the scientific treatment of the topic. The final goal of the program is to offer the fisheries and aquaculture community expert personnel with awareness, perception and skills that satisfactorily meet the modern challenges in the aquatic living resources production within the greater framework of sustainable development strategies.
4	**Criterion D: Characteristics of the educational program (Curriculum)**	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Life Science
5	**Criterion E: Teaching and assessment**	
5.1	Teaching and learning methods	N/A
5.2	Assessment	N/A
6	**Criterion F: Software competencies**	
6.1	Integral competence	N/A
6.2	General competences	N/A
6.3	Professional competences	1. To acquire skills to know-how and technological innovations, on the production, processing and marketing of fishery, aquaculture and animal products as well as the sustainable management of the aquatic ecosystem 2. To possesses an inter-scientific range of knowledge as he combines the field of application of biological, chemical, physical and economic sciences related to fisheries, aquaculture and processing-elaboration of fish catches and farmed animals, as well as the development and application of technologies and management methods, and assessment and evaluation of the environment.
7	**Criterion G: Program Learning Outcomes**	
7.1	Program learning outcomes	1. Knowledge and understanding of the principles of aquaculture and of the diversity of the cultured species including the most recent trends in production. 2. Understanding and critical appraisal of the development of sustainable techniques for aquatic organism's production. 3. Capability development for critical appraisal of novel production systems with respect to their socio-economic, technical and environmental aspects.

		4. Capability development for searching and assessing the available information on particular subjects and for synthesis of multi-sourced information. 5. Capability development for research planning and analyzing research data utilizing qualitative and quantitative methods. 6. Ultimate formation of scientists destined for the aquatic living resources industry with skills and knowledge suitable for a career in either the private or the public sector. 7. Preparation for doctoral level studies.	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	12 Teaching staff involved in the Program	
8.2	Material and technical support	N/A	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Data Analysis and Modelling Techniques (1st sem.)	7	N/A
9.1.2	Aquatic Ecosystem (1st sem.	7	N/A
9.1.3	Biology and Ecology of Aquatic Organisms (1st sem.)	8	N/A
9.1.4	Production System (1st sem.)	8	N/A
9.1.5	Fisheries and Environment (2nd sem.)	6	N/A
9.1.6	Modern Aquaculture Techniques and Materials (2nd sem.)	5	N/A
9.1.7	Environment-Friendly Technologies (2nd sem.)	5	N/A
9.1.8	Environment Protection (2nd sem.)	5	N/A
9.1.9	Enterprise Plans (2nd sem.)	4	N/A
9.1.10	Processing-Trade Quality Assurance (2nd sem.)	5	N/A
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	The Program does not have the selective components		
10	**Criterion L: Form of attestation**		
10.1	Requirements form	Thesis Thesis exam	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE N1		
1	The name of the course/module	**DATA ANALYSIS AND MODELLING TECHNIQUES**
2.	Faculty/department	Department of Fisheries and Aquaculture
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	7
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
5.	Introduction, Descriptive Statistics	
6.	ANOVA	
7.	Uni- and multi-variate regression.	

8.	Multivariate analyses
9.	Univariate and bivariate time series analyses
10.	GIS
11.	Modelling
12.	Introduction to database design
ASSESSMENT	
N/A	
TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE N2 Specialization: Aquaculture		
1	The name of the course/module	**AQUATIC ECOSYSTEM**
2	Faculty/department	Department of Fisheries and Aquaculture
3	Status of the educational component	Mandatory
4	Semester	1st
5	Number of ECTS credits	7
6	The total number of hours	N/A
7	General description and purpose of the educational component	N/A
8	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	Aquatic ecosystems. Water quality	
2.	Microbiological characteristics of aquatic ecosystems. Pathogenic microorganisms	
3.	Planktonic organisms, ecology and distribution of planktonic organisms	
4.	Benthic organisms, ecology and distribution of benthic organisms	
5.	Interaction of planktonic & benthic organisms with aquaculture.	
6.	The Mediterranean ecosystem – Lessepsian immigrants	
7.	Fishes, taxonomy	
8.	Productivity of water systems	
9.	Climate change	
10.	Biodiversity – Genetic diversity. Instructions for Writing Assignments.	
ASSESSMENT		
N/A		
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)	
N/A	N/A	

GENERAL INFORMATION ABOUT THE COURSE N3		
1	The name of the course/module	**BIOLOGY AND ECOLOGY OF AQUATIC ORGANISMS**
2.	Faculty/department	Department of Fisheries and Aquaculture

3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	8
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1	Macroalgae and phytobenthos biology, classification recognition	
2	Abundance and distribution measurement techniques	
3	Fish biology and anatomy	
4	Physiology of aquatic organisms	
5	Pathology of aquatic organisms (Infectious Diseases. Bacterial Diseases. Fungal Diseases. Parasitic Diseases)	
6	Fish Immunology & Epidemiology	
7	Morphological analysis of organisms	
8	Nutritional spectrum of organisms, nutritional level. Reproduction	
9	Age-growth and population based methods.	
ASSESSMENT		
N/A		

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE N4		
1	The name of the course/module	**PRODUCTION SYSTEMS**
2	Faculty/department	Faculty of Fisheries and Aquaculture
3	Status of the educational component	**Mandatory**
4	Semester	1st
5	Number of ECTS credits	**8**
5	The total number of hours	N/A
7	General description and purpose of the educational component	N/A
8	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1	Collective fishing (history, fishing gear, boats, context of use)	
2	Intensive and extensive aquaculture.	
3	Freshwater fish farming (trout, Mediterranean species, history, principles of operation, basic equipment, context of use)	
4	Extensive farming (closed circuits, History, basic equipment, species, operating flow).	
5	Fisheries management and legislation in fisheries.	
ASSESSMENT		
N/A		
TEACHING AND LEARNING METHODS		

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE N5		
1	The name of the course/module	**FISHERIES AND ENVIRONMENT**
2	Faculty/department	Fisheries and Aquaculture
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**6**
6	The total number of hours	N/A
7	General description and purpose of the educational component	N/A
8	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1	Indirect and direct effects of fisheries on the ecosystem. Interactions of environmental and anthropogenic parameters in fish stocks	
2	Fish stock assessment and population dynamics	
3	Marine Protected Areas. Spatio-temporal prohibitions of fishing gear. Fish by catch	
4	Structure of Greek and European legislation, Common Fisheries Policy, Third countries	
5	Methods for investigating trends and patterns of consumption of fishery products. Life Cycle Products	
6	Development and implementation of multi-specialists ecological models and ecological indicators	
ASSESSMENT		
TEACHING AND LEARNING METHODS		

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE N6		
1	The name of the course/module	**MODERN AQUACULTURE TECHNIQUES AND MATERIALS**
2	Faculty/department	Fisheries and Aquaculture
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**5**
6	The total number of hours	N/A
7	General description and purpose of the educational component	N/A
8	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		

1	Algae farming
2	Food Technology and Nutrition Practice
3	Genetic Improvement Program I
4	Pathological Monitoring of Aquaculture

ASSESSMENT

N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE N7		
1	The name of the course/module	**ENVIRONMENT-FRIENDLY TECHNOLOGIES**
2	Faculty/department	Fisheries and Aquaculture
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**5**
6	The total number of hours	N/A
7	General description and purpose of the educational component	N/A
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Vaccine
2	Water Recycling Systems
3	Algae farming
4	Fish Breeding
5	Integrated Multicultural Cultures

ASSESSMENT

N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE N8		
1	The name of the course/module	**ENVIRONMENT- PROTECTION**
2	Faculty/department	Fisheries and Aquaculture
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**5**
6	The total number of hours	N/A
7	General description and purpose of the educational component	N/A

8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Water quality framework Directive 2000/60 and monitoring techniques
2	Protected areas, Techniques and methods monitoring
3	Protected areas-Databases
4	Water Pollution & Principles of Toxicology
5	Effects of aquaculture on the environment
6	Aquaculture Spatial Planning

ASSESSMENT
N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE N9		
1	The name of the course/module	**ENTERPRISE PLANS**
2	Faculty/department	Fisheries and Aquaculture
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**4**
6	The total number of hours	N/A
7	General description and purpose of the educational component	N/A
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Introduction to Water Management's.
2	Economic and technical design of farm units.
3	Aquaculture Decision Making: Fish and shellfish farming.
4	Aquaculture Project Management.
5	Risk Management – ISO 31000 standard
6	Fixed and Variable Cost Calculation
7	Calculation of production costs and sales prices. Cash flows

ASSESSMENT
N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE N10

1	The name of the course/module	**PROCESSING-TRADE QUALITY ASSURANCE**
2	Faculty/department	Fisheries and Aquaculture
3	Status of the educational component	**Mandatory**
4	Semester	2nd
5	Number of ECTS credits	**5**
6	The total number of hours	N/A
7	General description and purpose of the educational component	N/A
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Traceability -Processing-Food packaging
2	Quality assurance control methods
3	Processing of Fishery Products.
4	Microbiological Safety and quality of fish products
5	Quality Assurance & Quality Management System HACCP, ISO 22000
6	Case study

ASSESSMENT

N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

UNIVERSITY OF SANTYAGO DE COMPOSTELLA

1	Criterion A: University profile	
1.1	Name of the University	**UNIVERSITY OF SANTYAGO DE COMPOSTELLA**
1.2	Classical or applied	Classical
2	**Criterion B: Profile of the educational program (Curriculum)**	
2.1	Number of Aquaculture disciplines	26 (8 mandatory, 18 elective)
2.2	The name of the educational program	**Master in Aquaculture**
2.3	Type of diploma	MSc
2.4	Total number of credits (ECTS)	Theory- 96 (of which 30 -mandatory dis., 66-optional) Thesis – 6 Internship in company – 24 (elective) Initiation to research – 24 (elective) Project – 24 (elective)
3	**Criterion C: Setting the educational program (Curriculum)**	
3.1	Duration of the program	1 year (2 semesters)
3.2	The purpose of the educational program	This degree provides students with knowledge and skills to design and carry out research in aquaculture and provide professional responses through the design and management of mainland and marine facilities, the evaluation of environmental impact and R&D&I necessities for the development of the aquaculture industry. It is an inter-university master's with the universities of A Coruña and Vigo.
4	**Criterion D: Characteristics of the educational program (Curriculum)**	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Biology
5	**Criterion E: Teaching and assessment**	
5.1	Teaching and learning methods	Teaching methods are specified within each discipline
5.2	Assessment	Project thesis Work experience placement (work placements in companies for degrees) Initiation to research
6	**Criterion F: Software competencies**	
6.1	Integral competence	• It will be guaranteed that the student possesses and understands the knowledge that gives him the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a research context. • It will be guaranteed that the student knows how to apply the knowledge acquired and his ability to solve problems in new or little-known environments within wider (or multidisciplinary) contexts related to his area of study. • It will be guaranteed that the student is able to integrate knowledge and face the complexity of formulating interpretations and judgments based on often incomplete information, including reflections on the social and ethical responsibilities linked to the resolution of specific problems. • It will be guaranteed that the student knows how to communicate his conclusions (and the knowledge and ultimate reasons that support them) to specialized and non-specialized audiences in a clear and unambiguous way. • It will be ensured that the student has the learning skills that will allow him to continue studying in a way that will have to be largely self-directed or autonomous.
6.2	General competences	• Acquisition of analysis and prospecting skills on the current and future situation of aquaculture • Appreciate the importance of debate and teamwork, interpersonal communication and responsibility • Assess the importance of multidisciplinary analyzes and the relationship between knowledge for solving problems and analyzing critical points • Use the appropriate scientific terminologies.

		• Write and defend professional reports and scientific publications, encouraging audiovisual, oral and written expression. • Find and consult the necessary sources of information and databases; analyze and synthesize documents • Contribute knowledge, proposing and developing research and cultivation projects. • Strengthen the management of foreign languages • Apply critical, logical and creative thinking. • Ability to work individually in experimental design, showing autonomy in laboratory work.	
6.3	Professional competences	• Assimilation of the importance of water quality and its supervision. • Knowledge of the biological cycle and physiological and morphological aspects of farmed animals and algae. • Develop and know the cultivation techniques of fish, molluscs, other invertebrates, algae, and auxiliary crops. • Control all the physiological, metabolic, immunological, environmental, feeding, ... factors that affect the well-being of species in culture, and implement the processes of reproduction, production, maintenance and pathology of key species and potential species in aquaculture. • Diagnose, prevent and control diseases. • Carry out quality controls and traceability. • Acquire knowledge about the technical and design characteristics of the facilities for cultivation. • Preventing the potential environmental impact of aquaculture. • Organize production ensuring its viability. • Identify relevant research objectives and plan their achievement. • Acquire basic and applied knowledge of genetics, genomics and proteomics applied to aquaculture. • Know the techniques used to assess the state of the immune system as well as the methodology used to determine the effects of diet, stress, immunostimulants and immunization on the immune system. • Identify and apply international, state and community regulations applicable to aquaculture.	
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	N/A	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	29 teaching staff is involved in Program	
8.2	Material and technical support	N/A	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Introduction to Aquaculture (1st sem)	3	Theory writing test Seminars Continuous evaluation
9.1.2	Biology of farms Aquatic Animals (1 sem)	3	Theoretical exam Practical exam
9.1.3	Biology of cultured algue (1st sem.)	3	Written test Test writing and collective participation in seminars Continuous evaluation
9.1.4	Physiology of farmed aquatic animals (1st)	6	Written exam Seminar: topic presentation Accomplishment of the subject practices
9.1.5	Genetics for aquaculture (1st sem.)	3	Written exam. Resolution of problems and questions Laboratory practice
9.1.6	Immunology of farmed aquatic animals (1st sem.)	3	Final exam Exam on practical classes

9.1.7	Pathology in aquaculture (1st sem.)	6	Written exam Defending seminars Realization of practical1
9.1.8	Feeding and nutrition (1st)	3	Written exam Seminar's grade
9.1.9	Master thesis (end of the degree Project's)	6	Thesis defence
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Culture of microalgae and zooplanktons (2nd)	3	Writing test Practical work
9.2.2	Disease diagnostics (2nd)	6	Written exam Realization of practices
9.2.3	Development of tools for prevention for prevention and control (2nd)	3	Theoretical exam
9.2.4	Tools for epidemiological analysis (2nd)	3	Theory exam Exercise resolution Presentation of works
9.2.5	Water quality and Management (2nd)	3	Attendance and participation Test
9.2.6	Toxicology and toxic tides (2nd)	3	Mixed exam Practical cases
9.2.7	Aquaculture farm management (2nd sem.)	3	Written exam Seminar topic presentation
9.2.8	Quality processing and traceability (2nd)	3	Written exam Practical exam
9.2.9	Culture of seaweeds (2nd sem.)	3	Written tests Continuous evaluation
9.2.10	Culture of fish (2nd sem.)	6	Exam test
9.2.11	Culture of bivalve molluscs (2nd sem.)	6	Exam test Defending seminars
9.2.12	Culture of other invertebrates (2nd sem.)	3	Exam test Defending seminars
9.2.13	Genetic improvement (2 nd sem.)	3	Exam Practices
9.2.14	Management of genetic resources (2 nd sem.)	3	Written exam Written works
9.2.15	Structural and functional genomics (2 nd sem)	3	Exam Practical activities Seminar
9.2.16	Biotechnological applications in aquaculture (2nd sem)	6	Written sheet Practical
9.2.16	Experimental design and data analysis (2 nd sem.)	3	Continuous evaluation Final exam
9.2.17	Phylogenetical analysis (2nd sem.)	3	Defense Exercises Project
9.2.18	Internship in a company	24	
9.2.19	Initiation to research (work placements in companies for degrees)	24	
9.2.24	New development project (work placements in companies for degrees)	24	
10	**Criterion L: Form of attestation**		
10.1	Requirements form	Thesis	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE N1		
1	The name of the course/module	**Intruduction to Aquaculture**
2.	Faculty/department	Faculty of Biology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	3
6.	The total number of hours	Contact hours 24 Student's hours 51 Total hours 75

7.	General description and purpose of the educational component	That the student obtains a basic training that allows him to know in broad strokes the historical evolution of the species, structures and production processes of the cultivated aquatic organisms; information needed to acquire a global vision of this discipline, an essential prerequisite for understanding the need and importance of the rest of the subjects of the Title.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

Theory writing test: 50-75%; seminars: 10-30% (Assistance and participation 0-30; Achievement, quality and defense 0-30); Continuous evaluation: assistance and participation: 0-20%

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Acquire capacity for analysis and prospecting on the current and future situation of aquaculture.
2. Use appropriate scientific terminology.
3. Developing and getting to know techniques for growing fish, molluscs, other invertebrates, algae and auxiliary crops.
4. Acquire knowledge about technical characteristics and the design of installations for cultivation.
5. The students are able to integrate knowledge and face the complexity of formulating interpretations and judgments based on less than incomplete information, including reflections on social and ethical responsibilities linked to the resolution of specific problems.
6. Skill in presenting knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computer resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	**Theory** Concept, definition and object of aquaculture. Origin and historical evolution
2.	Aquaculture in the world: economic importance, main species and producing countries. Aquaculture in Spain
3.	Classification of aquaculture: aquaculture for food, organic extraction, storage and inorganic extraction. Main advantages and disadvantages. Main crops and auxiliary crops
4.	Main installations, methods and techniques used in the cultivation of fish, molluscs, crustaceans, echinoderms and algae
5.	Aquaculture with an ecosystem approach. Fundamentals and main techniques and systems of Integrated Multitrophic Aquaculture (AMTI). Future prospects
6.	**Practical** Visit to the Estación de Ciencias Marinas de Toralla (ECIMAT) for the observation and analysis of the main installations and techniques used in the cultivation of fish, different invertebrates and algae

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face expository classes for the development and explanation of the concepts of the theoretical framework Interactive face-to-face classes for the exposition and judgment of the student's autonomous work. Interactive face-to-face classes at ECIMAT (Vigo) for the development of practical teaching. Autonomous student work for the search for information, study and understanding of some of the concepts of the subject. Personalized tutorials to resolve student doubts and plan new objectives and challenges in the subject. They will deal with questions relating to any aspect of the matter. The virtual platforms and/or electronic mail will also be used as a tool for non-face-to-face tutoring. If it is possible, an expert will be able to offer a talk or conference on the subject.	N/A

GENERAL INFORMATION ABOUT THE COURSE N2

1.	The name of the course/module	**BIOLOGY OF FARMED AQUATIC ANIMALS**
2	Faculty/department	Faculty of Biology

3	Status of the educational component	Mandatory
4	Semester	1st
5	Number of ECTS credits	3
6	The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
7	General description and purpose of the educational component	Learning the external and internal morphology of the animals that are cultivated. Knowledge of their ways of life and behavior, in the soil of their juvenile and adult stages, as well as larvae. Comprehension of the functioning of the organs. Mastery of reproduction, embryonic, larval development and metamorphosis. Given that the success of any crop depends to a large extent on understanding the life cycles of the species and their ecology, emphasis will be placed on knowing the life cycles of the species and how your understanding is essential at the time to develop successful cultivation, whether experimental or industrial.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

Theory and slate. A single examination of theory with test-type questions will be carried out. The exams will be carried out in the calls and closes determined by current regulations. The exam will last for 1 hour. (80%)
Practices. In the same theory exam, questions like test of the student studied in the practices will be proposed. (10%). In addition to assistance, participation and use of practices will account for 10% of the qualification.
Final evaluation. Once passed the exams (theoretical and practical) the grade will be weighted according to the percentages.
Aspects and evaluation criteria:
The questions used in the evaluation will be designed to assess the degree of achievement of the competences.
The only written exam that will be held with both theory and practice questions will be the only test that will compute for the final evaluation.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Acquisition of analysis and prospecting skills on the current and future situation of aquaculture.
2. Use appropriate scientific terminology.
3. Knowledge of the biological and morphological cycle of farm animals
4. The students are able to integrate knowledge and face the complexity of formulating judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments
5. It will be ensured that students have the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous
6. Self-criticism; overcoming desire; you are interested in the quality

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Theory Introduction Concept and characteristics of cultivable species. Main groups of cultivable species
2	Molluscs • General features. Classification. cultivable molluscs. • Gastropods. External morphology. Lifestyle. Nervous system and sense organs. Locomotion. Food. Water circulation and gaseous exchange. Excretion. Internal transport. reproduction. Embryonic and larval development. Metamorphosis. Haliotis spp life cycle • Bivalves. External morphology. Lifestyle. Nervous system and sense organs. Locomotion. Food. Water circulation and gaseous exchange. Excretion. Internal transport. reproduction. Embryonic and larval development. Metamorphosis. Life cycles of the main cultivable species • Cultivable cephalopods. External morphology. Lifestyle. Nervous system and sense organs. Locomotion and buoyancy. Food. gas exchange. Excretion. Internal transport. reproduction. I develop it. Life cycles of the main cultivable species
3	CRUSTACEANS. • General features. Classification. Cultivable crustaceans. • Decapods. External morphology. Lifestyle. Nervous system and sense organs. Locomotion. Food. Water circulation and gaseous exchange. Excretion. Internal transport. Growth and molt. reproduction. Embryonic and larval development. Metamorphosis. Life cycles of the main cultivable species. • Other cultivable crustaceans (mysids, copepods, branchiopods
4	Fish • General features. Classification. Cultivable fish. External morphology. Lifestyle. Nervous system and sense organs. Locomotion. Food. Water circulation and gaseous exchange. Excretion. Internal transport • Growth. reproduction. Embryonic and larval development. Metamorphosis. Life cycles of the main cultivable species
5	Practical

	Molluscs: Study of the morphological differences between different cultivable or potentially cultivable species. Exhaustive study of comparative internal anatomy through dissection of bivalve and cephalopods.
6	Crustaceans. Study of morphological differences between different cultivable or potentially cultivable species. Study of internal anatomy
7	Study of morphological differences between different cultivable or potentially cultivable species. Meristic parameters used in the monitoring of growth in cultivation. Exhaustive study of comparative internal anatomy by dissection. Study of external morphology. Determination with clefs of different species

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical classes. Oral exposition of the material that comprises the nomination program. The teacher explains the theoretical foundations and the student learns, takes notes and raises doubts. The students will tend to their disposal on the virtual teaching platforms before starting the classes all the power point presentations that are used to develop the theme. Practical classes. They constitute a fundamental complement to the theoretical classes. They are developed in the laboratory where the objectives are presented, the follow-up of the practices is oriented and tutored. To make the most of these practices, the student will have the corresponding guide available with all the information possible where the planning of the theoretical foundation, the objective of the practice and the description of the work to be carried out are specified tutorials. They will deal with questions relating to any aspect of the matter. Virtual platforms and electronic mail will also be used as a tool for non-face-to-face tutoring. Practices: 1 day, at UVigo	N/A

GENERAL INFORMATION ABOUT THE COURSE N3		
1.	The name of the course/module	**BIOLOGY OF CULTURED ALGAE**
2	Faculty/department	Faculty of Biology
3	Status of the educational component	Mandatory
4	Semester	1st
5	Number of ECTS credits	3
6	The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
7	General description and purpose of the educational component	The student will be trained and instructed in basic knowledge about diversity, biology, reproduction, biological cycles and the ecology of cultivable algae, as well as their relationship with the environment and the main environmental factors related to nutrition, growth, survival and reproduction, with the aim of applying them to other assignments from the master. Necessary skills and aptitudes will be developed for their application in the cultivation of algae and the development of research in aquaculture, as well as for the design and control of installations
8	Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT
Written test: The acquisition of the main theoretical concepts will be evaluated through test questions, short questions, themes, etc. (50-70%). Test writing and collective participation in seminars (0-20%). Practical test: By asking questions about the laboratory practices included in the written test (10-30%). Continuous evaluation: The student's activity and participation in theoretical and practical classes, etc. will be continuously evaluated. (0-20%).

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. Use appropriate scientific terminology. 2. Find and query sources of information and databases; analyze and synthesize documents. 3. Knowledge of the biological cycle and physiological and morphological aspects of farmed animals and algae. 4. Developing and getting to know techniques for growing fish, molluscs, other invertebrates, algae and auxiliary crops

	5. To possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous. 6. Ability to work autonomously and make decisions. 7. Skill in the search, analysis and interpretation of sources of varied information and in different languages (mainly English).	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1	Introduction to the study of cultivable algae. Morphology, reproduction and biological cycles: monogenetic, digenetic and trigenetic. Biological types and morphofunctional groups	
2	Morphological, reproductive and physiological diversity of Cyanophyta: Spirulina, Anabaina	
3	Morphological, reproductive and physiological diversity of Rhodophyta: Porphyra, Chondrus, Gigartina, Gracilaria, Gelidium, Eucheuma, Furcellaria, Kappaphycus, Hypnea, Mastocarpus, Palmaria	
4	Morphological, reproductive and physiological diversity of Ochrophyta: Phaeophyceae and Bacillariophyceae: Cladosiphon, Laminaria, Macrocystis, Nereocystis, Lessonia, Durvillaea, Undaria, Fucus, Hizikia, Chaetoceros, Thalassiosira, Phaeodactylon, Skeletonema	
5	Morphological, reproductive and physiological diversity of Haptophyta, Cryptophyta. Dinophyta y Euglenophyta: Isochrysis, Monochrysis, Rhodomonas, Ceratium, Prorocentrum, Dinophysis, Gymnodinium, Alexandrium	
6	Morphological, reproductive and physiological diversity of Chlorophyta: Chlorella, Ulva, Monostroma, Caulerpa, Codium, Haematococcus, Tetraselmis, Chlamydomonas, Dunaliella, Scenedesmus	
7	Factors regulating the growth and reproduction of cultivated algae (light, temperature, salinity, pH, nutrients, hydrodynamics, tides, substrate	
8	Morphological and physiological adaptations, and biological interactions (light, temperature, salinity, hydrodynamics, competition, epiphytism, parasitism)	
9	Practical Study of morphology, reproduction and cycles of green algae and other groups	
10	Study of morphology, reproduction and cycles of brown algae	
11	Study of the morphology, reproduction and cycles of red algae	
12	Study of the morphology, reproduction and cycles of red algae	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)		Study methods (what types of educational activities should be performed by the student independently)
Face-to-face classes for exposition of the theory theme and for the development of the seminar/blackboard. Face-to-face classes in the laboratory to develop the subject of practices and acquire skills/skills in the manipulation of physical material. Autonomous student work for the study and understanding of the theory and practice concepts, as well as for the search for information and bibliography for the realization of the seminar. Personalized tutorials for resolving student doubts and planning new objectives and challenges in the subject Practices. 1 day (8 hours), at UDC		N/A

GENERAL INFORMATION ABOUT THE COURSE N4		
1.	The name of the course/module	**PHYSIOLOGY OF FARMED AQUATIC ANIMALS**
2	Faculty/department	Faculty of Biology
3	Status of the educational component	Mandatory
4	Semester	1st
5	Number of ECTS credits	6
6	The total number of hours	Contact hours: 48 Student's hours: 102 Total hours: 150
7	General description and purpose of the educational component	Knowledge of the basic principles of metabolism, growth and reproduction in the main groups of susceptible animals for use in aquaculture (fish, molluscs and crustaceans). Learning of the physiological mechanisms that the different animals put in motion in their environmental adaptation, in general and specifically, in the face of changes in physicochemical parameters of the medium. Monitoring and analysis of physiological parameters indicative of the degree of well-being of species in cultivation. Knowledge of the effect produced by cultivation and stabling conditions, on parameters indicative of animal well-being and their impact on exploitation.

		Knowledge of the rhythmic properties of the physiological parameters involved in vital processes (intake, reproduction, motor activity, etc.)
8	Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

Written exam on the theoretical content of the subject: 60% of the grade. A minimum score of 3 is required in the exam to overcome the subject
2. Seminar: preparation and presentation of a topic related to the subject: 20% of the grade
3. Accomplishment of the subject's practices: 20% of the grade (50% assistance and participation, 50% written memory of the same)

Approval is achieved in 5 points

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Appreciate the importance of debate and teamwork, interpersonal communication and responsibility.
2. Use appropriate scientific terminology.
3. Find and query sources of information and databases; analyze and synthesize documents.
4. Enhance the handling of foreign languages.
5. Control all the physiological, metabolic, immunological, environmental, food factors, etc. that affect the welfare of the species in cultivation, and implement the processes of reproduction, maintenance, production and pathology of key species and potential species in aquaculture.
6. Knowing the techniques used to assess the state of the immune system as well as the methodology used to determine the effects of diet, stress, immunostimulants and immunization on the immune system.
7. that students be able to communicate their conclusions (and the knowledge and ultimate reasons they sustain) to specialized and non-specialized audiences in a clear and unambiguous way
8. Ability to work as a team: cooperation, debate, negotiation
9. Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computer resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Ecophysiology: - Nature, levels and mechanisms of physiological adaptation to changes in environmental parameters - Effect of temperature on animals of interest in aquaculture: mechanisms and adaptations - Effect of salinity on animals of interest in aquaculture: mechanisms and adaptations Growth and energy: Professor Jesús Míguez - Characteristics and control of growth in molluscs, crustaceans and fish - Study methods and quantitative analysis of growth. energy balance - Breathing and metabolism. Factors that affect energy expenditure - Potential growth and net retention. Abiotic and biotic influences
2	Reproduction - Gametogenesis and germinal lines - Sex determination and sex change - Reproductive cycles and conditioning - Nervous and endocrine control of maturation and reproduction - Control of reproduction by environmental parameters
3	Animal welfare - Animal welfare: Concepts - The stress and its effect on the aquatic species in cultivation - Evaluation of animal welfare - Biological rhythmicity: influence on animal well-being and the cultivation of aquaculture species

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical classes. The teacher, after planning the work system and defining key concepts, will develop, with the participation of the students, each one of the themes in the order established in the program. Seminars. At the beginning of the course, students will be exposed to a set of possible works to be carried out by peers on a specific research topic related to one of the 4 blocks of the subject. The students will be distributed in such a way that there are no repetitions and there are no jobs in each of the four blocks of material. Practical classes. The students will carry out practices in the laboratory in groups and will prepare a memoir of them. Will be taught in Uvigo	N/A

GENERAL INFORMATION ABOUT THE COURSE N5		
1.	The name of the course/module	**GENETICS FOR AQUACULTURE**
2	Faculty/department	Faculty of Biology
3	Status of the educational component	Mandatory
4	Semester	1st
5	Number of ECTS credits	3
6	The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
7	General description and purpose of the educational component	Know the most common genetic diseases that have importance in species with interest in aquaculture. - Knowing the sex determination mechanisms in species of interest to aquaculture. - Have basic knowledge of genomics and proteomics and their application to improving production processes in aquaculture. - Analysis of the effect of quantitative characters on the improvement of aquaculture species. - Acquire basic knowledge for the analysis of genetic variability and its use in the management and conservation of aquatic resources. - Comprehension of the genetic effects of four evolutionary factors: mutation, migration, genetic drift and natural selection.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

The domain of the key concepts will be valued through a written test (exam). This aspect will account for 50% of the total evaluation.
- Resolution of problems and questions: The application of key concepts will be evaluated through the resolution of two problem bulletins. This aspect will account for 20% of the total evaluation.
- Laboratory practices: The teacher will value assistance and performance. This aspect will account for 15% of the total evaluation.
- Assistance and participation in class: Both aspects will be valued and different questionnaires will be included that students will send to the teacher for their evaluation. This aspect will account for 15% of the total evaluation.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Use appropriate scientific terminology.
2. Enhance the handling of foreign languages.
3. Apply critical, logical and creative thinking.
4. Acquire basic and applied knowledge of genetics, genomics and proteomics applied to aquaculture.
5. To are able to integrate knowledge and face the complexity of formulating interpretations and judgments based on less than incomplete information, including reflections on social and ethical responsibilities linked to the resolution of specific problems;
6. To possess the learning skills that allow them to continue studying in a way that will have to be largely self-directed or autonomous.
7. Skill in the search, analysis and interpretation of sources of varied information and in different languages.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Theory The inheritance of Mendelian characters and sex determination: chromosomes, loci and alleles. Inheritance patterns of qualitative characters. Inheritance of color in fish. Karyotypes in aquatic organisms. Mitochondrial inheritance in bivalves of interest in aquaculture. Genetic determination of sex in aquatic organisms
2	Genomics and chromosomal and gene manipulation: Gynogenesis and androgenesis. Induction of polyploidy in aquatic organisms. Introduction to genomics and proteomics. Nuclear transfer techniques
3	Study of genetic diseases: Diseases and genetic anomalies in aquatic organisms. Cancer and apoptosis in species of interest in aquaculture. Applications of gene transfer in obtaining disease-resistant organisms
4	The inheritance of quantitative characters: The nature of continuous variation. Genetic model for quantitative traits: the studies of Johannsen and de East. Partition of phenotypic variance: genetic and environmental components. Concept of heritability and estimation methods
5	Population genetics. Population concept. Population genetic diversity estimators. Hardy-Weinberg Equilibrium. Evolutionary agents. Types of mating. Consanguinity and kinship. Small populations. conservation genetics
6	Practical Solving questions and problems
7	DNA extraction, electrophoresis, enzymatic digestion and PC

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The development of the course contents is carried out with the help of a PowerPoint presentation together with transparencies, videos, animations, slate and any other material that helps and facilitates the understanding of the concepts that are addressed. Trouble bulletins: Students will solve bulletins of problems of increasing complexity related to the concepts of Mendelian, Quantitative and Population Genetics.	N/A

GENERAL INFORMATION ABOUT THE COURSE N6		
1.	The name of the course/module	**IMMUNOLOGY OF FARM AQUATIC ANIMALS**
2	Faculty/department	Faculty of Biology
3	Status of the educational component	Mandatory
4	Semester	1st
5	Number of ECTS credits	3
6	The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
7	General description and purpose of the educational component	Possess a broad theoretical knowledge of the components (organs, tissues, cells, genes and molecules) of the immune system of fish and marine invertebrates of interest in aquaculture. - Be able to locate and identify the organs and cells of the immune system. - Know the functioning of the immune system - Knowing the importance of food and immunostimulants in the function of the immune system and resistance to pathogens. - Knowing the techniques used to assess the state of the immune system as well as the methodology used to determine the effects of diet, stress, immunostimulants and immunization on the immune system. - To be able to elaborate an experimental design that allows to analyze the immune responses - Experimentally manipulate the immune system - Know and manage the main sources of information in Immunology
8	Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

The students must pass an exam in the theoretical part that will represent 70% of the final grade. The approval is at 5 out of 10.
- The assistance to the practical classes is necessary for overcoming the mismas. There will be an exam on the practical part that will represent 20% of the final grade.
- Attendance to the theoretical and practical classes will be valued, which will account for 10% of the final grade.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Use appropriate scientific terminology.
2. Find and query sources of information and databases; analyze and synthesize documents.
3. Enhance the handling of foreign languages.
4. Apply critical, logical and creative thinking
5. Control all the physiological, metabolic, immunological, environmental, food factors, etc. that affect the welfare of the species in cultivation, and implement the processes of reproduction, maintenance, production and pathology of key species and potential species in aquaculture.
6. Knowing the techniques used to assess the state of the immune system as well as the methodology used to determine the effects of diet, stress, immunostimulants and immunization on the immune system.
7. To possess and understand the knowledge that they bring to the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a research context;
8. To possess the learning skills that allow them to continue studying in a way that will have to be largely self-directed or autonomous
9. Ability to work autonomously and make decisions.
10. Skill in the search, analysis and interpretation of sources of varied information and in different languages

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Introduction to the immune system. • Generalities of the immune system.

	• Cellular and humoral components of the innate immune system • Cellular and humoral components of the acquired immune system
2	Vaccines • Monoclonal antibodies: potential uses • The immune system of fish • Lymphomyeloid organs in agnathous, chondrial and osteictian fish. General types and characteristics.
3	Innate immunity. Characteristics. Cellular components: monocytes/macrophages, granulocytes, natural cytotoxic cells, primed cells. Humoral components: complement, lysozyme and antimicrobial peptides, antiproteases, natural antibodies, lectins, cytokines. The inflammatory response in fish. 4.c. Acquired immunity. B and T lymphocytes. Immunoglobulins: structure and function. Immunoglobulin genes. T cell receptors. Cytokines. Antigen-presenting cells. The main histocompatibility system.
4	Ontogeny of the immune responses. Formation of lymphomyeloid organs. Development of innate and acquired immunity. Influence of temperature and photoperiod on the development and function of the immune system. Immunity against bacteria, viruses and parasites. Immunization. Inflammatory response. Immune tolerance.
5	The stress and the immune response. Effects of stress on immune function and disease resistance Nutrition and immune system. Effect of diet components (lipids, vitamins, micronutrients…) on immune response and resistance to pathogens Immunomodulation. Immunostimulants: types and mode of action. Immunostimulants and resistance to pathogens.
6	The immune system of molluscs and crustaceans Cellular components (hemocytes and hematopoiesis). Humoral components (lectins, bioactive peptides, complement.
7	Practical Macro and microscopic study of the cells, tissues and organs of the fish immune system.
8	Obtaining cells from the wheel's immune system. Cell count. Cell viability. Isolation of the different types of leukocytes. Measurement of various cellular activities
9	Determination of various activities in wheeled blood (complement, lysozyme, microbicidal activity)

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Group techniques, with the participation of the students in the elaboration of contents and exposition in class. - Laboratory practices (1 day, at USC-Campus Vida) - Personalized tutorials to help guide and solve student problems related to this subject.	N/A

GENERAL INFORMATION ABOUT THE COURSE N7		
1.	The name of the course/module	**PATHOLOGY IN AQUACULTURE**
2	Faculty/department	Faculty of Biology
3	Status of the educational component	Mandatory
4	Semester	1st
5	Number of ECTS credits	6
6	The total number of hours	Contact hours: 48 Student's hours: 102 Total hours: 150
7	General description and purpose of the educational component	Know the main infectious pathologies that can affect animal species cultivated in aquaculture (fish, molluscs and crustaceans), their etiology and epidemiology. • Identify the main clinical signs associated with each disease, the most commonly used methods for its diagnosis and the possible control measures. • Know the necropsy technique (complete, orderly and systematic) in specimens, differentiating postmortem alterations from lesions and sepa to take samples and write properly necropsy reports. • Acquire a basic knowledge of the main groups of lesions and of the morphological characters that serve for their identification and differentiation in fish, using their own terminology to describe and define the lesions. • Know which are the regulations for application in pathology.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT
Written exam (55%), consisting of test, short and/or development questions, which will cover the parts given by all the teachers, and which will be corrected by the corresponding teacher.

Realization of practices (20%), without discarding an examination of valuation of acquired activities and skills Conducting and defending seminars (25%); Among other aspects, the quality of the documentation used, the structure and clarity of the exhibition presented, the use and mastery of the multimedia tools and, when applicable, the ability to work in a group will be valued, among other aspects. the previous
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. Appreciate the importance of debate and teamwork, interpersonal communication and responsibility. 2. Find and query sources of information and databases; analyze and synthesize documents. 3. Enhance the handling of foreign languages. 4. Diagnose, prevent and control diseases 5. To be able to integrate knowledge and face the complexity of formulating interpretations and judgments based on incomplete information, including reflections on social and ethical responsibilities linked to the resolution of specific problems; 6. To possess the learning skills that allow them to continue studying in a way that will have to be largely self-directed or autonomous. 7. Ability to manage time and tasks, and work under pressure and in critical situations (flexibility, willingness to change, effort). 8. Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computer resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Basis of clinical recognition in fish. Importance of necropsis in the diagnosis of fish diseases. Description and macroscopic diagnosis of lesions in fish. Introduction to the systemic pathology of the main organs Presentation of practical cases
2	Bacterial diseases in aquaculture. Characteristics of the pathogens and symptomatology caused. Main diagnostic and control methods. Epidemiology of the most important bacterial pathologies. Legislation.
3	Viral diseases in aquaculture: Main diseases and emerging pathologies: etiological agents, clinical signs, diagnosis, epidemiology and control methods. Legislation
4	Practical classes Necropsy and rapid diagnostic techniques. Microscopic observation of the main organs and tissues of fish. More frequent injuries. Observation of practical cases

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and practical face-to-face classes. Work and resolution of practical cases. Personalized tutorials. Autonomous student work. Charlas Practices: 1 day on the Lugo campus	N/A

GENERAL INFORMATION ABOUT THE COURSE N8		
1.	The name of the course/module	**FEEDING AND NUTRITION**
2	Faculty/department	Faculty of Biology
3	Status of the educational component	Mandatory
4	Semester	1st
5	Number of ECTS credits	3
6	The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
7	General description and purpose of the educational component	The course provides knowledge of the basic principles of food and nutrition in the main groups of susceptible animals for use in aquaculture (fish, molluscs and crustaceans).
8	Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT
Written exam on the content of the subject: 65% of the grade. To be able to average, a minimum qualification of 3.0 is required. 2. Seminars: 35% of the final grade. It will be scored according to the following rubric: WRITTEN MEMORY: 60% - Presentation and organization of the memory (sections, tables/diagrams): 10% - Organization of the theme (structure, organization of contents). Focus and depth on physiological aspects: 35% - Writing: 10%

- Adequacy of the bibliography: 5% PRESENTATION-EXPOSITION: 40% - Adequacy to the exposition time and quality of the graphic presentation: 10% - Organization of the theme in the presentation: 10% - Expression, transmission capacity and mastery of the technical language: 10% - Answers to questions: 10%

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. To have the skills of debate and teamwork, interpersonal communication and responsibility.
2. Use appropriate scientific terminology.
3. Find and query sources of information and databases; analyze and synthesize documents.
4. Enhance the handling of foreign languages.
5. Control all the physiological, metabolic, immunological, environmental, food factors, etc. that affect the welfare of the species in cultivation, and implement the processes of reproduction, maintenance, production and pathology of key species and potential species in aquaculture.
6. Capacity to communicate their conclusions (and the knowledge and ultimate reasons they sustain) to specialized and non-specialized audiences in a clear and unambiguous way
7. Ability to work as a team: cooperation, debate, negotiation.
8. Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computer resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Food conduct. Diversity in the search for food in fish. Sensory systems involved. Factors influencing food acceptance. Stimulant identification methods.
2	Food conduct and intake control. Short, medium and long signals. Peripheral and central factors.
3	Feeding habits in molluscs and crustaceans. Organization and functional regionalization of the digestive tract. Digestive physiology.
4	Digestive anatomy and physiology in fish. Control of digestive processes
5	Nutrients and energy. Dietary needs of animals in cultivation. Quantification methods
6	Proteins and essential amino acids. Lipids and essential fatty acids. Lacking effects. Lipid oxidation: mechanisms, consequences and protection.
7	Carbohydrates: interests and limits of their contribution. Vitamins and Minerals.
8	Diets/pies. Ingredients: types and selection criteria. Basic considerations in formulating diets/foods. Formulation methods.
9	Practical Formulation problems

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical classes. The teacher, after planning the work system and defining key concepts, will develop, with the participation of the students, each one of the themes in the order established in the program Seminars. At the beginning of the course, students will be exposed to a set of possible works to be carried out by groups of 2-3 students on aspects of food/nutrition of specific species (salmón, rodaballo, dorada, langostino, etc). You must prepare a memoir (maximum 15 pages) and present a summary of this topic that will be discussed in the corresponding session Practical classes. Diet formulation problems Personalized tutorials for direct support to students.	N/A

GENERAL INFORMATION ABOUT THE COURSE N9

The name of the course/module	**DISEASE DIAGNOSTICS**
Faculty/department	Microbiology and parasitology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	6
The total number of hours	Contact hours: 48 Student's hours: 102 Total hours: 150

General description and purpose of the educational component	The purpose of course is related to the most basic diagnostic techniques, up-to-date and pointers in diagnosing bacterial, viral and parasitic diseases in aquaculture, techniques used in each case, and in function of specific situations and concrete cases. The students will be capable of interpreting the results of a diagnosis and making decisions in this regard.
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

Written examination of theory and practice (45-65%), consisting of test questions, cuts and/or development, which will cover the parts taught by all the teachers, and which will be corrected by the corresponding teacher.
Realization of practices (20-40%), without excluding an examination of the valuation of activities and acquired skills, or the development of a manual or a book of practices
Conducting and defending seminars (0.20%); Among other aspects, the quality of the documentation used, the structure and clarity of the exhibition presented, the use and mastery of the multimedia tools and, when applicable, the ability to work in a group will be valued, among other aspects.
Assistance and participation (0-15%): Use of charlas [Assistance and summary] and participation in other activities; the score of this section, of not being applicable, will be added to the previous one]

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Valuing the importance of multidisciplinary analyzes and the relationship between knowledge for the resolution of problems and for the analysis of critical points.
2. Enhance the handling of foreign languages
3. Apply critical, logical and creative thinking
4. Diagnose, prevent and control diseases
5. To be able able to integrate knowledge and face the complexity of formulating interpretations and judgments based on incomplete information, including reflections on social and ethical responsibilities linked to the resolution of specific problems
6. Ability to work as a team: cooperation, debate, negotiation.
7. Skill in the search, analysis and interpretation of sources of varied information and in different languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Theory Reliability parameters and validation of diagnostic techniques
2	First steps in bacteriological diagnosis
3	First steps in parasitological diagnosis
4	First steps in virological diagnosis
5	Histology and immunohistochemistry techniques
6	Serological techniques: Methods of obtaining and types of antiseuros (polyclonal / monoclonal); foundation and description of serological/immunological techniques (agglutination and hemagglutination, seroneutralization, immunomarker techniques
7	Molecular diagnostic and typing techniques: Nucleic acid hybridization; amplification techniques (PCR, qPCR, NASBA, LAMP). EFTs, RFLPs, HRM, sequencing/phylogeny
8	Present and future of diagnostics: DNA chips and arrays; arrays based on qPCR, ddPCR, NGS
9	Diagnostic techniques in molluscs: Signs and macroscopic indications. Optical microscopy techniques. Electronic microscopy techniques. Techniques based on detection of nucleic acids. Immunoassays. Techniques based on the incubation of fabrics/fluids in culture media. Use of these techniques in European and OIE legislation
10	Practical First steps in bacteriological diagnosis: Taking samples for bacteriological analysis. Bacteriological diagnosis with and without isolation of the pathogen. Identification of bacterial pathogens: classical methods and multi-trial methods. Automated identification systems.
11	First steps in the parasitological diagnosis First steps in virological diagnosis: processing samples for virology; preparation, maintenance and subculture of cell cultures; Inoculation of cell cultures and viral isolation. Preparation of samples for electron microscopy.
12	Histology and immunohistochemistry techniques
13	Serological techniques: Titration of antiseuros. Agglutination and serotyping of bacteria; ELISA and other immunomarker techniques. serum neutralization Molecular diagnostic techniques: HAN, PCR/RT-PCR, Analysis of qPCR and ddPCR results Diagnostic techniques in molluscs

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and practical face-to-face classes. Work and resolution of practical cases. Personalized tutorials. Autonomous student work.	N/A

GENERAL INFORMATION ABOUT THE COURSE N10	
The name of the course/module	**DEVELOPMENT OF TOOLS FOR PREVENTION AND CONTROL**
Faculty/department	Faculty Biology Department Microbiology and Parasitology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	Aims and Objectives It is intended that the student will be able to: - To know and apply the tools of formulation, design and preparation of new vaccines and immunization strategies. - To know, develop and apply prevention and control strategies. - Know current regulations regarding products used in the treatment of diseases in aquaculture, treatment and disposal of waste.
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

Theoretical exam [Theoretical exam (40-60% of final grade) Description: multiple-choice exam, although the option of a question to be developed is retained].
Description: Attendance (0-20); continuous assessment (0-20) and notebook presentation (0-20).
Attendance and participation (0-15%) Use of the talks [Attendance and summary] and participation in other activities; the score in this section, if not applicable, will be added to the previous one].

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General competences:

1. Evaluate the importance of multidisciplinary analysis and the relationship between knowledge to solve problems and to analyze critical points.
2. Search and consult information sources and databases; analyze and synthesize documents.
3. Promote the use of foreign languages.
4. To apply critical, logical and creative thinking.
5. Specific competences.
   Diagnosis, prevention and control of diseases.
6. Basic skills.
   To know how to apply the acquired knowledge and their capacity to solve problems in new or unknown environments within broader (or multidisciplinary) contexts related to their area of study
7. To be able to integrate knowledge and face the complexity of formulating interpretations and judgments from information that is often incomplete, include reflections on social and ethical responsibilities linked to the resolution of specific problems.
8. Cross-cutting competencies
   Dexterity in the search, analysis and interpretation of diverse sources of information in different languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	9. Prevention of infectious diseases. General measures. Vaccination: basic concepts. Types of vaccines and routes of administration. Interactive effects of antigens. Vaccination strategies.
2	10. Development of bacterial vaccines. Design of traditional vaccines: criteria for the selection of antigens. Methods of production and inactivation of vaccines. Limitations in the production of vaccines according to the traditional model. New strategies in the development of bacterial vaccines and immunization protocols
3	11. Development of viral vaccines. Production of attenuated and inactivated viral vaccines. Limitations in the production of vaccines according to the traditional model. New generation vaccines and immunization protocols
4	12. Law on medicinal products. Regulations for the control of the quality and sterility of vaccines for aquaculture. Regulations for the evaluation of the efficacy and safety of vaccines for aquaculture. Sanitary registers. Patents and Legislation

5	13. Sanitary and Hygiene Control. General hygiene measures. Disinfection. Physical and chemical treatments. Criteria for the choice of disinfection methods. Search and evaluation of disinfectant substances. Regulations on waste treatment and disposal
6	14. Biological methods for the control of infectious diseases. Phagotherapy and enzibiotics. Probiotics. Synthetic siderophores conjugated with antibiotics and interception of quorum sensing
7	15. Control of non-infectious diseases in aquaculture. Control of infectious diseases. Criteria for the selection of antimicrobial agents and methods of application. Responsible use of pharmaceuticals in aquaculture
8	16. Law on medicinal products. Legislation on therapeutics and maximum residue limit
9	17. Practical 18. In vitro evaluation of the efficacy of antimicrobial agents and disinfectants
10	19. Evaluation of the efficacy and safety of vaccines: "in vivo" trials and analysis and interpretation of the results
11	20. Determination of critical control points in aquarium systems and determination of microbiological parameters
12	21. Search for information on patents, treatments, vaccines and legislation

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical classes: They will have an approximate duration of 50 minutes. The exhibition method will be used, supported by multimedia presentations (power point, videos and connections to interesting web resources). At the beginning of the course, the student will receive a script of each of the topics with the recommended bibliography. Personalized tutorials for the direct support to the students. Seminars: these are complementary to the theoretical classes, and are intended to contribute to consolidating the knowledge acquired in the theoretical classes. Practices: 1 day at USC, Campus Vida Plant visit (subject to availability of funding)	N/A

GENERAL INFORMATION ABOUT THE COURSE N11	
The name of the course/module	**TOOLS FOR EPIDEMIOLOGICAL ANALYSIS**
Faculty/department	Faculty Biology Department Microbiology and Parasitology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	The course aim design, optimize, evaluate, validate and apply new diagnostic strategies, and compare them with the pre-existing and official ones. Students need to know, develop and apply molecular epidemiology tools, establish deductive models on the origin and evolution of pathologies
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT
Theory exam (15-35% of the final grade): test-type exam, although the option of some questions to be developed is maintained Exercise resolution (55-75%) Presentation of works (5-25%) Assistance and participation (0-15)

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
General skills: 1. Valuing the importance of multidisciplinary analyzes and the relationship between knowledge for the resolution of problems and for the analysis of critical points 2. Find and query sources of information and databases; analyze and synthesize documents. 3. Enhance the handling of foreign languages 4. Apply critical, logical and creative thinking

Specific skills 5. Diagnose, prevent and control illnesses Basic skills: 6. The students apply the acquired knowledge and their ability to solve problems in new or little known environments within broader contexts (or multidisciplinary) related to their study area 7. The students are able to integrate knowledge and face the complexity of formulating interpretations and judgments based on incomplete information, including reflections on social and ethical responsibilities linked to the resolution of specific problems Transversal Skills: 8. Skill in the search, analysis and interpretation of sources of varied information and in different languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Theory Introduction to epidemiology-Causality
2	Elements of qualitative epidemiology
3	Probability and Bayes theorem
4	Diagnosis: validation parameters and diagnosis quality
5	Mostraxe: characteristics of the exhibitions and design of the showcase
6	Design of epidemiological studies
7	Collection of information through surveys
8	Analysis of epidemiological data
9	Practical Resolution of exercises in qualitative epidemiology
10	Resolution of diagnostic techniques validation exercises
11	Resolution of sample exercises and design of epidemiological studies

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and slate face-to-face classes. Development of commissioned works. Personalized tutorials. Autonomous student work.	N/A

GENERAL INFORMATION ABOUT THE COURSE N12	
The name of the course/module	**WATER QUALITY AND MANAGEMENT**
Faculty/department	Faculty Biology Department Agroforestry Engineering
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	Mastery of water quality analysis procedures. Knowledge of coastal processes (currents, oil, wind, transport of contaminants and sediment) and their influence on aquaculture. Comprehension of the operating principles of the hydraulic installations used in aquaculture. Dominion of the calculation tools for the design of the aquaculture installations. Technical competence to design an installation. Carrying out design and calculation practices for installations
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT
There will be a personalized follow-up of each student, counting attendance and participation (15-35%), completed with an objective test-type test (65-85% of the material) For cases of fraudulent performance of exercises or tests will be applied to the Regulations for the evaluation of the academic performance of students and for the review of qualifications.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
General skills: 1. Valuing the importance of multidisciplinary analyzes and the relationship between knowledge for the resolution of problems and for the analysis of critical points

2. Use appropriate scientific terminology. 3. Apply critical, logical and creative thinking Specific skills: 4. Understanding the importance of water quality and supervision 5. Acquire knowledge about technical characteristics and the design of installations for cultivation 6. Organize production ensuring its viability Basic skills: 7. To possess the learning skills that allow them to continue studying in a way that will have to be largely self-directed or autonomous Transversal Skills 8. Ability to manage time and tasks, and work under pressure and in critical situations (flexibility, willingness to change, effort) 9. Creativity, initiative and entrepreneurial spirit

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Theory Quality indicators
2	Filtration: fundamentals. Classification of filtration systems. Mechanical filtration
3	Biofiltration: nitrification, denitrification
4	Air/oxygenation
5	Monitoring and control
6	Disinfection: basic concepts. Disinfection Methods
7	Facilities and Engineering in Aquaculture
8	Types of Installations or Cultivation Systems.
9	Closed production units and marine cages
10	Sizing of installations
11	Water supply and distribution
12	Practice Theme
13	Calculation of water distribution networks and pumping systems

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The teaching development of the subject is structured around face-to-face classes where the theoretical foundations of the subject are explained and the criteria are established so that the student develops the basic concepts through lectures and work. In these classes, interaction between teachers and students will be sought. The interactive teaching is intended to focus on the application of theoretical concepts. Practical cases of sizing hydraulic installations will be developed in practices. A technical visit will be made to an aquatic production or water treatment facility. Personalized tutorials will be held for direct support to the student.	N/A

GENERAL INFORMATION ABOUT THE COURSE N12

The name of the course/module	**WATER QUALITY AND MANAGEMENT**
Faculty/department	Faculty Biology Department Agroforestry Engineering
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	Mastery of water quality analysis procedures. Knowledge of coastal processes (currents, oil, wind, transport of contaminants and sediment) and their influence on aquaculture. Comprehension of the operating principles of the hydraulic installations used in aquaculture. Dominion of the calculation tools for the design of the aquaculture installations. Technical competence to design an installation. Carrying out design and calculation practices for installations

Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

There will be a personalized follow-up of each student, counting attendance and participation (15-35%), completed with an objective test-type test (65-85% of the material)
For cases of fraudulent performance of exercises or tests will be applied to the Regulations for the evaluation of the academic performance of students and for the review of qualifications.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
1. Valuing the importance of multidisciplinary analyzes and the relationship between knowledge for the resolution of problems and for the analysis of critical points
2. Use appropriate scientific terminology.
3. Apply critical, logical and creative thinking

Specific skills:
4. Understanding the importance of water quality and supervision
5. Acquire knowledge about technical characteristics and the design of installations for cultivation
6. Organize production ensuring its viability

Basic skills:
7. To possess the learning skills that allow them to continue studying in a way that will have to be largely self-directed or autonomous

Transversal Skills
8. Ability to manage time and tasks, and work under pressure and in critical situations (flexibility, willingness to change, effort)
9. Creativity, initiative and entrepreneurial spirit

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Theory Quality indicators
2	Filtration: fundamentals. Classification of filtration systems. Mechanical filtration
3	Air/oxygenation. Biofiltration: nitrification, denitrification
4	Monitoring and control
5	Disinfection: basic concepts. Disinfection Methods
6	Facilities and Engineering in Aquaculture
7	Types of Installations or Cultivation Systems
8	Technical components of an aquaculture plant
9	Closed production units and marine cages
10	Sizing of installations
11	Water supply and distribution
12	Practice Theme Calculation of water distribution networks and pumping systems

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The teaching development of the subject is structured around face-to-face classes where the theoretical foundations of the subject are explained and the criteria are established so that the student develops the basic concepts through lectures and work. In these classes, interaction between teachers and students will be sought. The interactive teaching is intended to focus on the application of theoretical concepts. Practical cases of sizing hydraulic installations will be developed in practices. A technical visit will be made to an aquatic production or water treatment facility. Personalized tutorials will be held for direct support to the student. 1 day of practices at the UDC	N/A

GENERAL INFORMATION ABOUT THE COURSE N13

The name of the course/module	**TOXICOLOGY AND TOXIC TIDES**
Faculty/department	Faculty Biology

Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	The course provides comprehension of the complex process that supposes the tides or toxic episodes, knowledge of the different types of biotoxins, their toxicity and detection systems, prediction and mitigation systems for harmful episodes.
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

Mixed exam of test questions and short questions
Practical cases, elaboration, presentation and discussion
Aspects and evaluation criteria:
Exam (40-60%);
Practices (assistance, benefit; 15-35%);
Conducting and defending seminars (5-25%); Assistance and participation (0-20%)

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
1. Acquire analysis and prospecting capacity on the current and future situation of aquaculture.
2. Appreciate the importance of debate and teamwork, interpersonal communication and responsibility.
3. Enhance the handling of foreign languages.

Specific skills
4. Identify relevant research objectives and plan their achievement.

Basic skills
5. • CB01 - the students pose and understand the knowledge that provides the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a research context
6. • CB04- that students communicate their conclusions (and the knowledge and ultimate reasons they sustain) to specialized and non-specialized audiences in a clear and unambiguous way

Transversal competences
7. Capacity to work as a team: cooperation, debate, negotiation.
8. Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computer resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Theory Harmful episodes: Definitions, types, consequences, species, groups of compounds and processes involved.
2	Effects of phytoplanktonic blooms on cultivated organisms
3	The toxins: structure, chemical properties and associated toxic syndromes
4	Analytical methodologies for the detection and quantification of toxins and evaluation of their toxicity
5	Regulation of the main groups of toxins: Bases and current levels
6	Phytoplankton proliferation and toxin production
7	Accumulation of toxins in bivalves: processes and models. Proliferation control systems.
8	Methods for mitigating the consequences of the episodes
9	Quantification of the toxicity of contaminating compounds
10	Practical Phytoplankton dentification and quantification. Application of analytical methodologies for the identification and quantification of toxins present in phytoplankton samples and cultured organisms
11	Modeling of the accumulation of toxins

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and practical face-to-face classes. Development of commissioned work and face-to-face defense. Personalized tutorials. I work autonomously. Conferences. company visits. Practical classes: 1 day at UVi and 1 day at CIMA Corón	N/A

GENERAL INFORMATION ABOUT THE COURSE N14

The name of the course/module	**AQUACULTURE FARM MANAGEMENT**
Faculty/department	

	Faculty Biology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	Identify the international, community, state and autonomous regulations relating to the organization and management of aquaculture. Know the public and private organizations that intervene in the field of aquaculture. Knowing how to interpret legal techniques and management procedures in aquaculture. Deepen in the specialization of the responsible and technicians of the aquaculture explorations, in particular in the fields of national and international commercialization, in the fiscality and in the financing. The aim is to train students in the selection criteria for placements, introduction of preventive and corrective measures and in the environmental management of the fish farms.
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

Written exam (test questions, short questions and/or problems) of the program contents (65-85% of the grade). Seminar: preparation and presentation of a topic related to the subject (15-35%)

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:

1. Acquire analysis and prospecting capacity on the current and future situation of aquaculture.
2. Use appropriate scientific terminology.
3. Find and query sources of information and databases; analyze and synthesize documents

Specific skills

4. Prevent the potential environmental impact of aquaculture.
5. Organize production ensuring its viability.
6. Identify and apply international, state and community regulations applied to aquaculture.

Basic skills

7. The students pose and understand the knowledge that provides the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a research context
8. That students apply the acquired knowledge and their ability to solve problems in new or little known environments within broader contexts (or multidisciplinary) related to their study area

Transversal competences

9. Skill in the search, analysis and interpretation of sources of varied information and in different languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Theory Aquaculture and Development. Levels of technical development.
2	Production structure. Economy of the aquaculture company
3	Commercialization, prices and markets. Trasability and Marketing
4	Innovation.
5	Policies concerning aquaculture in the EU, Spain and the CCAA. Aquaculture and the legal system..
6	The competitive system of aquaculture in Spain. Integral ordination of the coast and marine crops
7	**Control and promotion measures for activities related to aquaculture. Qualifying titles for the ordination and exploitation of aquaculture**
8	**Environmental protection and aquaculture. General aspects of environmental management**
9	**Environmental aspects of aquaculture**
10	Available and emerging techniques for environmental improvement. Territorial planning for aquaculture: spatial occupation and potential; Conflicts with other uses. Sustainable aquaculture.
11	Regulations for the environmental management of aquaculture
12	Seminar Questions on aquaculture authorizations and concessions Application of the integrated management model on aquaculture
13	Environmental audit procedures Techniques for selecting locations

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Initial activities: brief review of the knowledge of analysis and theory to familiarize the student with the language and methodology of the program. Master session: presentation and explanation by the teacher of the topics included in the program with ICT support. Assignments: carrying out brief research assignments on topics related to the program. Personalized tutorials for direct support to the student	N/A

GENERAL INFORMATION ABOUT THE COURSE N15	
The name of the course/module	**QUALITY, PROCESSING AND TRACEABILITY**
Faculty/department	Faculty Biology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	This multidisciplinary assignment has the objective of knowing the parameters that determine the quality of the aquaculture product and the tools that can ensure it. Likewise, it intends to know new processes and technologies that allow improving the quality of the aquaculture product in its chain of production, transformation and consumption, as well as estimating the demands of the consumer on the quality of the aquaculture product. It is also intended to know the different aspects that affect the quality of the products obtained in the aquaculture processes, both from different types of animal organisms and from marine macroalgae. Aspects ranging from its composition and organoleptic and nutritional properties to evolution over time and methods of conservation or extraction of its active principles are treated, passing through themes both of food safety and the types of controls (microbiological and critical points) that must be carried out and its methodology for doing so. On the other hand, it is about knowing the fundamentals of molecular traceability, and the methodology for the development of integral systems of the same, knowing how to design this type of systems for any aquaculture product and applying them in the study of practical cases.
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT
General considerations: At least one written test will be carried out with short questions and/or test questions on aspects of both expository teaching and the implementation of practical classes. The expansion of the material will also be proposed through readings, consultations and searches in an individual format or in a small group, with a daily exposition and a brief description of the process followed. Likewise, a continuous evaluation will be carried out on the assistance and participation in the different activities of the subject. Aspects and evaluation criteria: Theoretical exam (40-60% of the final grade). Description: test-type exam, although the option of a brief development question is maintained. Practical exam (10-30% of the final grade). Descripción: exam type test or short questions contained in the theoretical test. Evaluation continues. Assistance and participation (0-20%). Seminars (10-30% of the final grade). Description: Valuation of the documentation used, the actuality of the theme and the sources, the presentation and the defense

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
General skills: 1. Use appropriate scientific terminology. 2. Enhance the handling of foreign languages Specific skills: 3. Carry out quality and traceability controls. 4. Acquire basic and applied knowledge of genetics, genomics and proteomics applied to aquaculture. Basic skills:

5. That the students apply the acquired knowledge and their ability to solve problems in new or little known environments within broader contexts (or multidisciplinary) related to their study area Transversal competences 6. Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computer resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Theory Chemical composition of the aquatic species and alteration pathways during processing. Food quality and safety in aquaculture products: Methods and molecular biomarkers of quality and freshness
2	Application of advanced technologies for the conservation of aquaculture products: natural antioxidants and antimicrobials, high pressures and liquid ice. Current legislation on food traceability in the EU.
3	Current status of research, industry and market regarding the availability of fishery and aquaculture products. Molecular foundations and methods available for the calibration of genetic traceability systems. DNA barcodes
4	Elements of authenticity contrastable with molecular tools: limitations and trends. Integrated traceability systems: smart labels and new containers
5	General applications of marine macroalgae. The phycocoloides of algae. Types and applications. Processing of the main cultivated species for the extraction of alginic acid, agar and carrageenans
6	The marine macroalgae cultivated as a source of biomass for agricultural use or for human nutrition and health. Macroalgae as a source of energy. Biorefineries based on algal biomass
7	Practical Determination of the quality of aquaculture products through the application of sensorial and chemical methods. Algae phycocoloides properties: Alginates, agar and carrageenans. Melting point and gelation in agar. Gel hardness. Direct and reverse spherification techniques. Sensory analysis of food marine macroalgae
8	Application of PCR-based techniques for the molecular identification of fishery and aquaculture products: adaptation of available techniques to each biological situation and commercial product. Diagnostic power and limitations of techniques

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and interactive face-to-face classes: The face-to-face credits that correspond to the theory classes will take place through interuniversity videoconferencing. The face-to-face credits of laboratory practices were developed in the laboratories corresponding to the theme and teacher of the assignment, following a manipulative-oriented class system, consistent in exposition of objectives and means, experimental development by the student with continuous feed-back and final interpretation of results in debate format. The laboratory practices strengthen the conceptual approach and are programmed for a day at each of the three universities. Development of commissioned work and face-to-face defense. Autonomous student work. The interactive credits (resolution of exercises, expansion of material, related readings, work for the assignment, preparation of exams, etc.), will be previously programmed with the teacher to guide the autonomous work in face-to-face. Group and individual tutorials will be real or virtual. Practices: 1 day at UDC	N/A

GENERAL INFORMATION ABOUT THE COURSE N16	
The name of the course/module	**CULTURE OF MICROALGUE AND ZOOPLANKTON**
Faculty/department	Faculty Biology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	The objective of the course is basic learning of microalgae cultivation techniques in the laboratory and in the cultivation plant. Cultivation and management of live food in Aquaculture. Use of different analytical techniques, both for the studio growth of crops, as

	for the determination of their biochemical composition. Introduction to the production of microalgae for different biotechnological applications
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

General considerations:
Aspects and evaluation criteria:
The final grade will be the proportional sum of the different evaluable sections that are detailed below.
Test writing; this test will represent 70% of the overall grade for the subject, and it is also essential to have it approved in order to include the other valuable aspects in the final grade.
Evaluation of practical work through the results of practices; this section of the evaluation will correspond to 30% of the overall grade of the subject. Of this percentage, 20% corresponds to the practical case of planning production in the plant and 10% to the sheet of results of laboratory practices.
The students who, due to labor incompatibility, cannot carry out the practices established in the program and carry out an alternative activity, cannot achieve the maximum valuation in this section.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
1. Appreciate the importance of debate and teamwork, interpersonal communication and responsibility.
2. Enhance the handling of foreign languages.

Specific skills
3. Develop and learn techniques for growing fish, molluscs, other invertebrates, algae and auxiliary crops.
4. Organize production ensuring its viability.

Basic skills
5. The students apply the acquired knowledge and their ability to solve problems in new or little known environments within broader contexts (or multidisciplinary) related to their study area.
6. Transversal Skills
7. Ability to manage time and tasks, and work under pressure and in critical situations (flexibility, willingness to change, effort)

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Theory General information on the cultivation of photoautotrophic microorganisms and cultivable species. Isolation and maintenance of strains
2	Factors that influence growth: physical parameters of cultivation, nutrients and cultivation media.
3	Biomass cultivation and collection systems. Biotechnological applications
4	Zooplankton cultivation. Generalities of live food: Importance and purpose
5	Cultivation of rotifers: life cycle, cultivation, feeding and enrichment
6	Artemia cultivation: life cycle, decapsulation and hatching of cysts, cultivation, feeding and enrichment. Cultivation of copepods
7	Practical Water sterilization and preparation of culture medium. Biomass Determinations
8	Manipulation of crops and count of rotifers. Decapsulation and hatching of Artemia cysts
9	Planning of production in plant. Valuation of experiment

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Assistance to the practical classes both in the laboratory and in the production of plant is mandatory and an essential requirement to approve the assignment. master classes Seminars in which aspects of the planning of microalgae production systems in plants and experimental research designs in microalgae and zooplankton cultivation will be analyzed. In addition to the personalized tutorials for resolving specific questions from the students, there will be a face-to-face tutorial, which is not obligatory, for carrying out the planning exercises for production in the plant. Laboratory practices (at USC, 1 day) and at the IGAFA crop plant (1 day). Each group will deliver a report on the results obtained in laboratory practice. Assistance to practices is obligatory.	N/A

GENERAL INFORMATION ABOUT THE COURSE N17

The name of the course/module	**CULTURE OF SEAWEEDS**
Faculty/department	

	Faculty Biology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	The course objective is comprehension of the importance of the cultivation of primary producers such as marine macroalgae in the context of world aquaculture. Recognition of the idiosyncrasy of marine macroalgae and the main aspects that differentiate their cultivation techniques from those of other organisms. Knowledge of the different types of phytoculture, its foundations, advantages and disadvantages and main applications. Descriptive of the cultivation techniques employed in the most important species worldwide. Developing the capacity to design projects for the cultivation of these organisms. Knowledge related to the main aspects that could negatively affect the viability of these crops and the future trends of this activity.
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

The knowledge and skills acquired by the student will be taken into account, through written tests and continuous evaluation.
Aspects and evaluation criteria:

Written test: A written test will be carried out to evaluate the acquisition by the student of the main theoretical and practical concepts (70-90% of the qualification in the subject).
Evaluation continues: [The assistance, activity and participation will be valued both in the expository teaching and in the rest of the interactive activities that are planned (10-30% of the qualification in the subject)

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:

1. Acquire the capacity for analysis and prospecting on the current and future situation of aquaculture.
2. Use appropriate scientific terminology.
3. Enhance the handling of foreign languages.

Specific skills:

4. Knowledge of the biological cycle and physiological and morphological aspects of farmed animals and algae.
5. Develop and learn techniques for growing fish, molluscs, other invertebrates, algae and auxiliary crops.

Basic skills:

6. That the students apply the acquired knowledge and their ability to solve problems in new or little known environments within broader contexts (or multidisciplinary) related to their study area.

Transversal skills:

7. Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computer resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Theory Industrial cultivation of marine macroalgae: History, world importance and evolution of different techniques. Sustaining, extensive and intensive phytoculture.
2	Plant (indoor) and sea (outdoor) and mixed sea-plant cultivation techniques
3	Main techniques for cultivating alginophytes. Cultivation of Laminariales.
4	Main techniques for growing agarophytes. Cultivation of Gracilaria and Gelidium.
5	Main techniques for carrageenan cultivation. Cultivation of Eucheuma-Kappaphycus and Chondrus
6	Main techniques for cultivating food algae. Cultivation of Pyropia spp. Other crops
7	Applications of marine macroalgae cultivation in integrated multitrophic aquaculture techniques and in environmental bioremediation. Future prospects for marine macroalgae cultivation
8	Importance and measurement techniques of the different parameters that influence the development of macroalgae in cultivation. Estimates of growth rates.
9	Selection of carrageenan inoculums. Observation of structures and/or stages of reproduction of laminarial algae.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face classes for exposition of the subject of theory and interactive teaching. Face-to-face classes in the laboratory for the development of practical teaching. Autonomous student work for the studio and understanding of the theory and practice concepts. Personalized tutorials to resolve student doubts and plan new objectives and challenges in the subject. Practices: 1 day in the macroalgae cultivation laboratory of the Center for Advanced Scientific Research (CICA) of the UDC.	N/A

GENERAL INFORMATION ABOUT THE COURSE N18	
The name of the course/module	**CULTURE OF BIVALVE MOLLUSCS**
Faculty/department	Faculty Biology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	6
The total number of hours	Contact hours: 48 Student's hours: 102 Total hours: 150
General description and purpose of the educational component	Goals of the course is to provide the knowledge of traditional systems and current technology applied to cultivation at all stages of the process. Skills for the development of its cultivation and the management of a semilla production and pre-fat farm. Ability to evaluate the strengths and weaknesses of this socio-economic sector. Acquisition of the practical skills necessary to direct and develop this production process. Ability to understand and evaluate the advances of biotechnology and its possible use for the benefit of aquaculture in clams. Comprehension of the aquaculture-environment system relationship
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

Exam test (65-85%);
Assistance and participation in theoretical classes (0-20%);
assistance and use in practices (0-15%);
Conducting and defending seminars (0-20%)

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
1. Acquire analysis and prospecting capacity on the current and future situation of aquaculture.
2. Finding the necessary sources of information and databases; consult them and analyze and synthesize documents.

Specific skills
3. Develop and learn techniques for growing fish, molluscs, other invertebrates, algae, auxiliaries and production
4. Control all the physiological, metabolic, immunological, environmental, food factors, ... that affect the welfare of the species in cultivation, and implement the processes of reproduction, production, maintenance and pathology of key species and potential species in aquaculture.
5. Organize production ensuring its viability.

Basic skills
6. It will be guaranteed that the students possess and understand the knowledge that provides the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a research context
7. Students will be guaranteed to communicate their conclusions (and the knowledge and ultimate reasons they sustain) to specialized and non-specialized audiences in a clear and unambiguous way

Transversal competences
8. Skill in the search, analysis and interpretation of sources of varied information and in different languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Theory Biology and Ecophysiology of the crop species
2	The conditioning of the players: Introduction. Installation required. Parameters to be controlled. Feeding and calculation of ratios

3	Induction to the puesta in oviparous bivalve: Spawning in dioecious bivalve and spawning in monoecious bivalve. Fertilization procedures
4	Incubation: Types of tanks. Water quality. Limitation of airing. Embryo culture: incubation time, embryo density, salinity. Recovery of D-veliger larvae
5	Larval culture: Types of tanks. Cultivation densities. Airflow and filters. Cleaning of tanks and material. Water treatment. Types of cultivation: static, or open (continuous circulation). Cultivation tasks: water changes, density variation. Crop variable control states. Contajes. Larvae measurement. Observation of different fractions. Increased efficiency. Aspects of diet and ratios. Factors that affect fixation and metamorphosis
6	Metamorphosis. Signs that announce fixing. Stimuli for fixing: thermal shocks, neurotransmitters. Suitable substrates for fixing. Fixing methods: oysters; scallops; craves and mussels. remote capture
7	Post-Larvary Cultivation: Upflow and Downflow Cultivation Systems. Closed and partially or totally open circulation systems. Classification and estimation of the seed. Diets and food ratios. growth and survival
8	Cultivation in semillero: Obtention of semilla from the natural medium. Cultivation in intertidal parks. Cultivation in batch. FLUPSY systems (floating systems with ascending flow)
9	Practical Induction to puesta by different methods, egg count and fertilization Practice 6.-
10	Management of players Control of the conditioning circuit. Larva count
11	Control and monitoring of an oyster larval culture tank
12	Preengagement in Nursery. Systems and techniques for preengagement and engorde in the natural medium
13	Auxiliary cultivation and larval cultivation
14	Management of crop parks

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and practical face-to-face classes. Development of commissioned work and face-to-face defense. Personalized tutorials for direct support to students. Autonomous student work. Conferences. company visits The classes will be taught at the IGAFA (Illa de Arousa; 2 days), the CIMA de Ribadeo (1 day) and the facilities of the Cofradía de Noia (1 day)	N/A

GENERAL INFORMATION ABOUT THE COURSE N19

The name of the course/module	**CULTURE OF FISH**
Faculty/department	Faculty Biology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	6
The total number of hours	Contact hours: 48 Student's hours: 102 Total hours: 150
General description and purpose of the educational component	Acquire basic knowledge for the cultivation of marine and freshwater fish species. The student to be able to a) Know the cultivation techniques of different species of fish b) Have a vision of the different stages of fish cultivation. c) Knowing the minimum needs of cultivation d) Be able to approach all and each of the phases of cultivation e) Value and interpret the parameters that influence the reproduction f) Improvement of production
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

Exam test (65-85%);
Assistance and participation in theoretical classes (0-20%);
Assistance and use in practices (0-5%);
Conducting and defending seminars (0-20%)

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:

1. Finding the necessary sources of information and databases; consult them and analyze and synthesize documents

Specific skills 2. Develop and learn techniques for growing fish, molluscs, other invertebrates, algae, auxiliaries and production 3. Control all the physiological, metabolic, immunological, environmental, food factors, that affect the welfare of the species in cultivation, and implement the processes of reproduction, production, maintenance and pathology of key species and potential species in aquaculture. 4. Organize production ensuring its viability. Basic skills. 5. It will be guaranteed that the students possess and understand the knowledge that provides the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a research context 6. Students will be guaranteed to communicate their conclusions (and the knowledge and ultimate reasons they sustain) to specialized and non-specialized audiences in a clear and unambiguous way Transversal competences. 7. Skill in the search, analysis and interpretation of sources of varied information and in different languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Theory Exhibition Classes. Fish farming systems
2	Species selection criteria for aquaculture. Employment selection criteria.
3	Installations of the different phases of fish cultivation. Food in the cultivation of fish. Cultivation controls in the different stages of production.
4	Production management.
5	Biological bases of the most interesting species (classification, biological cycle, habitats, behavior, anatomy, food.)
6	Breeding: selection and storage of breeders; manipulation, production of ovules and gametes, fertilization and development.
7	Larval culture systems. Preengorde and engorde
8	Practical Recognition and preparation of food used in fish farming
9	Control of the physico-chemical parameters that affect fish cultures
10	Conducting samples and classifying fish
11	Breeder management. Practical study of flat fish cultivation phases. Larval culture and auxiliary cultures.
12	Growth of larvae and juveniles. Auxiliary crops. Growth Shows
13	Control of the conditioning of sea bream breeders
14	Follow-up of larval cultivation of lubina, bream and sea bream
15	Feeding and sampling of populations of lubina and besugo

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and practical face-to-face classes. Development of commissioned work and face-to-face defense. Personalized tutorials for direct support to students. Autonomous student work. Conferences. Company visits. Depending on presupposed and organizational availability, conferences or talks (evaluable) on topics of interest to the subject will be organized. The classes will be taught at the facilities of the IEO (Canido, Vigo; 4 days) and the IGAFA (Illa de Arousa; 1 day)	N/A

GENERAL INFORMATION ABOUT THE COURSE N20	
The name of the course/module	**CULTURE OF OTHER INVERTEBRATES**
Faculty/department	Faculty Biology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 21 Student's hours: 51 Total hours: 72
General description and purpose of the educational component	Th e main objective of discipline is acquisition of technical skills for the cultivation of crustaceans; knowledge of strengths and weaknesses in experimental cultivation with a great future such as cephalopod cultivation;

	knowledge of the current status and prospects for the future of possible new invertebrate cultures
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

Exam test (65-85%); Assistance and participation in theoretical classes (0-20%); assistance and use in practices (0-15%); Conducting and defending seminars (0-20%)

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:

1. Acquire analysis and prospecting capacity on the current and future situation of aquaculture
2. Finding the necessary sources of information and databases; consult them and analyze and synthesize documents.

Specific skills

3. Develop and learn techniques for growing fish, molluscs, other invertebrates, algae, auxiliaries and production
4. Control all the physiological, metabolic, immunological, environmental, food factors, that affect the welfare of the species in cultivation, and implement the processes of reproduction, production, maintenance and pathology of key species and potential species in aquaculture
5. Organize production ensuring its viability

Basic skills

6. It will be guaranteed that the students possess and understand the knowledge that provides the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a research context
7. Students will be guaranteed to communicate their conclusions (and the knowledge and ultimate reasons they sustain) to specialized and non-specialized audiences in a clear and unambiguous way

Transversal competences

8. Skill in the search, analysis and interpretation of sources of varied information and in different languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Theory Biology of cephalopods. Cephalopod cultures in the world. Pulpo (Octopus vulgaris): Capture and transport. Conditioning of reproducers. Obtention of puestas in incubation. Larval cultivation
2	Pulpo (Octopus vulgaris): Fattening process in tanks and floating cages. Marker experiences (paralarvae and subadults).
3	Biology and cultivation of crustaceans
4	Biology and cultivation of gastropods
5	Practical Observation of preparations of Octopus vulgaris: number of suckers, burbuja, chromatophores
6	Freshly hatched brine shrimp, brine shrimp A1 and brine shrimp A4
7	Zooplankton. puesta pulpo
8	Control of the embryonic development of the pulp Octopus vulgaris · Identify stages of embryonic development. Estimate days to hatch. · Count number of huevos per group. Estimate fertility
9	Octopus vulgaris paralarva culture tank Collection of paralarvae on a clear day in a puesta tank Volumetric estimation of the number of paralarvae (5 counts in 50 mL) Assembly of tank from 100 L to 10 paralarvae L-1
10	Artemia content. Preparation of the artemia doses (50,000 artemias in 4 doses) Cultivation of curstaceans. Cultivation of gastropods

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and practical face-to-face classes. Development of commissioned work and face-to-face defense. Personalized tutorials for direct support to students. Autonomous student work. Conferences. Company visits. The classes will be taught at the IGAFA (Island of Arousa; 1 day), the ECIMAT (Island of Toralla; 1 day) and the IEO (Canido, Vigo; 1 day)	N/A

GENERAL INFORMATION ABOUT THE COURSE N21

The name of the course/module	**GENETIC IMPROVEMENT**
Faculty/department	Faculty Biology Department of Zoology, Genetics and Physical Anthropology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	Provide an introduction to the techniques. Estimation of the genetic parameters of populations. Genetic evaluation of breeders based on phenotypes and genomic information. Artificial selection. Genetic improvement plan design
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

Exam (70%); practices (assistance, benefit; 20%); Assistance and participation (10%)

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:

1. Valuing the importance of multidisciplinary analyzes and the relationship between knowledge for the resolution of problems and analysis of critical points
2. Use appropriate scientific terminology
3. Enhance the handling of foreign languages

Specific skills:

4. Identify relevant research objectives and plan their achievement
5. Acquire basic and applied knowledge of genetics and genomics applied to aquaculture

Basic skills:

6. Know how to apply the knowledge acquired and your ability to solve problems in new or little known environments within broader contexts (or multidisciplinary) related to your study area.

Transversal competences:

7. Ability to work autonomously and make decisions
8. Skill in the search, analysis and interpretation of sources of varied information and in different languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Theory Introduction to Genetic Improvement and Quantitative Genetics. Decomposition of the phenotypic value. Reproductive value.
2	Estimation of heritability and response to selection
3	Genetic evaluation based on phenotypes
4	Combination of different sources of information: selection indexes and BLUP. Multicharacter selection
5	Genetic evaluation based on genotypes and genomic selection
6	Structure and design of a genetic improvement plan
7	Practical Computer simulation of the processes of genetic evaluation of breeders and artificial selection.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
-Theoretical face-to-face classes and seminars. Multimedia presentation and planning of problem seminars / practical cases as support for the conceptual development of the program. - In-person practical classes: Computer simulation of the processes of genetic evaluation and artificial selection. The practices will be taught at USC, Campus Vida (1 day). -Personalised tutorials: Solving doubts and supporting the achievement of popular objectives in the subscription.	N/A

GENERAL INFORMATION ABOUT THE COURSE N22

The name of the course/module	**MANAGEMENT OF GENETIC RESOURCES**
Faculty/department	Faculty Biology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	Transmit to the student basic concepts on population genetics and its application in aquaculture. For example, the study of the importance of poblational genetic variability for evolution through natural and artificial selection, the impact that the variations in the effective size of population have on this process, as well as the preponderance of consanguineous crosses or the mix of individuals from different stocks, etc. Ultimately, the study of the different mechanisms responsible for evolutionary change at a population level, as well as their interaction, constitute fundamental information when designing artificial selection programs aimed at the genetic improvement of characters of productive interest.
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT

The basic evaluation criteria will consist of the demonstration of a critical understanding of the fundamental concepts, their expositive clarity and application.
The main evaluation instrument will consist of a written exam (value 70%). Written works on particular themes will also be evaluated, as well as competences and skills shown during the practical classes (value 30%).

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
1. Contribute to increasing knowledge by planting and developing research and cultivation projects
2. Enhance the handling of foreign languages.

Specific skills
3. Identify relevant research objectives and plan their achievement
4. Acquire basic and applied knowledge of genetics, genomics and proteomics applied to aquaculture

Basic skills
5. Know how to apply the acquired knowledge and your ability to solve problems in new or little known environments within broader contexts (or multidisciplinary) related to your study area
6. Know how to communicate your conclusions (and the knowledge and ultimate reasons they sustain) to specialized and non-specialized audiences in a clear and unambiguous way

Transversal skills
7. Skill in the search, analysis and interpretation of sources of varied information and in different languages (mainly English)
8. Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computer resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Theory Quantification of population of genetic variability
2	Natural selection models and their implications for aquaculture
3	Consanguinity and consanguineous depression
4	Genetic drift. Botella cuellos and founding effect in aquaculture
5	Population subdivision and identification of stocks
6	Conservation of genetic resources in aquaculture
7	Practical Analysis of population genetic structure from data derived from codominant genetic markers.
8	Analysis of population genetic structure from nucleotide sequence data.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Master classes using computer resources for the layout and graphic illustration of the contents corresponding to each topic. Use of specific computer programs for the population genetic analysis of data on variation in nucleotide sequences, allozyme loci and microsatellites.	N/A

Access to public databases of interest in population genetics and molecular ecology. Theoretical and practical face-to-face classes. Development of commissioned work and face-to-face defense. Personalized tutorials for direct support to students. Autonomous student work. Practices: at USC, Campus Vida (1 day) and at UVigo (1 day)	

GENERAL INFORMATION ABOUT THE COURSE N23	
The name of the course/module	**STRUCTURAL AND FUNCTIOAL GENOMICS**
Faculty/department	Faculty Biology Department Zoology, Genetics and Physical Anthropology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	Acquire knowledge about basic principles of genomics, and their application for the sustainable genetic improvement of aquaculture species. Acquire knowledge on techniques. Structural and Functional genomic analysis. Bioinformatic analysis of genomic data.
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT
Exam (60%); participation of practical activities (15%); realization of seminars (15%); attendance and participation (10%).

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
General competences: 1. Importance of multidisciplinary analysis and relation between knowledge to solve problems and analyze critical points 2. Use of proper scientific terminology 3. Promote the use of foreign languages Specific competences: 4. Identifying significant research aims and planning strategies to reach goals 5. Acquire basic and applied knowledge in genetics, genomics and proteomics in aquaculture Basic competences: 6. Warranting students to be able to apply acquired knowledge and problem-solving within pioneering, multidisciplinary contexts, related to the field of study Transversal competences: 7. Capacity for autonomous work and decision making 8. Ability for searching, analyzing and interpreting different information sources in distinct languages (preferably English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Structure and organization of genomes. Genomic analysis. Size and organization of genomes. Fragmentation and separation of genomic sequences. Isolation of chromosomes. In situ hybridization. Genomic libraries. Vectors. Strategies of genomic sequencing. Modifications of Sanger method. NGS (next generation sequencing). Revision in aquaculture
2	Genetic maps and comparative mapping. Linkage and recombination. Segregating populations and genetic markers. Genetic cartography, High-resolution linkage mapping. Comparative mapping and evolutionary genomics. Identification of QTL (quantitative trait loci). Integration of genetic and physical maps. Fine mapping. Positional cloning. Genome mining. Targeted sequencing. Genome Mining. Detection of candidate genes. Genome wide association analysis (GWAS). Revision and applications in aquaculture
3	Functional genomics. Microarray. RNAseq. Regulatory regions. Epigenomics: 3D structure of DNA, DNA methylation, histone modification, access to DNA. Metagenomics. Genomic edition. Single-cell genomic technologies. Identification of candidate genes and pathways related to biological processes of productive and evolutionary interest. Applications in aquaculture.
4	Practical classes

	Genomic analysis: Platform for sequencing and functional genomics: equipment and technologies. Sampling, RNA extraction: amount and quality, library preparation for sequencing. Discussion on practical cases in aquaculture species to study the functional genetic basis of productive trait
5	Bioinformatics: Management, annotation of genomic sequences. In silico characterization and genotyping of microsatellite and SNP markers. Genetic and comparative mapping. Genome mining. Analysis of differential expression starting from RNAseq data. Practical cases in aquaculture species

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes and seminars. Multimedia presentations and proposal of exercises/case studies to support the conceptual development of the program. -Practical activities. Laboratory (equipment and processes for functional and structural genomic analysis), bioinformatics (analysis and management of genomic and transcriptomic sequences, genetic and comparative mapping, genome mining, differential gene expression analysis from RNAseq data). Practical classes will be held in USC-Campus Terra, Lugo. -Tutorial support for solving doubts and support to achieve the proposed aims of the course.	N/A

GENERAL INFORMATION ABOUT THE COURSE N24	
The name of the course/module	**BIOTECHNOLOGICAL APPLICATIONS IN AQUACULTURE**
Faculty/department	Faculty Biology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	6
The total number of hours	Contact hours: 48 Student's hours: 102 Total hours: 150
General description and purpose of the educational component	The course is acquire knowledge of different biotechnological techniques and processes applicable to different aspects of aquaculture production. Deepen the methodology for genetic and chromosomal manipulation of fish, molluscs and other marine organisms. Knowing the characteristics and applications of organisms subjected to genetic or chromosomal manipulation. Acquire knowledge about the manipulation of microalgae for different biotechnological purposes. Acquire knowledge about the basic principles of functional genomic analysis (transcriptomics and proteomics: analysis of gene function through transcribed genes and encoded proteins, respectively).
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT
Written sheet on the aspects treated in theory classes (75%). Assistance, development and use of practices (25%). The student who does not carry out the written test will be considered as IN THE PRESENT.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
General skills: 1. Enhance the handling of foreign languages 2. Apply critical, logical and creative thinking Specific skills: 3. Control all the physiological, metabolic, immunological, environmental, and food factors that affect the well-being of the species in cultivation, and implement the processes of reproduction, maintenance, production and pathology of key species and potential species in aquaculture 4. Acquire basic and applied knowledge of genetics, genomics and proteomics applied to aquaculture Basic skills: 5. The students pose and understand the knowledge that provides the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a research context 6. That students apply the acquired knowledge and their ability to solve problems in new or little known environments within broader contexts (or multidisciplinary) related to their field of study Transversal skills:

7. Skill in the search, analysis and interpretation of sources of varied information and in different languages (mainly English) 8. Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computer resources	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Theory Induced polyploidy.
2	Ginogenesis and androgenesis 1
3	Production and use of transgenic animals
4	Trasgenic pieces
5	Microalgae production
6	Production of secondary metabolites from microalgae
7	Genetic modifications in microalgaes
8	Introduction to proteómics
9	Practical Techniques for the creation of genetically modified organisms
10	Techniques for the identification of polyploids and gynogenetics/androgenetics
11	Analysis and determination of secondary metabolites of microalgal origin
12	Identification of proteins using proteomics techniques

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and practical face-to-face classes. Work development. Personalized tutorials. Autonomous student work Practices: 1 day at UDC and 1 day at UVi	N/A

GENERAL INFORMATION ABOUT THE COURSE N25	
The name of the course/module	**EXPERIMENTAL DESIGN AND DATA ANALYSIS**
Faculty/department	Faculty Biology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	Objective is to develop and use remarkable probability distribution models. Knowing how to handle computer and mathematical tools. Know and understand some of the most notable techniques of statistics.
Prerequisites for studying the course/module, connection with other educational components	N/A
ASSESSMENT	
Continuous evaluation [40-60% of the overall grade consists of having an account of assistance to the theoretical and practical classes (20-40% of the overall grade) as well as the results of brief knowledge evaluation questionnaires (10-30%)] Final assessment. 40-60% of the global grade. At the end of the quarter, a brief questionnaire will be carried out to evaluate the global knowledge (40-60% of the overall grade)	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT	
General skills: 1. Enhance the handling of foreign languages 2. Apply critical, logical and creative thinking 3. Ability to work individually in experimental design, demonstrating autonomy in laboratory work Specific skills: 4. Identify relevant research objectives and plan their achievement. Basic skills: 5. The students pose and understand the knowledge that provides the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a research context	

6. The students should communicate their conclusions (and the knowledge and ultimate reasons they sustain) to specialized and non-specialized audiences in a clear and unambiguous way Transverse competences: 7. Ability to work autonomously and make decisions 8. Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity, use of computer resources.	

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Design of experiments: types of variability, design of an experiment, classic experimental designs
2	Analysis of variance: model, estimation of parameters, analysis of differences, diagnosis of the model
3	Analysis of time series: stationary ARMA processes, non-stationary ARIMA processes, identification and estimation of models, diagnosis of models
4	Regression and correlation; multiple linear regression
5	Multivariate analysis: principal components, discriminant analysis, cluster analysis, discriminant analysis, ROC curves
6	Practical Design of experiments: analysis of a design case with a fixed factor, analysis of a design case in completely randomized blocks
7	Analysis of variance: model specification, parameter estimation, simplification contrasts, diagnosis and validation
8	Analysis of time series: analysis of a case, initial identification of the structure, estimation of parameters and diagnostic contrast
9	Regression and correlation; multiple linear regression
10	Multivariate analysis: principal components, cluster
11	Multivariate analysis: discriminant analysis, ROC curves

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The teacher will explain in class and by videoconference the basic theory of assignment. Several examples will illustrate the application of the theoretical results. The laboratory classes will be a complement to the theoretical classes. It will work with problem bulletins and with specific software for the topics covered. tutorials: The use of virtual tutorials will be promoted through some tele-teaching platform. Material: The course material will be made available to students on the website through some tele-teaching platform	N/A

GENERAL INFORMATION ABOUT THE COURSE N26	
The name of the course/module	**PHYLOGENETICAL ANALYSIS**
Faculty/department	Faculty Biology
Status of the educational component	Elective
Semester	2nd
Number of ECTS credits	3
The total number of hours	Contact hours: 24 Student's hours: 51 Total hours: 75
General description and purpose of the educational component	Within the course students are expected to learn how to design a phylogenetic study for the resolution of a practical case, selecting the most suitable algorithms for their types of data. It is sought that students learn to extrapolate the techniques of phylogenetic classification applied in a zoological context to other scientific and social situations. Understanding and knowing how to define fundamental concepts of phylogenetics. Manage bioinformatics tools for phylogenetic analysis. Properly interpret the meaning of a phylogenetic tree. Discern between advantages and disadvantages of phylogenetic methods. Implement the a priori construction of trees to contrast biological hypotheses.
Prerequisites for studying the course/module, connection with other educational components	N/A

ASSESSMENT
Participation: Participatory assistance in physical and virtual presence, motivation, initiative, and fulfillment of formalities Registration of teacher assistance; registration of use of the platform, interaction in the group 10-30%

Realization, resolution and defense of the daily exercises on the concepts of the day. Online platform and defense in class 30-50%
Applied project: Implementation, resolution and defense of the applied case Presentation and defense in Seminar 30-50%
Total 100

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
1. Appreciate the importance of debate and teamwork, interpersonal communication and responsibility
2. Valuing the importance of multidisciplinary analyzes and the relationship between knowledge for the resolution of problems and for the analysis of critical points
3. Find and query sources of information and databases; analyze and synthesize documents
4. Enhance the handling of foreign languages
5. Apply critical, logical and creative thinking

Specific skills:

6. Identify relevant research objectives and plan their achievement

Basic skills:

7. The students possess and understand the knowledge that they bring to the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a research context
8. The students apply the acquired knowledge and their ability to solve problems in new or less familiar environments within broader contexts (or multidisciplinary) related to their study area
9. The students should communicate their conclusions (and the knowledge and ultimate reasons they sustain) to specialized and non-specialized audiences in a clear and unambiguous way

Transversal Skills

10. Ability to manage time and tasks, and work under pressure and in critical situations (flexibility, willingness to change, effort)
11. Capacity to work as a team: cooperation, debate, negotiation.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Theory Introduction to phylogenetics. Rooting of phylogenetic trees. Monophyly and polyphyly. Characters and states. Orthology and paralogy. Cladism and phenetics. General applications of phylogeny. Alignment of sequences. Substitution, insertion and deletion. Pair alignment. Multiple alignment. Alignment programs. alignment filter
2	Molecular evolution models. Saturation. Change probability. Nucleotide substitution models. Selection of models. Phylogenetic searches. Characters vs. distances. Algorithms and optimality. Landscapes of trees. Exact and approximate searches. Topological exchanges. Consensus trees.
3	Maximum parsimony. parsimony criterion. Reconstruction of ancestral states. Attraction of the wide branches. Methods of distances. Patristic distances Additivity and ultrametricity. Fitch-Margoliash Criterion. Minimal evolution. Corrected distances. algorithmic methods
4	Maximum likelihood. Concept of verisimilitude. Calculation of verisimilitude in trees. Reconstruction of ancestral states. parsimony vs. likelihood. Bayesian Inference. Prior and posterior probabilities. Bayes theorem. Bayes versus likelihood. Monte Carlo Markov Chains (MCMC). Show and convergence MCMC
5	Phylogenetic contrasts. Phylogenetic error. Bootstrap. Comparison of topologies. Molecular clock tests. Applications
6	Practical Alignment, sequence editing, and molecular evolution models
7	Maximum parsimony and distance methods
8	Maximum verisimilitude and Bayesian analysis
9	Evaluation of applied cases

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The teacher presents the program of the session with its objectives for the day. The concepts to be employed are introduced masterfully. The tool needed to solve the applied cases is analyzed. The session ends with the focus on the daily exercises, the instructions for using the software and the consultation works. Daily exercises connected with the conceptual class are implemented, for the apprehension of the material. Team work. The students will use ICTs and specific software, in order to be able to elaborate a complete practical case through collaborative learning. The Tema platform will be used for the majority of processes: repository, chat, debate, questions, links, exercises and self-evaluation	N/A

UNIVERSITY OF ABERDEEN

1	Criterion A: University profile	
1.1	**Name of the University**	**UNIVERSITY OF ABERDEEN**
1.2	Classical or applied	Classical
2	Criterion B: Profile of the educational program (Curriculum)	
2.1	Number of Aquaculture disciplines	1
2.2	The name of the educational program	Applied Marine and Fisheries Ecology
2.3	Type of diploma	MSc
2.4	Total number of credits (ECTS)	120
3	Criterion C: Setting the educational program (Curriculum)	
3.1	Duration of the program	2 or 4 semesters
3.2	The purpose of the educational program	Run in collaboration with staff at Marine Scotland Science, this MSc programme will provide with an appreciation of the key issues that are central to the management of marine resources, practical skills and field work experience that students can apply to real world situations and opportunities to expand their professional network. Taught by renowned researchers and leading practitioners students will gain valuable insights into marine ecosystems in Scotland and internationally. Students will learn to analyse and interpret marine data sets, understand relevant policy, write professional reports and apply their knowledge and skills to the challenging task of managing marine resources. Studying at world class facilities, students will have the opportunity to undertake field research in marine ecology at the Lighthouse Field Station, Cromarty. There are also opportunities to carry out research in partnership with professional agencies such as Marine Scotland Science (MSS), Scottish Natural Heritage (SNH) and the Joint Nature Conservation Committee (JNCC). This MSc is aimed at individuals with a relevant undergraduate degree who wish to gain specialist knowledge and technical skills. The programme will benefit individuals looking to progress to PhD level and those already working in marine sciences who are keen to upgrade their knowledge and skills.
4	Criterion D: Characteristics of the educational program (Curriculum)	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	
5	Criterion E: Teaching and assessment	
5.1	Teaching and learning methods	Our programme combines traditional lectures and practicals with a range of learning formats. Student debates and group working are an integral part of the programme, enhancing communication and team working skills. You will have opportunities to engage with staff from Marine Scotland, SNH and JNCC, as well as professionals from non-governmental organisations (NGOs) and the private sector representing environmental consulting firms and fishing interests. Activities are designed to develop generic professional skills such as how to write your CV, team working, time management, writing reports, participating in meetings and giving presentations. Aberdeen is well situated for providing students with learning opportunities* outside the classroom, including: • Outdoor field work at the University's field station and research sites • Tours of marine industry facilities, including aquaculture farms and fish markets • Access to laboratories that monitor water quality, fish health and fisheries • Tours of Marine Scotland's fleet of research vessels • Safety at sea certification *please note that some of these opportunities may incur an additional cost and are subject to availability. The research project is the ultimate learning experience, drawing together the knowledge and skills you have acquired to address a specific research question under the supervision of experts in the

		field. Projects can be field-based, laboratory-based or desk-based according to individual learning objectives. Learning methods will involve field trips, field work, group projects, individual projects, lab work, lectures, research	
5.2	Assessment	The degree programme is assessed using a diverse range of formats including written reports, oral presentations, practical write-ups, group reports, management plans, literature reviews, project plans and the research project report. Academics provide detailed, individual feedback	
6	**Criterion F: Software competencies**		
6.1	Integral competence	Not defined	
6.2	General competences	Not defined	
6.3	Professional competences	Not defined	
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	1. Students will develop quantitative skills such as statistical analysis and geographical information systems, making them more attractive to prospective employers. 2. Students will gain essential research skills including project planning, literature reviewing, data analysis and interpretation which will be beneficial to their future career. 3. Students will have the opportunity to engage with Marine Scotland staff, go on tours of their fleet of research vessels and collaborate with them for research projects. A number of our graduates have gone on to work for Marine Scotland after completing their degree.	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	• Guest lectures from NGOs, the fishing industry, government agencies and staff from Marine Scotland Science. Courses are delivered by internationally renowned academics, government scientists, teaching fellows and marine resource managers.	
8.2	Material and technical support	Lighthouse field station; Sir Duncan Rice Library; Zoology museum etc are under the disposal of students.	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Population ecology	7.5	2 summative project reports (60%), oral presentation (40%)
9.1.2	Experimental design and analysis	7.5	summative project reports
9.1.3	Marine and fisheries ecology, conservation and management	7.5	Summative (practical work 60%), online test (15%), Group oral presentation (25%)
9.1.4	Molecular ecological techniques	7.5	Poster presentation (55%), computer assessment (45%)
9.1.5	Applications of GIS	7.5	Formative assessment
9.1.6	Fisheries science	7.5	2 Lab reports
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Ecology, conservation and society	7.5	Seminar participation (10%), Performance leading a discussion (20%), Critical essays (70%)
9.2.2	Marine spatial management	7.5	Poster (20%), Group report (40%), Individual report (40%)
9.2.3	Environmental impact assessment	7.5	A group presentation or report on selected aspects of an EIA case study
9.2.4	Sustainable aquaculture	7.5	Seminar (20%), Poster presentation (50%), Essay (30%)
9.2.5	Marine conservation management	7.5	Participation in Stakeholder workshop (20%), Blogs (30%), Written response to marine conservation consultation document (50%)

10	Criterion L: Form of attestation	
10.1	Independent research project that can cover any area of applied marine and fisheries ecology, and which may be field, computer or laboratory based; Provides a thorough training in managing all aspects of a research project from inception to delivery of a thesis in the format of a manuscript for an international scientific journal or a consultancy report; Projects can be based anywhere in the world and are often associated with current cutting-edge research by academic staff; Collaboration with external organisations is encouraged to enable students to gain a greater range of experience and contacts.	Research project in Applied Marine and Fisheries Ecology (30 ECTS)

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Population ecology
2.	Faculty/department	The School of Biological Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1
5.	Number of ECTS credits	7.5
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	This course will explore current understandings of processes operating in populations of organisms, through a combination of theoretical and empirical studies.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
7.		It will start by developing an understanding of the dynamics of simple non-spatial and discrete-generation populations. This will include concepts related to density and environment dependence and will consider cyclic and chaotic population dynamics. The course will then progress by introducing different forms of realism and complexity. Stage and sex-structured population dynamics will be considered. The role of spatial structure with local populations linked by the movement of individuals will be addressed. Finally, we will also introduce some trophic interactions, including predator prey, parasite host and plant herbivores as well as species embedded in more complex set of trophic interactions, including apparent competition. Throughout the course, we will focus on relatively simple discrete time models and students will be taught how to develop these using R and to use them to explore and describe emergent behaviours. We will also introduce a state-of-the-art population modelling software (called RangeShifter), recently developed at Aberdeen, and the students will be provided the opportunity to use this software to simulate how species are likely to change their biogeographic distributions under climate and/or land use change.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures and computer practical exercise.	N/A

GENERAL INFORMATION ABOUT THE COURSE #2		
1.	The name of the course/module	Experimental design and analysis
2.	Faculty/department	The School of Biological Sciences

3.	Status of the educational component	Mandatory
4.	Semester	1
5.	Number of ECTS credits	7.5
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	This course is uniquely tailored for biologists and will provide students with the required background theory and practical skills relevant to modern ecology and biology. Our example-led lectures and real-world based practicals will provide you with a foundation to become confident and proficient in analysing real data. Throughout this course, we will introduce you to using the programming language R to implement modern statistical modelling techniques. You will use the flexible linear and generalised linear modelling frameworks to analyse biological data with emphasis on robust and reproducible statistical methods.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Week 1: You are introduced to concepts of sampling, statistical inference, uncertainty and using R and RStudio for reproducible research and data analysis. Week 2: You will learn about the process of analysing biological data and are introduced to data exploration and visualisation in R using real-world data examples. Data and instructions for your final assessment will be released to you this week. Week 3: During this week you will learn about the theory and practice of fitting simple linear models in R. You will also learn how to validate and interpret linear models. Towards the end of the week you will complete your first in-class course assessment (20% of final course mark). Week 4: You will learn how to extend the linear modelling framework and apply it to more complex models and data. You will also learn how to compare different plausible models and select the most informative model. You will undertake your second in-class assessment (20% of final course mark) Week 5: During this week, you will learn how to extend the linear modelling framework to fit generalised linear models (GLMs) to analyse different types of data. Specifically, this week you will learn how to model discrete count data with a Poisson GLM. Week 6: In this week you will further extend the generalised linear modelling framework to fit models to binary (0/1) data with a binomial GLM. You will also submit your final assessment which will be a structured written report based on your analysis and interpretation of a pre-existing dataset released to you in week 2 (60% of final course mark).

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures and computer practical exercise	N/A

GENERAL INFORMATION ABOUT THE COURSE #3

1.	The name of the course/module	Marine and fisheries ecology, conservation and management
2.	Faculty/department	The School of Biological Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1
5.	Number of ECTS credits	7.5
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	Using the North Sea as a case study this course provides essential knowledge about the marine environment and food webs. Linkages between the population biology of commercial fish species in the North Sea and the policies used to define sustainable harvesting will be highlighted to illustrate the ecological principles that underpin the management of marine resources. Policies relevant to conservation of the North Sea ecosystem and the policy instruments available will be reviewed. The role that

		different stakeholders play in management of marine ecosystems will be reviewed. In groups, students have the opportunity to apply their understanding to a marine ecosystem in another part of the world, to characterise its properties and to evaluate the state of development of ecosystem-based management. The course will be delivered by marine ecologists, industry consultants and government scientists working in applied marine management. The course does not require a detailed knowledge of marine ecology and ecosystems. Students already having a background in biology will benefit from the material on policy and management.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		

The intended learning outcomes are that on successful completion of the course you should be able to:

- identify the main physical processes and chemical properties of marine environments relevant to biological productivity and biodiversity
- describe the structure and function of a temperate shelf-sea marine ecosystem
- explain critical aspects of fish population dynamics and the effects of climate change on them
- outline the main international and regional conventions that drive policy relating to management of marine ecosystems in the northeast Atlantic
- define the roles of key organisations involved in marine ecosystem management in European waters
- understand how marine science is used to support management

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures and seminars, field course and practicals	N/A

GENERAL INFORMATION ABOUT THE COURSE #4

1.	The name of the course/module	Molecular ecological techniques
2.	Faculty/department	The School of Biological Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1
5.	Number of ECTS credits	7.5
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	By the end of the course students will be equipped with the knowledge and experience of a range of techniques currently used in molecular ecology, and appreciate emerging topics that will dictate how the field develops. The course will also provide direct experience of data analysis, interpretation and presentation.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- to glean and evaluate information from molecular genetics publication
- to gain experience with techniques used in molecular ecology and to critically reflect on their application
- to demonstrate a critical and informed understanding of a relevant piece of molecular research and to apply that understanding to an ecological context
- to understand biochemical basis of inheritance, how this generates genetic variation, how certain evolutionary processes affect variation in the natural environment

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	The central dogma of molecular biology. Molecular markers and PCR. Microevolutionary processes and the Hardy-Weinberg paradigm. Molecular markers in 1) population genetics; 2) phylogenetics; 3) relatedness and parentage Genomics and transcriptomics. Epigenetics.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, computer practical, laboratory work	N/A

GENERAL INFORMATION ABOUT THE COURSE #5		
1.	The name of the course/module	Applications of GIS
2.	Faculty/department	The School of Biological Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2
5.	Number of ECTS credits	7.5
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	This course aims to give you an introduction to Geographic Information Systems (GIS) and its applications, using the ArcGIS suite of programs (specifically, ArcCatalog, ArcMap, ArcToolbox).
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- use ArcGIS software to address a range of ecological and environmental research questions
- to create and export maps of a standard suitable for publication
- to analyse spatial data to address a research question, to interpret the results and present a report that includes a critique and evaluation.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Topics covered in the course will include: fundamentals of geographical information systems (GIS), data collection using GPS, importing and editing spatial data, spatial analyses, map design, creating and exporting maps.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Computer practical; Lecture; Support tutorial	N/A

GENERAL INFORMATION ABOUT THE COURSE #6		
1.	The name of the course/module	Fisheries science
2.	Faculty/department	The School of Biological Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2
5.	Number of ECTS credits	7.5
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	The course, which includes a significant contribution from Marine Scotland Science staff of the Marine Laboratory Aberdeen, introduces students to the essential elements of fisheries science. It consists of three main sections: fishing technology and behaviour, fishery independent methods, and stock assessment techniques. Ultimately it will equip students with the basic knowledge and skills required to assess the abundance and distribution of fish and to understand key elements of the provision of advice for fisheries management.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

To distinguish between types of fishing gear, describe fish capture processes and differentiate between responses of different fish to different gear

Design and analyse an acoustic survey, Write appropriate computer code and utilise R functions in relation to fisheries analysis and stock assessment To distinguish between survey types, employ fishery survey statistics, explain basics of fisheries acoustics and apply principles and methods of stock assessment and fisheries analysis

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	The first section reviews the various types of fishing methods, as well as measurement and observation in fishing gear experiments. Various behavioural concepts are covered, including swimming and fish sensory systems. The concept of selectivity is described in theoretical detail, followed by a description of the various methods of improving selectivity of fishing gear and a review of 'unaccounted mortality'. The second section covers fishery independent (survey) methods, with lectures on each of the main types of survey: acoustic, trawl, larvae, egg and TV surveys. Survey design concepts relating to all types of survey are introduced in a lecture and illustrated through a practical as applied to acoustic surveys. Lectures are also given covering survey statistics common to all methods, including one on geostatistics. The final section covers stock assessment, introducing students to ideas about analysing fisheries data and applying both classic and modern fisheries science models. This part of the course is based on a series of computer-based practicals which deal with three main concepts: cohort analysis using fisheries data, separable analysis using survey data, and length-based stock assessment. Extensive use will be made of both Excel spreadsheets and (for the first two concepts) the R programming language.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures and tutorials	N/A

GENERAL INFORMATION ABOUT THE COURSE #7

1.	The name of the course/module	Ecology, conservation and society
2.	Faculty/department	The School of Biological Sciences
3.	Status of the educational component	Optional
4.	Semester	2
5.	Number of ECTS credits	7.5
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	The aim of this module is to examine aspects of interface of ecology, conservation and society and to explore aspects of environmental sustainability.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- Engage with scholarly work from anthropology, philosophy, environmental economics and human geography to promote reflection on the role of epistemology in problem definition and interpretation;
- Develop communication skills relevant for facilitating discussions, engaging with the public and writing focused, concise essays;
- Interpret and analyse scientific publications and position papers and develop focused and critical discussion essays;
- Develop knowledge and understanding related to the key themes addressed during the course and increased their awareness and appreciation of the ethical and moral issues embedded in conservation, sustainable development and environmental management;
- Develop their skills in facilitating group discussions, dealing flexibly with new situations, and becoming adept at taking different perspectives;
- Develop their capacity for attentive exchange, informed argument and reasoning and the ability to express their ideas concisely;
- Develop their skills in interpreting complex ideas and in writing creatively, concisely and critically;
- Develop their willingness to question accepted wisdom and their capacity for self-reflection and an enhanced awareness of personal strengths and weaknesses

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	1) Given how our world is changing, do we need to change how we do science? 2) How does science influence policy? How do we consider the impact of research? 3) How does the move towards interdisciplinary approaches to complex environmental problems impact the practice of conservation and ecological sciences?

	4) What characterises resilient, flexible and adaptable socio-ecological systems and what are the messages for ecologists, environmental scientists and conservation biologists? 5) How and why is the public being encouraged to participate in science? 6) What is good practice in relation to communicating science to the public?.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar	N/A

GENERAL INFORMATION ABOUT THE COURSE #8		
1.	The name of the course/module	Marine spatial management
2.	Faculty/department	The School of Biological Sciences
3.	Status of the educational component	Optional
4.	Semester	2
5.	Number of ECTS credits	7.5
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	Course Aims: This course aims to enable students to appreciate the level of understanding of the physical oceanography, trophic interactions, species survival and reproduction that are required to implement spatially explicit, sustainable ecosystem-base management and effective marine spatial planning. This course will explore the driving forces underlying changes in the abundance and distribution of highly mobile marine species and consider how anthrophonic changes (such as addition of MPAs, large scale renewable energy developments and climate change) may affect their spatial population densities. The course will provide background on new policy drivers (Marine Strategy Framework Directive, MSFD) and the policy instruments (Good Environmental Status, GES) and through the work on assessments, will provide students with the type of experience with marine data understanding and knowledge of management and research planning frameworks that many employers from researcher organizations through consultants and government establishments are looking for.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: by the end of the course students should be able to • Appreciate the range of diverse marine habitats (landscapes) within the oceans • Understand the important linkages between habitat and ecological (trophic interactions) and physical forcing (i.e. tides and climate change) • Be able to problem-solve in small groups, and integrate diverse data sources and modelling output to define the reasons for specific location and the design of marine protected areas and to determine what factors may drive changes in the abundance and distribution of mobile marine animals (fish, seabirds and mammals). • Possess an understanding of the techniques available to monitor changes in the abundance, biodiversity and distribution of fish, marine mammals and seabirds. • Understand the process by which the MSFD, GES and OSPAR policies will be taken up and what the current gaps are in the effectiveness of GES/OSPAR descriptors. • Understand the range of impacts of marine offshore energy developments and how they can be assessed and mitigated. Practical and transferable skills leading to greater employability • Understanding of 1-D biological-physical coupled model • Understanding of spatially explicit population models • Understanding of current and European and UK legislation of MSFD and GES and for the creation of MPAs and Marine Spatial Planning process. • Be familiar with the key UK and International organisations responsible for monitoring and managing fish, marine mammal and seabird populations. • To build on key skills (eg. GIS and R) offered in the degree programme

• Know where to access data from fisheries, marine mammal and seabird monitoring programmes in UK & European waters, and display the quantitative skills required to evaluate the status of populations and GES descriptors in different regions.	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Key concepts covered: • Marine Ecology: habitats, oceanographic processes, trophic interactions biodiversity spatial conservation options and climate variation • Current Marine Spatial planning legislation and ecological design of marine protected areas (MPAs). • Lectures will cover the theory and practice of assessing change in the size, status and distribution of important fish, seabird and marine mammal populations. Our focus will be on UK monitoring and research programmes, but we will draw comparison with similar initiatives in the EU and North America. • Practical sessions/labs will include an introduction to the equipment, field and analytical techniques social skills used in the above range of concepts and aims to build on key skills (eg. GIS and R) developed earlier in the degree programme.
TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar: computer practicals	N/A

GENERAL INFORMATION ABOUT THE COURSE #9		
1.	The name of the course/module	Environmental impact assessment
2.	Faculty/department	The School of Biological Sciences
3.	Status of the educational component	Optional
4.	Semester	2
5.	Number of ECTS credits	7.5
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	Human activities affect the natural and human environment in a multitude of ways, varying in characteristics of effect, magnitude, spatial extent and timescale. In recent decades, concern about environmental damage in different parts of the world has led to public pressure on governments to regulate developers. Environmental Impact Assessment (EIA) has been developed to minimise adverse environmental effects, while allowing economic activities to continue. It is a critical component of the approach to achieving sustainable development. It is therefore important to understand, apply and evaluate the EIA process. The aim of the course is to provide training in principles, methods and application of EIA in the United Kingdom, European Union and elsewhere in the world. The course also aims to foster balanced judgement of the strengths and weaknesses of EIA. The practical components of the course develop skills to enhance employability; in particular, collection, appraisal and dispassionate analysis of evidence; working independently and as part of a team; effective communication in written and oral forms; as well as appreciation of the concepts of enterprise and societal regulation of business activities.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
By the end of the course, you should be able to describe the different stages of the EIA process, the types of activity involved, and main participants. You will also be able to deepen expertise on environmental effects of selected development types, taking account of the scientific evidence base, as well as critically review impact identification, impact analysis, and proposed mitigation measures in case studies.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	N/A	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)	

Lectures, seminars, workshops	N/A

GENERAL INFORMATION ABOUT THE COURSE #10		
1.	The name of the course/module	Sustainable aquaculture
2.	Faculty/department	The School of Biological Sciences
3.	Status of the educational component	Optional
4.	Semester	2
5.	Number of ECTS credits	7.5
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	Lectures by research staff working in aquaculture provide you with specialised knowledge in a range of current issues, including growth, nutrition, health and disease resistance, genetics and environmental interactions. Preparation for seminars and the essay allow you to direct your own learning and explore methods and current advances in your chosen topic. Participation in the seminars helps you to develop your communication skills and provides you with feedback on your understanding of the issues.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
To gain specialist knowledge and to apply this in critical analyses of published work		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	Nutrition: fish feeds, fish meal fish oil, global shortage, how to overcome this shortage with new diets (plant protein oils) Health of aquacultured animals: diseases, vaccination methods of controlling health, parasitic diseases interaction wild and farmed. Selective breeding, genetics, effects on wild populations - future genomic applications to aquaculture. Environmental impacts - ecological impacts of aquaculture, diversity and approaches to reduce environmental loading. Future directions of aquaculture.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures	N/A

GENERAL INFORMATION ABOUT THE COURSE #11		
1.	The name of the course/module	Marine conservation management
2.	Faculty/department	The School of Biological Sciences
3.	Status of the educational component	Optional
4.	Semester	2
5.	Number of ECTS credits	7.5
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	Conservation of marine biodiversity depends upon a sound understanding of science and policy, and the ability to effectively engage with stakeholder communities. Graduates working in this field require an open mind, creativity, and the ability to learn and problem solve independently and in groups. The course has been designed to use a blended approach to understand marine conservation management, the types of management interventions implemented and the science underpinning these measures. The success of these interventions depends crucially upon good problem solving skills and an ability to work with diverse stakeholders. In preparation for this, this course places a strong emphasis on directed self-learning and discussion sessions with your peers and course team, underpinned by

<table>
<tr><td></td><td></td><td colspan="2">knowledge gained through directed reading, on-line lectures and analysis of case studies.
Your experience of the course will therefore benefit from a sound background of current marine conservation issues and recent research. You are therefore strongly encouraged to use all opportunities to follow news channels, social media and key scientific journals to explore current marine conservation issues and emerging scientific findings.</td></tr>
<tr><td>8.</td><td>Prerequisites for studying the course/module, connection with other educational components</td><td colspan="2">N/A</td></tr>
<tr><th colspan="4">LEARNING OUTCOMES BY EDUCATIONAL COMPONENT</th></tr>
<tr><td colspan="4">N/A</td></tr>
<tr><th colspan="4">CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)</th></tr>
<tr><td>1.</td><td colspan="3">N/A</td></tr>
<tr><th colspan="4">TEACHING AND LEARNING METHODS</th></tr>
<tr><td colspan="3">Teaching methods (work to be carried out by the teacher during classroom classes, consultations)</td><td>Study methods (what types of educational activities should be performed by the student independently)</td></tr>
<tr><td colspan="3">Seminars</td><td>N/A</td></tr>
</table>

SLOVAK UNIVERSITY OF AGRICULTURE IN NITRA

1	Criterion A: University profile		
1.1	**Name of the University**	**SLOVAK UNIVERSITY OF AGRICULTURE IN NITRA**	
1.2	Classical or applied	Classical, applied	
2	**Criterion B: Profile of the educational program (Curriculum)**		
2.1	Number of Aquaculture disciplines		
2.2	The name of the educational program	Management of Animal Production	
2.3	Type of diploma	Master	
2.4	Total number of credits (ECTS)	120	
3	**Criterion C: Setting the educational program (Curriculum)**		
3.1	Duration of the program	4 semestres	
3.2	The purpose of the educational program	Provide students with the knowledge and training required for the analyze and manage animal production and specific animal breeding with regard to food safety and quality, environment management and protection, biodiversity protection, animal welfare.	
4	**Criterion D: Characteristics of the educational program (Curriculum)**		
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Biological, technological, economic and management aspects of animal production	
5	**Criterion E: Teaching and assessment**		
5.1	Teaching and learning methods	Lectures, seminars, excursions, field exercises, external study, engineering practice	
5.2	Assessment	Examinations; Diploma Thesis, State Qualifying Exam	
6	**Criterion F: Software competencies**		
6.1	Integral competence	N/A	
6.2	General competences	N/A	
6.3	Professional competences	N/A	
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	1. Graduate of a Master of engineering degree of Management of animal production can analyze and manage animal production and specific animal breeding with regard to food safety and quality, environment management and protection, biodiversity protection, animal welfare and compete at international level. 2. Deep and wide knowledges on biological, technological, economic and management aspects of animal production allow to analyze and solve actual problems of animal production, manage development projects and team of operators as well as various enterprises. 3. The graduate has skills as expert in management and in organizational structure of public and self-governance dministration, as main technologist in biological services, manufacturing and commercial enterprises, in agricultural research and education. 4. The graduate is ready to work in enterprises focused on farm animal production, breeding of animals for sport use or hobby breeds, development of husbandry systems for farm animals.	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	Sufficient human resources (education and research) from one of the leading European universities	
8.2	Material and technical support	Sufficient material and technical resources, rich base for research and practice	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Animal Breeding	4	exam
9.1.2	Biometrics	4	exam
9.1.3	Special Hygiene of Animals	4	exam
9.1.4	Feeding of Non-Ruminants	6	exam
9.1.5	Feeding of Ruminants	6	exam
9.1.6	Management and Technology of Cattle Breeding	6	exam
9.1.7	Management and Technology of Pig Breeding	6	exam
9.1.8	Management and Technology of Sheep and Goat Breeding	4	exam

9.1.9	Processing Technology of Animal Products	4	exam
9.1.10	Small Animal Breeding Technology	6	exam
9.1.11	Diploma Thesis Seminar	4	Pass credit
9.1.12	Engineering Practice	6	Pass credit
9.1.13	State engineering exam	0	exam
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Applied Economics and Finance for Farmers	4	exam
9.2.2	Feed Science	6	exam
9.2.3	Infections and Intoxications	6	exam
9.2.4	Population Genetics	6	exam
9.2.5	Special Reproduction of Animals	6	exam
9.2.6	Beekeeping	6	exam
9.2.7	Biodiversity in Farm Animal Population	4	exam
9.2.8	Meadow and Pasture Management	6	exam
9.2.9	Animal Breeding Programmes	4	exam
9.2.10	Assessment and Evaluation of Feeds	4	exam
9.2.11	Breeding of Horses	6	exam
9.2.12	Genetic Technologies in Animals	6	exam
9.2.13	Nutrition and Metabolic Disorders of Animals	4	exam
9.2.14	Technologies in Feeding Industry	6	exam
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Diploma Thesis, State Qualifying Exam	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1.	The name of the course/module	Animal Breeding
2.	Faculty/department	Faculty of Agrobiology and Food Resources
3.	Status of the educational component	Mandatory
4.	Semester	1 semester
5.	Number of ECTS credits	4
6.	The total number of hours	103 hours
7.	General description and purpose of the educational component	To equip the graduates with profound the theoretical and practical knowledge in the field of breeding and genetic improvement of animal characteristics
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The graduate of the course will understand the theoretical and practical knowledge in the field of breeding and genetic improvement of animal characteristics.
Skills: Based on the latest knowledge of modern livestock breeding, he can apply estimates of the genetic quality of animals.
Competences: Can analyze genetic evaluation systems in livestock at the level of the herd and at the level of the whole population.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	General concepts, principles of selection, types of selection and selection procedures
2.	Breeding value estimation of livestock
3.	Breeding methods
4.	Selection indexes
5.	Basic principles of the breeding programmes
6.	Genomic selection and its use in animal breeding

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Lectures, seminars	Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #2		
1	The name of the course/module	Biometrics
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	1 semester
5	Number of ECTS credits	4
6	The total number of hours	103 hours
7	General description and purpose of the educational component	To equip the graduates with theoretical and practical knowledge in the field of statistical evaluation of biological data
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The graduate of the course will understand the theoretical and practical knowledge in the field of statistical evaluation of biological data.
Skills: Can apply and present basic statistical methods in the analysis of biological data and processes of livestock and humans.
Competences: Is able to independently statistically analyze biological data in the preparation of final theses, professional and scientific publications.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Introduction, basic biometric and statistical concepts
2	Basic statistical characteristics of biological data
3	Fundamentals of probability theory
4	Statistical hypothesis testing, parametric and nonparametric tests
5	Correlation and regression analysis
6	Analysis of variance
7	The use of biometrics in genetics in animal production and nutrition in humans and animals

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #3		
1	The name of the course/module	Special Hygiene of Animals
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	1 semester
5	Number of ECTS credits	4
6	The total number of hours	115 hours
7	General description and purpose of the educational component	Inform students about the needs and requirements of individual species of livestock for the breeding environment in relation to the micro-climate, hygiene, welfare, production, reproduction and health.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The student of the course will gain knowledge about the needs and requirements of individual species of livestock for the breeding environment in relation to the micro-climate, hygiene, welfare, production, reproduction and health. They will gain practical and methodological knowledge about the importance of disease prevention related to the breeding

environment and systems of breeding and handling of animals and can formulate appropriate recommendations for the implementation of practice. Skills: The graduate of the course is able to analyze the factors of the breeding environment and their impact on individual species and category of livestock in terms of welfare, health and performance. Independently and proactively apply professional knowledge to breeding measures and improve the hygiene of breeding of individual types of livestock. Professionally present the results of own study and practice in breeding management. Competences: Obtained knowledge through innovative and creative thinking is able to apply in improving the living and husbandry conditions of pets and cattle in practice.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Basic hygiene requirements for quality livestock environment in relation to thermoregulation, yield, health and welfare of animals according species and categories.
2.	Protecting farms against the introduction of infection diseases
3.	Prevention of production diseases - external and internal causes

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars, exercises	Excursions, field exercises, individual work, external study

GENERAL INFORMATION ABOUT THE COURSE #4		
1	The name of the course/module	Applied Economics and Finance for Farmers
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	1 semester
5	Number of ECTS credits	4
6	The total number of hours	52 hours
7	General description and purpose of the educational component	The position of agriculture in the national economy, the development of Slovak and world agriculture are evaluated, importers' policies are taken over, agricultural policy instruments - prices, direct payments, production quotas, emphasis is placed on EU CAP, rural development and structural funds, attention is paid to practical aspects for farmers as the foundations and principles of the common agricultural policy, direct payments, project support, sources of financing and risk management.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
The graduate will have the opportunity to get acquainted with the practical aspects of agricultural economics, policy and finance, will be able to assess the practical impact of agricultural policy on households and businesses and overall well-being. The graduate will be able to use various quantitative methods to assess the impact of agricultural policy, get acquainted with practical aspects such as the basics and principles of the common agricultural policy, direct payments, project support, funding sources and risk management.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	The position of agriculture in the national economy, the development of Slovak and world agriculture are evaluated, importers' policies are taken over, agricultural policy instruments - prices, direct payments, production quotas, emphasis is placed on EU CAP, rural development and structural funds.
2.	The practical aspects for farmers as the foundations and principles of the common agricultural policy, direct payments, project support, sources of financing and risk management
3.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	

GENERAL INFORMATION ABOUT THE COURSE #5

1	The name of the course/module	Feed Science
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	1 semester
5	Number of ECTS credits	6
6	The total number of hours	156 hours
7	General description and purpose of the educational component	Inform students about the nutritive value of forages and concentrate feeds, as well as their dietetic functions.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: Student will take complex knowledge about the nutritive value of forages and concentrate feeds, as well as their dietetic functions. Will understand feed diversity in animal nutrition.
Skills: Student will understand problems of precise nutritional and dietetic quality of forages and concentred feeds. Will be able to insufficient nutritional feed quality analyze.
Competences: Student will be able after the graduation to nutritional and dietetic feed diversity define, identify causes of low quality and create solutions for improvement.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Nutrients composition of plants and animals
2.	Classification of feeds, their nutritive value and digestibility
3.	Specific properties of fresh green feedsuffs, silages, sillaged grits, root-crops, hay, corns, rests after industrial processing, animal feedstuffs and synthetic feedstuffs. Water in animal feeding
4.	Unconventional feedstuffs, additives of biofactors and other additives.
5.	Feedstuffs as source of minerals and specific active nutrients
6.	Nutritive additives
7.	Antinutritive ingredients and toxic ingredients in feestuffs

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #6

1	The name of the course/module	Infections and Intoxications
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	1 semester
5	Number of ECTS credits	6
6	The total number of hours	156 hours
7	General description and purpose of the educational component	Inform to students with contagious bacterial, viral, parasitic diseases of animals and on prionosis infections. After completion of the subject the student understands of the principles of immunity against infections and infections patogenesis, is able to solve the prevention against infections, is able to apply knowledge for breeding of animals, is able to analyse symptoms of infections,is able to identify most frequentions of animals infections.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: Students will gain theoretical knowledge of the basics of immunology, knowledge of etiology, transmission to animals and humans, the clinical course of infection and the prevention of serious infectious bacterial, viral, parasitic and fungal diseases. They know the requirements for healthy breeding.

Skills: Students will master the procedures for handling animals that show signs of disease, have the skill for simple medical procedures and drug application. They can apply legislative requirements for animal health control to the infectious process and various types of infectious diseases. Competences: After acquiring the above knowledge and skills, students can implement preventive measures against the occurrence of individual infectious diseases and can apply in practical conditions legislative guidelines for the current disease situation.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
1. Legislation
2. Prophylaxis and zoonoses
3. Immunity
4. Infectious process

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #7		
1	The name of the course/module	Population Genetics
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	1 semester
5	Number of ECTS credits	6
6	The total number of hours	150 hours
7	General description and purpose of the educational component	Inform students about the principles of genetic variability of qualitative and quantitative traits at the individual level and can apply them at the population level.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: The student will gain new knowledge about the principles of genetic variability of qualitative and quantitative traits at the individual level and can apply them at the population level. Skills: The student is able to independently analyze genetic parameters and interpret their significance for the genetic evaluation of animal populations. The student will gain practical skills in evaluating the dynamics of changes in genotypic structure in small populations. Competences: Based on the gained knowledge, the student is able to analyze genetic variability in specific conditions and can predict the dynamics of its changes in animal populations.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
1. Genetic variability of qualitative and quantitative traits and characteristics in populations.
2. Genetic and genotypic structure of populations.
3. Equilibrium in populations and its changes.
4. Methods of evaluation of frequency changes of genes and genotypes.
5. Dynamics of genotypic changes and genetic distances of populations.
6. Genetic parameters onf production traits, methods of estimation and its use in selection and breeding.
7. Genetic basis of heterosis and inbreeding depression.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #8		
1	The name of the course/module	Special Reproduction of Animals
2	Faculty/department	Faculty of Agrobiology and Food Resources

3	Status of the educational component	Optional
4	Semester	1 semester
5	Number of ECTS credits	6
6	The total number of hours	160 hours
7	General description and purpose of the educational component	We want to give the information to students on the reproduction process of various species animals, on the control methods of animals reproduction and reproduction biotechnology, on an organization of breeding reproduction, on most important reproductive disorders. After completion of the student understands on the difference species, is able to solve specific requests of individual species of farm animals, is able to apply knowledge in practical reproduction of animals, is able to analyze the reasons of reproduction disorders, is able to identify of an animal infertility.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: Students will gain theoretical knowledge about interspecific differences in livestock reproduction about their physiological specifics about the most common problems and pathological conditions of reproductive organs.
Handiness: The students the use of technical aids in controlling the various stages of their reproductive process. As a result of the internships of students during livestock births, they will acquire skills in terms of assistance in controlled and directed births. They will gain skills in primary care in dealing with fertility disorders and venereal diseases.
Powers: Based on the above skills, they can organize and control the reproductive process of an pets and animals husbandry.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Fertility.
2.	Neuroendocrine disorders of reproduction.
3.	Food sterility.
4.	Disorders of puerperia.
5.	Biotechnology of reproduction.
6.	Reproduction of small ruminants and dogs, reproduction of equides, reproduction of small ugulates, reproduction of domestic-social animals.
7.	Biotechnology of reproduction
8.	Reproductive biotechnology
9.	Economics of animal reproduction

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Excursions, field practices Individual work

GENERAL INFORMATION ABOUT THE COURSE #9

1	The name of the course/module	Feeding of Non-Ruminants
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	2 semester
5	Number of ECTS credits	6
6	The total number of hours	156 hours
7	General description and purpose of the educational component	To introduce students to the theoretical principles for feeding according to the requirements of energy and nutrients for different kinds and categories of non-ruminants - poultry, pigs, horses and fur-bearing animals.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: Student will take knowledge about nutrients and energy requirements for individual age categories of swine, horses and poultry. Will understand the principles of feed mixtures and feed rations formulation.

Skills: Student will understand the principles of precise feed rations formula for swine, horses and poultry. Competences: After the subject graduation, student will be able to errors analyze in feeding and with software support apply the solution in praxis.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Theoretical principles for feeding according to the requirements of energy and nutrients for different kinds and categories of non-ruminants - poultry, pigs, horses and fur-bearing animals.
2.	The selection and dosing of components for the feed mixtures and diets.
3.	Feeding optimization according to economical considerations is achieved.
4.	Theoretical principles of animal feeding according to age, life weight, physiological status and production effects are given.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #10		
1	The name of the course/module	Feeding of Ruminants
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	2 semester
5	Number of ECTS credits	6
6	The total number of hours	156 hours
7	General description and purpose of the educational component	Inform students about the right nutrition of ruminants practice, understand the process of calculating feed rations and compound feeds for ruminants.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: The graduate will gain knowledge about the right nutrition of ruminants practice, understand the process of calculating feed rations and compound feeds for ruminants. Skills: Can calculate the rations and compound feeds for the different species and categories of ruminants. Competences: He is able to analyze rations and compound feeds for ruminants and, based on the analysis, optimize ruminant nutrition with the aim of high production and good animal health.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Composition diet feeding for ruminants.
2.	The nutrient requirements for dairy cows, fattening cattle, sheep and goats.
3.	The feed intake capacity in ruminants.
4.	Complete - diet feeding of dairy cows.
5.	Manipulation of rumen fermentation.
6.	Influence of ruminant nutrition on milk quality and reproduction in the dairy cows.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Excursions, field practices, semestral work Individual work

GENERAL INFORMATION ABOUT THE COURSE #11		
1	The name of the course/module	Management and Technology of Cattle Breeding
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	2 semester

5	Number of ECTS credits	6
6	The total number of hours	152 hours
7	General description and purpose of the educational component	The aim of this course is to acquaint students with recent theoretical knowledge and practical methods for planning, managing and developing of the technological conditions in beef and dairy cattle farming.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: Student will acquire knowledge about the organizing principles and management of cattle farming, the current and progressive technologies in cattle farming and the difference in farming management between dairy and beef.
Skills: Student will be able to apply acquired knowledge in the organizing of cattle farming operations and management.
Competences: Student understand the organizing daily routine operations, the farming procedures and management of various cattle categories. Student is able to analyze usage of appropriate methods and to eliminate the risks associated with usage of improper methods and technologies.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	The characteristics of production systems and current and innovative trends in cattle farming technologies, legislation and regulations for cattle farming leading to improve environment.
2.	Farming management and techniques for various cattle categories, traditional and progressive farming practices using smart technologies.
3.	The characteristics of various housing systems in relation to biological and physiological requirements for animal welfare.
4.	The possibilities of usage various technologies for feeding, watering, milking, manure removing and creation of suitable micro climatic conditions in relation to specific housing systems.
5.	The principles of ensuring the good health of musculoskeletal system in relation to used technology.
6.	The characteristics of flooring systems and other equipment.
7.	The organizing and technological possibilities for elimination of heat stress.
8.	The fundamental changes in farming management and daily routine related to farm automatization and robotization.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #12

1	The name of the course/module	Management and Technology of Pig Breeding
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	2 semester
5	Number of ECTS credits	6
6	The total number of hours	156 hours
7	General description and purpose of the educational component	Inform students about the management and technology of pigs and is able to solve the problem of optimizing breeding environment for the pigs. Student is able to identify and choose correctly the new techniques and technology lines in accordance with the legislative determinative the environment conditions and welfare of pigs.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: After completion of the subject the student understands new knowledge about the management and technology of pigs and is able to solve the problem of optimizing breeding environment for the pigs. Student is able to identify and choose correctly the new techniques and technology lines in accordance with the legislative determinative the environment conditions and welfare of pigs.
Skills: The student is able to apply the new trends in technology and technological approaches in breeding and rearing of pigs and in the management of fattening pigs. The student gain practical skills of the organization cyclogram of the production of piglets and management of rotational pork production, optimalization of microclimate in the high productive meat type of

pigs. The student is able to acquire the management of excrements removal and methods of elimination which can apply in the practical farming conditions in relation to the protection of the environment. Competences: Student can analyze the elements of housing and can recognize them in the specific farms.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Characteristics of the current gene pool of foreign breeds and business and corporate hybridization programs.
2.	Presentations of new technical and technological solutions in the reproduction and fattening of pigs.
3.	Description and explanation of the techniques and technologies used for breeding sows and weaners in an alternative system.
4.	Technology of fattening pigs in terms of production efficiency, production and environmental protection.
5.	Ensuring health measures and Welfare in pig farming.
6.	Housing characteristics of high-breeding, farrowing and lactating sows.
7.	Requirements for housing housed and sows.
8.	Description of breeding techniques and technologies used in the housing of weaners in breeding farms.
9.	Breeding techniques and ways of housing breeding boars and sows. Optimized biological - technological principles of feeding technology of various categories of pigs and used technological systems of feeding pigs.
10.	New views on the zootechnical, technical and hygienic principles of feeding pigs.
11.	Housing requirements for pre-fattening and fattening pigs.
12.	Optimization of parameters of microclimatic conditions in the breeding of individual categories of pigs and their possible technical influence.
13.	Principles of cyclogram production of weaners and rotation production of pork.
14.	Technological systems for the removal of excrement from buildings for pigs and the ecological way of their use.
15.	Hardware and software solutions in the management of production and production of pork.
16.	Principles, principles, possibilities and descriptions of current models of pork production and their use in practice.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Excursions, field practices, semestral work Individual work

GENERAL INFORMATION ABOUT THE COURSE #13		
1	The name of the course/module	Beekeeping
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	2 semester
5	Number of ECTS credits	6
6	The total number of hours	153 hours
7	General description and purpose of the educational component	Inform students about the honeybee colony biology and the utilisation of the production potential of honeybee colonies.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: Student will gain knowledge about the honeybee colony biology and the utilisation of the production potential of honeybee colonies. Skills: The graduate of the course is able to assess the suitability of the apiary location, choose the appropriate type of hives and tools, manage and implement preventive, curative and breeding measures, reproduce colonies, breed bee queens and implement measures to ensure profitability of beekeeping operations. Competences: The student is able to understand and analyze the interaction between bee colony and the external environment. By completing the course the student is able to practically master the basics of beekeeping and production of bee products.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Beekeeping equipment and hive construction.
2.	Honey bee castes, anatomy and physiology of the honeybee.
3.	Creating new colonies, queens breeding and testing.
4.	Beehives management during the year.
5.	Pollination and bee pasture in Slovakia.
6.	Diseases, pests and poisoning of bee colonies.
7.	Legislation and subsidy programs for beekeepers.
8.	Practical work on apiary and excursion.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #14		
1	The name of the course/module	Biodiversity in Farm Animal Population
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	2 semester
5	Number of ECTS credits	4
6	The total number of hours	120 hours
7	General description and purpose of the educational component	Inform students about the importance of animal genetic resources in terms of food production and use in agriculture, assessment of genetic diversity and the need to protect it.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: the student will gain knowledge about the importance of animal genetic resources in terms of food production and use in agriculture, assessment of genetic diversity and the need to protect it.
Skills: the student can analyze and quantify the state of diversity of animal populations using methods based on the analysis of pedigree and molecular genetic data. The student can interpret the results of analyses correctly and is competent to assess the degree of threat to populations of animal genetic resources by loss of diversity.
Competences: the student proposes and applies ways to address the loss of genetic diversity in populations of animal genetic resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Biological diversity, gene pool and animal genetic resources.
2.	Management of animal genetic resources, their classification by risk of endangerment and conservation methods.
3.	Evaluation and monitoring of genetic diversity in animal population.
4.	Utilisation of pedigree information to assess the genetic diversity of the breed.
5.	Utilisation of molecular genetic information to assess the genetic diversity of the breed.
6.	Mating systems.
7.	Strategy for development of animal genetic resources.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #15		
1	The name of the course/module	Meadow and Pasture Management
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	2 semester
5	Number of ECTS credits	6
6	The total number of hours	150 hours
7	General description and purpose of the educational component	Inform students about the composition and structure of the grass community, their relationship to the environment, the typology and management of grasslands, and the possibilities of using agroecological support in grassland management.
8	Prerequisites for studying the course/module, connection	

	with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: After graduation, the student has knowledge of the composition and structure of the grass community. Their relationship to the environment. Masters the typology and management of grasslands. He knows the possibilities of using agri-environmental support in grassland management.
Skills: The graduate is able to apply knowledge about biological and ecological characteristics of grasslands in their management and use depending on the classification of the stand. They will learn to determine the condition of the stand from a nutritional and moist point of view on the basis of knowledge of structural characteristics, to apply it in a differentiated approach to grassland management in the context of habitat conditions, floristic composition, and animal requirements for feed quality, resp. to compile a complex mix of perennial species of grasses and clover when establishing temporary stands.
Competences: It is characterized by a high degree of independence and is able to define and creatively address the elimination of negative environmental impacts and management in the context of production and non-production aspects of grassland cultivation.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Production and ecological functions of grasslands.
2.	Composition and structure of the grass community.
3.	Grasslands and environment.
4.	Phytocoenology and typology of grasslands.
5.	Grass ecosystem.
6.	Grassland management - nutrition, regeneration, and sowing.
7.	Use of grasslands - mowing, grazing.
8.	Possibilities of using agri-environmental support in grassland management.
9.	Evaluation and ecological characteristics of grasslands.
10.	Compilation of temporary clover grass stands.
11.	Project from differentiated grassland management.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #16

1	The name of the course/module	Management and Technology of Sheep and Goat Breeding
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	3 semester
5	Number of ECTS credits	4
6	The total number of hours	112 hours
7	General description and purpose of the educational component	To inform students about progressive systems in flocks of small ruminants, with different production orientation, different intensity of breeding and economic conditions. To get acquainted with the progressive breeding practices in dairy sheep and goats, with the use of modern techniques and technology based on electronic identification of animals, as well as with the principles of organic farming using the principles of welfare.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: Students will gain in-depth knowledge of progressive systems in flocks of small ruminants, with different production orientation, different intensity of breeding and economic conditions. They will get acquainted with the progressive breeding practices in dairy sheep and goats, with the use of modern techniques and technology based on electronic identification of animals, as well as with the principles of organic farming using the principles of welfare.
Skills: Graduate of the course is able to rationally manage different types of sheep and goat farms, regardless of the production orientation and size of the farm.
Competences: The graduate is able to use modern techniques and technology and rationally use appropriate husbandry and breeding procedures leading to increased productivity.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Characteristics of intensive, semi-intensive and extensive sheep and goat production in different orientations (milk, meat, wool, mohair, cashmere, combined yield).

2.	Management of sheep and goat farms, breeding year, sheep and goats of different categories during the winter housing and summer grazing; turnover of flock.
3.	Characteristics and use of advanced technology systems of housing, feeding, milking, watering and shearing.
4.	Precise sheep farming based on electronic animal identification.
5.	Organic breeding and economic aspects of breeding.
6.	The students complement the theoretical knowledge by studying of technological lines directly on farms.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #17		
1	The name of the course/module	Processing Technology of Animal Products
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	3 semester
5	Number of ECTS credits	6
6	The total number of hours	52 hours
7	General description and purpose of the educational component	Inform students about the principles of genetic variability of qualitative and quantitative traits at the individual level and can apply them at the population level.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The student will gain new knowledge about the principles of genetic variability of qualitative and quantitative traits at the individual level and can apply them at the population level.
Skills: The student is able to independently analyze genetic parameters and interpret their significance for the genetic evaluation of animal populations. The student will gain practical skills in evaluating the dynamics of changes in genotypic structure in small populations.
Competences: Based on the gained knowledge, the student is able to analyze genetic variability in specific conditions and can predict the dynamics of its changes in animal populations.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Genetic variability of qualitative and quantitative traits and characteristics in populations.
2.	Genetic and genotypic structure of populations.
3.	Equilibrium in populations and its changes.
4.	Methods of evaluation of frequency changes of genes and genotypes.
5.	Dynamics of genotypic changes and genetic distances of populations.
6.	Genetic parameters onf production traits, methods of estimation and its use in selection and breeding.
7.	Genetic basis of heterosis and inbreeding depression.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures (13 hours), seminars (39 hours)	Individual work (98 hours)

GENERAL INFORMATION ABOUT THE COURSE #18		
1	The name of the course/module	Small Animal Breeding Technology
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	3 semester
5	Number of ECTS credits	6
6	The total number of hours	156 hours

7	General description and purpose of the educational component	To inform students about Inform students about the use of highly effective biological material of selected species of small livestock - poultry and rabbits in intensive breeding systems, the organization of poultry and breeding work in the Slovak Republic, the technological and alternative technological breeding systems used, the requirements of individual species on the conditions in rearing, breeding and fattening.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The student will gain knowledge about the use of high-performance biological material of selected species of small livestock - poultry and rabbits in intensive breeding systems, the organization of poultry and breeding work in the Slovak Republic, the technological and alternative technological breeding systems used, the requirements of individual species on the conditions in rearing, breeding and fattening.
Skills: The graduate of the course will be able to apply the acquired knowledge in connection with the provision of microclimatic and technological conditions as well as prevention and health protection in the breeding of rabbits, chickens, turkeys, ducks and geese in intensive breeding conditions.
Competences: After completing the course, the student will learn the procedures for the use of intensification of reproductive processes and evaluation of performance characteristics of rabbits and poultry. He will acquire the ability to provide technology and breeding techniques in compliance with welfare conditions.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	The use of high-performance biological material of perspective species of small animals - poultry and rabbits.
2.	Selection and breeding.
3.	Development of high-performance populations.
4.	Insemination and reproductive process.
5.	Intensive systems of breeding.
6.	Technological systems of breeding.
7.	Alternative technologic systems of breeding.
8.	Evaluation of products according to EU legislation.
9.	Zoohygienics.
10.	Health and Safety.
11.	Welfare in production.
12.	Evaluation of performance.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #19

1	The name of the course/module	Animal Breeding Programmes
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	3 semester
5	Number of ECTS credits	4
6	The total number of hours	100 hours
7	General description and purpose of the educational component	Inform students about breeding program set up on biological, technical and economical base.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: Student gets knowledge about breeding program set up on biological, technical and economical base.
Skills: Student will understand continuity of knowledge of biological character from Animal Science, Genetics, of technical character about animal husbandry of different farm animal species a their economic impact and can critically analyze them.
Competences: Student is able to apply knowledge from Animal Breeding, Population Genetics and Biodiversity of Farm Animals and after completing the course prepared to set up breeding program in practical conditions.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Role of breeding programmes in populations of farm animals.
2.	Technical and organisational outlines of creation of breeding programme, effects affecting breeding programmes of different farm animal species.
3.	Effect of population size, farm structure, systems of use of sires on breeding programme design.
4.	Constitution of mating programmes for young sires testing, mating programmes for production of new generation of sires and mating programmes in production herds.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #20		
1	The name of the course/module	Assessment and Evaluation of Feeds
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	3 semester
5	Number of ECTS credits	4
6	The total number of hours	109 hours
7	General description and purpose of the educational component	Inform students about the possibilities and methods of assessment and evaluation of feed quality.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: The student will gain knowledge about the possibilities and methods of assessment and evaluation of feed quality. Skills: The student is able to apply knowledge about the principles and importance of chemical analysis and evaluation of feed quality. Competences: The student is able to independently assess the quality and nutritional value of feed.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Weenden´s Soest´s detergent analysis of fodders, chemical and physico-chemical instrumental methods in the analytics of fodders, taking samples and their treatment for laboratory analyse, laboratory determination of organic and inorganic nutrients in fodders, a determination the digestibility of organic matter in vitro, a calculation of the parameters of nutrient values of fodders for ruminants and non-ruminants, a determinantion of results of the fermentative process of silages, a determination of the qualitative class of conserved fodders.
2.	Valuation of sensorial quality of fodders in practical conditions.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Excursions, field practices Laboratory protocol Individual work

GENERAL INFORMATION ABOUT THE COURSE #21		
1	The name of the course/module	Breeding of Horses
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	3 semester
5	Number of ECTS credits	6
6	The total number of hours	156 hours
7	General description and purpose of the educational component	Development of horse breeding and selection work in horse breeding, assessment of body composition and charactering major breeds of horses, identifying and describing different categories of horses, basic principles of technology breeding,

		rearing and training of horses, principles of new production systems operation, welfare in horse breeding, horse nutrition.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: Student obtains knowledge needed for horse management and breeding of certain utility types.
Abilities: Student will gain knowledge of the use of individual breeds of horses, evaluation of their exterior and performance as well as the correct management of horse breeding.
Competence: The student will be able to apply the information in the field of breeding technology, nutrition and breeding of young horses. Basic knowledge of technique and technology of horse breeding will be obtained by the graudate.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Horse breeding in Slovakia.
2.	Domestic and foreign horse breeds.
3.	Breeding records in horse breeding.
4.	Stud farms in Slovakia and abroad.
5.	Breeding programs in horse breeding.
6.	Ethology and psychology of horses.
7.	Basic horse training.
8.	Testing horses' utility capabilities.
9.	Nutrition and feeding of horses.
10.	Horse gene reserves.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars, consultations	Excursion, Individual work

GENERAL INFORMATION ABOUT THE COURSE #22

1	The name of the course/module	Genetic Technologies in Animals
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	3 semester
5	Number of ECTS credits	6
6	The total number of hours	150 hours
7	General description and purpose of the educational component	To introduce students to the theoretical and practical molecular genetic methods, genetic engineering methods and gene manipulation.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The student will gain theoretical and practical knowledge of molecular genetic methods, genetic engineering methods and gene manipulation. Understands genetic methods for gene characterization, identification and genetic engineering techniques.
Skills: The student, based on the acquired knowledge, knows the genetic procedures of gene identification, organization and techniques of animal genome mapping. He knows the methods of transgenic animals detection. He knows to apply methods of integration and expression of a foreign gene.
Competences: The student is to work with genetic databases and web tools for the design of molecular genetic procedures for detecting of successful transgenesis in in-silico conditions. He knows to verify the results of the in-silico analyzes and can to propose molecular-genetic procedures in practice.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Genetic methods suitable for the characterization of genes, their identification, and processes required for evaluation of the gene mapping organization.
2.	Generation of genetic maps.
3.	Molecular-genetic markers, MAS, QTL, and ETL.
4.	Comparative mapping, utilization of individual markers for breeding purposes.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #23		
1	The name of the course/module	Nutrition and Metabolic Disorders of Animals
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	3 semester
5	Number of ECTS credits	4
6	The total number of hours	39 hours
7	General description and purpose of the educational component	The goal of the subject is to introduce of students to the impact of alimentary disproportions on the health of the animals, with the emergence, course and consequences of Metabolic Disorders and the way to avoid them. The student understands the principle of the development of metabolic disorders can assess its cause, is able to assess the metabolic profile test and can take appropriate precautions against the occurrence of metabolic disorders.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The student will gain knowledge about animal nutrition disorders and their consequences, the regulation of metabolic processes, the principles of metabolic disorders, the role of organs in metabolism, organ changes in metabolic disorders and adaptation syndrome.
Skills: Students will master and be able to apply the assessment of the condition of animals as BMI, assess the adequacy of nutrition in relation to condition and metabolic disorders, know the importance and based on the practical skills gained from laboratory exercises can evaluate the metabolic profile test.
Competence: Student after the acquired knowledge and skills can optimize the dietary side of animal nutrition, assess the condition of animals and evaluate the regular metabolic profile of animals.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Influence of nutrition on homeostasis of the organism.
2.	Disorders of genetic metabolism.
3.	Energy metabolism disorders.
4.	Disorders of fat metabolism.
5.	Carbohydrate metabolism disorders.
6.	Disorders of protein metabolism.
7.	Disorders of mineral metabolism.
8.	Disorders of acid-base balance
9.	Disorders of vitamin metabolism
10.	Hematological profile
11.	Metabolic profile test (MPT)

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures (13 hours), seminars (26 hours)	N/A

GENERAL INFORMATION ABOUT THE COURSE #24		
1	The name of the course/module	Technologies in Feeding Industry
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	3 semester
5	Number of ECTS credits	6

6	The total number of hours	156 hours
7	General description and purpose of the educational component	Inform students about the principles and nutritional effects of various methods of processing feed materials used in feed. Understand the problematics of industrial feed production and good manufacturing practice.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The graduate will gain knowledge about the principles and nutritional effects of various methods of processing feed materials used in feed. Understand the problematics of industrial feed production and good manufacturing practice.
Skills: Can analyze the physical structure of feed mixtures and feed rations, calculate the mixing index of individual components in the feed mixture, respectively. in the feed ration.
Competences: Based on the analysis, he is able to optimize procedures for improving the quality of feed mixtures and feed rations, and optimize conditions for storage and handling of feed.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	The importance and trends in the feeding industry from the point of view of new technologies development of raw materials as components of the fodder mixtures and dosages..
2.	The principles and nutritional effects of physical, chemical and biological raw material prepartion (tastiness, digestibility, biological value, health quality, durability, physical structure).
3.	The physical-chemical properties of fodder in terms of the homogenity, stability and storage of fodder mixtures and dosages and pre-production treatment of fodder.
4.	The technological lines for conditioning, production, conservation, storage and fodder handling.
5.	In practical conditions valuating of physical characteristics of feed mixtures, valuating of homogenity and structure of total mixed rates.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Excursions, field practices, Semestral work Individual work

GENERAL INFORMATION ABOUT THE COURSE #25

1	The name of the course/module	Diploma Thesis Seminar
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	4 semester
5	Number of ECTS credits	4
6	The total number of hours	100 hours
7	General description and purpose of the educational component	The goal of the subject is to introduce students understands the structure of the diploma thesis, can determine a clear goal and methodology of the work. Based on the established hypotheses and the obtained results, formulate the conclusions of the diploma thesis.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The graduate of the course understands the structure of the diploma thesis, can determine a clear goal and methodology of the work. Based on the established hypotheses and the obtained results, he can formulate the conclusions of the diploma thesis.
Skills: The student is able to work independently, apply basic scientific methods and work with professional literature.
Competences: By completing the course, student can use the acquired knowledge to master the issues addressed in the thesis in terms of professional and formal aspects.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Regular consultations with the supervisor of the diploma thesis in its processing.
2.	Work with professional and scientific literature, standards.
3.	Elaboration of graphic and tabular part.
4.	Statistical evaluation of results.

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Consultations	Individual work

GENERAL INFORMATION ABOUT THE COURSE #26		
1	The name of the course/module	Engineering Practice
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	4 semester
5	Number of ECTS credits	6
6	The total number of hours	150 hours
7	General description and purpose of the educational component	The aim is to complete the professional profile of the graduate in the study program, verify the acquired theoretical knowledge in practice, create an idea of the business and gain knowledge about the organization, management, operation and provision of practical tasks in various entities and organizations within the agri-food complex. The graduate of the course is able to solve practical tasks assigned to him, can apply knowledge of theoretical subjects under the supervision of agronomists or zootechnics on the farm, can analyze various situations on the farm.
8	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
Knowledge: acquires knowledge of professional and managerial work in his specialization. Skills: the graduate acquires and deepens skills and procedures in the field of practical activities related to the acquisition of basic elements in farm management, planning and production cycle in individual sections of plant and animal production Competences: he is able to work as a manager and specialist according to the studied specialization, as well as a top manager and executive in all types of business entities in the field of agriculture and agri-food. The graduate will also be employed in research and education.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	Individual professional practice the student will gain experience from specific zootechnical or agronomic practice in breeding and crop production in all types of business entities in the field of agriculture, agri-food, state administration and self-government institutions, in processing companies, in catering establishments, in research, etc.	
2.	Management practice the student synthesizes and practically applies the acquired theoretical knowledge from the study in the analysis, design and practical management of the farm at all levels of the production process..	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)	
Consultation / briefing	Professional individual practice, Management practice	

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SLOVAK UNIVERSITY OF AGRICULTURE IN NITRA

1	**Criterion A: University profile**		
1.1	**Name of the University**	**SLOVAK UNIVERSITY OF AGRICULTURE IN NITRA**	
1.2	Classical or applied	Classical, applied	
2	**Criterion B: Profile of the educational program (Curriculum)**		
2.1	Number of Aquaculture disciplines		
2.2	The name of the educational program	Special animal breeding	
2.3	Type of diploma	Master	
2.4	Total number of credits (ECTS)	120	
3	**Criterion C: Setting the educational program (Curriculum)**		
3.1	Duration of the program	4 semestres	
3.2	The purpose of the educational program	To equip the graduates with profound expertise and knowledge based on an interdisciplinary and holistic perspectives in modern biotechnology and the sustainable development of the agriculture.	
4	**Criterion D: Characteristics of the educational program (Curriculum)**		
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Biological, technological, economic and management aspects of animal breeding	
5	**Criterion E: Teaching and assessment**		
5.1	Teaching and learning methods	Lectures, seminars, excursions, field exercises, external study, engineering practice	
5.2	Assessment	Examinations; Diploma Thesis, State Qualifying Exam	
6	**Criterion F: Software competencies**		
6.1	Integral competence	N/A	
6.2	General competences	N/A	
6.3	Professional competences	N/A	
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	1. A graduate of the study program manages the issue of biological features and properties of various kinds of livestock, domestic and exotic animals, genetic and physiological aspects of their breeding, health, hygiene, nutrition, feeding and breeding, as well as the issue regarding prevention against diseases. 2. The graduate is able to creatively apply his theoretical knowledge into practical animal breeding in line with the home country legislation and international conventions. 3. The graduate uses his gained knowledge at solving problems in special animal production as well as in self-management of agricultural farms. 4. Graduates are ready to work as managers and specialists in areas dealing with breeding livestock, domestic and exotic animal species in zoos, in breeding associations and unions. They can also work in the field of marketing, expert counseling and trading with various breeding goods.	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	Sufficient human resources (education and research) from one of the leading European universities	
8.2	Material and technical support	Sufficient material and technical resources, rich base for research and practice	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Biometrics	4	exam
9.1.2	Husbandry of Exotic Even-Toed and Odd-Toed Ungul	4	exam
9.1.3	Population Genetics	6	exam
9.1.4	Rabbit Breeding	4	exam
9.1.5	Applied Economics and Finance for Farmers	4	exam
9.1.6	Beekeeping	6	exam
9.1.7	Feeding of Pet and Exotic Animals	6	exam
9.1.8	Special Hygiene of Animals	4	exam
9.1.9	Breeding of Horses	6	exam
9.1.10	Breeding of Non-Traditional Birds	4	exam
9.1.11	Small Animal Breeding Technology	6	exam
9.1.12	Diploma Thesis Seminar	4	Pass credit
9.1.13	Engineering Practice	6	Pass credit

9.1.14	State engineering exam	0	exam
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Feed Science	6	exam
9.2.2	Infections and Intoxications	6	exam
9.2.3	Management and Technology in Animal	6	exam
9.2.4	Special Reproduction of Animals Husbandry	6	exam
9.2.5	Animal Breeding	4	exam
9.2.6	Biodiversity in Farm Animal Population	4	exam
9.2.7	Feeding of Non-Ruminants	6	exam
9.2.8	Meadow and Pasture Management	6	exam
9.2.9	Sustainable and Organic Animal Production	6	exam
9.2.10	Animal Breeding Programmes	4	exam
9.2.11	Nutrition and Metabolic Disorders of Animals	4	exam
9.2.12	Processing Technology of Supplementary Animal	4	exam
9.2.13	Technologies in Feeding Industry	6	exam
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Diploma Thesis, State Qualifying Exam	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Biometrics
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	1 semester
5	Number of ECTS credits	4
6	The total number of hours	103 hours
7	General description and purpose of the educational component	To equip the graduates with theoretical and practical knowledge in the field of statistical evaluation of biological data.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The graduate of the course will understand the theoretical and practical knowledge in the field of statistical evaluation of biological data.
Skills: Can apply and present basic statistical methods in the analysis of biological data and processes of livestock and humans.
Competences: Is able to independently statistically analyze biological data in the preparation of final theses, professional and scientific publications.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Introduction, basic biometric and statistical concepts
2	Basic statistical characteristics of biological data
3	Fundamentals of probability theory
4	Statistical hypothesis testing, parametric and nonparametric tests
5	Correlation and regression analysis
6	Analysis of variance
7	The use of biometrics in genetics in animal production and nutrition in humans and animals

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #2

1	The name of the course/module	Husbandry of Exotic Even-Toed and Odd-Toed Ungul
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	1 semester
5	Number of ECTS credits	4
6	The total number of hours	103 hours
7	General description and purpose of the educational component	To equip the graduates with theoretical and practical knowledge on the breeding of the chosen species and breeds of exotic even-toed and odd-toed ungulates bred on farms and in zoological gardens.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The students gain knowledge on the breeding of the chosen species and breeds of exotic even-toed and odd-toed ungulates bred on farms and in zoological gardens.
Skills: The student is able to apply acquired knowledge in managing of flock of chosen even-toed and odd-toed ungulates.
Competences: The graduate is able to identify factors affecting the production and quality of their main products (milk, meat, wool, cashmere).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Taxonomic inclusion and domestication of selected species and breeds of exotic even-toed and odd-toed ungulates.
2.	Description of the most exotic ungulates kept as livestock (zebu, buffalo, yak, Bali-banteng, reindeer, camels, llamas and alpacas, angora and kashmir goats, asses, mules and exotic breeds of pigs and sheep, deer farms) or kept in zoos respectively in the field (bison, giraffe, rhino, hippo, Przewalski horse, zebra, etc.).
3.	Specifics of breeding, reproductive biology, nutrition and feeding, adaptation and management features of exotic ungulates..

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #3

1	The name of the course/module	Population Genetics
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	1 semester
5	Number of ECTS credits	6
6	The total number of hours	150 hours
7	General description and purpose of the educational component	Inform students about the principles of genetic variability of qualitative and quantitative traits at the individual level and can apply them at the population level.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The student will gain new knowledge about the principles of genetic variability of qualitative and quantitative traits at the individual level and can apply them at the population level.
Skills: The student is able to independently analyze genetic parameters and interpret their significance for the genetic evaluation of animal populations. The student will gain practical skills in evaluating the dynamics of changes in genotypic structure in small populations.
Competences: Based on the gained knowledge, the student is able to analyze genetic variability in specific conditions and can predict the dynamics of its changes in animal populations.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Genetic variability of qualitative and quantitative traits and characteristics in populations.
2.	Genetic and genotypic structure of populations.

3.	Equilibrium in populations and its changes.
4.	Methods of evaluation of frequency changes of genes and genotypes.
5.	Dynamics of genotypic changes and genetic distances of populations.
6.	Genetic parameters onf production traits, methods of estimation and its use in selection and breeding.
7.	Genetic basis of heterosis and inbreeding depression.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #4		
1	The name of the course/module	Rabbit Breeding
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	1 semester
5	Number of ECTS credits	4
6	The total number of hours	104 hours
7	General description and purpose of the educational component	To equip the graduates with theoretical and practical knowledge about biological properties and zootechnical requirements for extensive and intensive conditions of rabbit breeding.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The student will gain knowledge about biological properties and zootechnical requirements for extensive and intensive conditions of rabbit breeding. He knows the products and their quality from the farms.
Skills: The student is able to modulate the conditions of the breeding environment and apply knowledge to the implementation of breeding in order to use the production potential of animals while maintaining good health and welfare of rabbits.
Competences: The student is able to use the information to use and create a breeding environment, procedures and programs for the effective use of the potential of rabbits.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	History and domestication of rabbits.
2.	Distribution and characteristics of rabbit groups according to live weight.
3.	Division of rabbit breeds according to coat length.
4.	Hybridisation in rabbit breeding.
5.	Reproduction of rabbits.
6.	Breeding of rabbits. Techniques of rabbit breeding..
7.	Rabbit nutrition.
8.	Health issues in rabbit breeding.
9.	Products of rabbit breeding.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #5		
1	The name of the course/module	Feed Science
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	1 semester
5	Number of ECTS credits	6

6	The total number of hours	156 hours
7	General description and purpose of the educational component	Inform students about the nutritive value of forages and concentrate feeds, as well as their dietetic functions.
8	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
Knowledge: Student will take complex knowledge about the nutritive value of forages and concentrate feeds, as well as their dietetic functions. Will understand feed diversity in animal nutrition. Skills: Student will understand problems of precise nutritional and dietetic quality of forages and concentred feeds. Will be able to insufficient nutritional feed quality analyze. Competences: Student will be able after the graduation to nutritional and dietetic feed diversity define, identify causes of low quality and create solutions for improvement.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	Nutrients composition of plants and animals	
2.	Classification of feeds, their nutritive value and digestibility	
3.	Specifical properties of fresh green feedsuffs, silages, sillaged grits,root-crops,hay, corns, rests after industrial processing, animal feedstuffs and synthetic feedstuffs. Watter in animal feeding	
4.	Unconventional feedstuffs, additives of biofactors and oher additives.	
5.	Feedstuffs as source of minerals and speciffic active nutrients	
6.	Nutritive additives	
7.	Antinutritive ingredients and toxic ingredients in feestuffs	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)		Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars		Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #6		
1	The name of the course/module	Infections and Intoxications
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	1 semester
5	Number of ECTS credits	6
6	The total number of hours	156 hours
7	General description and purpose of the educational component	Inform to students with contagious bacterial, viral, parasitic diseases of animals and on prionosis infections. After completion of the subject the student understands of the principles of immunity against infections and infections patogenesis, is able to solve the prevention against infections, is able to apply knowledge for breeding of animals, is able to analyse symptoms of infections,is able to identify most frequentions of animals infections.
8	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
Knowledge: Students will gain theoretical knowledge of the basics of immunology, knowledge of etiology, transmission to animals and humans, the clinical course of infection and the prevention of serious infectious bacterial, viral, parasitic and fungal diseases. They know the requirements for healthy breeding. Skills: Students will master the procedures for handling animals that show signs of disease, have the skill for simple medical procedures and drug application. They can apply legislative requirements for animal health control to the infectious process and various types of infectious diseases. Competences: After acquiring the above knowledge and skills, students can implement preventive measures against the occurrence of individual infectious diseases and can apply in practical conditions legislative guidelines for the current disease situation.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	Legislation	
2.	Prophylaxis and zoonoses	

3.	Immunity
4.	Infectious process

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #7		
1	The name of the course/module	Management and Technology in Animal Husbandry
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	1 semester
5	Number of ECTS credits	6
6	The total number of hours	150 hours
7	General description and purpose of the educational component	The aim of this course is to acquaint students with comprehensive knowledge and practical skills for livestock management and technology.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: Student will acquire knowledge about the organizing principles, farming techniques and management, and usage of current and progressive technologies in cattle, sheep and pig farming. Skills: Student will be able to apply acquired knowledge in the organizing of livestock farming operations, management and technologies used in farming of various cattle, sheep and pig categories. Competences: Student is able to analyse the suitability of farming procedures, management and technologies used for farming various categories of cattle, sheep and pigs. Student understand the possibilities of automatization and robotization of various operations in animal husbandry.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	The current situation and trends in cattle, sheep and pig farming technique and technology.
2.	Legislation and regulation in animal husbandry and new farming solutions leading to improve environment.
3.	Farming management and techniques for various livestock categories, traditional and progressive farming practices using smart technologies.
4.	The characteristics of various housing systems in relation to biological and physiological requirements for animal health and welfare.
5.	The alternative technologies for feeding, watering, milking, manure removing systems and principles of flooring systems, technical possibilities of creating suitable micro climatic conditions and other barn components and equipment.
6.	The changes in farming management related to the application of automatization and robotization in animal husbandry.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #8		
1	The name of the course/module	Special Reproduction of Animals
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	1 semester
5	Number of ECTS credits	6

6	The total number of hours	160 hours
7	General description and purpose of the educational component	We want to give the information to students on the reproduction process of various species animals, on the control methods of animals reproduction and reproduction biotechnology, on an organization of breeding reproduction, on most important reproductive disorders. After completion of the student understands on the difference species, is able to solve specific requests of individual species of farm animals, is able to apply knowledge in practical reproduction of animals, is able to analyze the reasons of reproduction disorders, is able to identify of an animal infertility.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: Students will gain theoretical knowledge about interspecific differences in livestock reproduction about their physiological specifics about the most common problems and pathological conditions of reproductive organs. Handiness: The students the use of technical aids in controlling the various stages of their reproductive process. As a result of the internships of students during livestock births, they will acquire skills in terms of assistance in controlled and directed births. They will gain skills in primary care in dealing with fertility disorders and venereal diseases. Powers: Based on the above skills, they can organize and control the reproductive process of an pets and animals husbandry.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Fertility.
2.	Neuroendocrine disorders of reproduction.
3.	Food sterility.
4.	Disorders of puerperia.
5.	Biotechnology of reproduction.
6.	Reproduction of small ruminants and dogs, reproduction of equides, reproduction of small ugulates, reproduction of domestic-social animals.
7.	Biotechnology of reproduction
8.	Reproductive biotechnology
9.	Economics of animal reproduction

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Excursions, field practices Individual work

GENERAL INFORMATION ABOUT THE COURSE #9		
1	The name of the course/module	Applied Economics and Finance for Farmers
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	2 semesters
5	Number of ECTS credits	4
6	The total number of hours	52 hours
7	General description and purpose of the educational component	The position of agriculture in the national economy, the development of Slovak and world agriculture are evaluated, importers' policies are taken over, agricultural policy instruments - prices, direct payments, production quotas, emphasis is placed on EU CAP, rural development and structural funds, attention is paid to practical aspects for farmers as the foundations and principles of the common agricultural policy, direct payments, project support, sources of financing and risk management.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
The graduate will have the opportunity to get acquainted with the practical aspects of agricultural economics, policy and finance, will be able to assess the practical impact of agricultural policy on households and businesses and overall well-being. The graduate will be able to use various quantitative methods to assess the impact of agricultural policy, get acquainted with practical aspects such as the basics and principles of the common agricultural policy, direct payments, project support, funding sources and risk management.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	The position of agriculture in the national economy, the development of Slovak and world agriculture are evaluated, importers' policies are taken over, agricultural policy instruments - prices, direct payments, production quotas, emphasis is placed on EU CAP, rural development and structural funds.
2.	The practical aspects for farmers as the foundations and principles of the common agricultural policy, direct payments, project support, sources of financing and risk management

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	

GENERAL INFORMATION ABOUT THE COURSE #10		
1	The name of the course/module	Beekeeping
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	2 semester
5	Number of ECTS credits	6
6	The total number of hours	153 hours
7	General description and purpose of the educational component	Inform students about the honeybee colony biology and the utilisation of the production potential of honeybee colonies.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: Student will gain knowledge about the honeybee colony biology and the utilisation of the production potential of honeybee colonies.
Skills: The graduate of the course is able to assess the suitability of the apiary location, choose the appropriate type of hives and tools, manage and implement preventive, curative and breeding measures, reproduce colonies, breed bee queens and implement measures to ensure profitability of beekeeping operations.
Competences: The student is able to understand and analyze the interaction between bee colony and the external environment. By completing the course the student is able to practically master the basics of beekeeping and production of bee products.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Beekeeping equipment and hive construction.
2.	Honey bee castes, anatomy and physiology of the honeybee.
3.	Creating new colonies, queens breeding and testing.
4.	Beehives management during the year.
5.	Pollination and bee pasture in Slovakia.
6.	Diseases, pests and poisoning of bee colonies.
7.	Legislation and subsidy programs for beekeepers.
8.	Practical work on apiary and excursion.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #11		
1	The name of the course/module	Feeding of Pet and Exotic Animals
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	2 semester
5	Number of ECTS credits	6

6	The total number of hours	150 hours
7	General description and purpose of the educational component	To equip graduates with the theoretical and practical knowledge necessary to calculate daily nutrient requirements, as well as the nutritional value of feeds for a particular feeding in relation to different types of domestic or exotic animals.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: Graduate gain information required for daily nutrients needs calculations, as well as about nutritional value of feeds specific feeding regarding to different species of companion or exotic animal.
Skills: Graduate can calculate the daily nutrients need and design the optimal diet composition of different species of companion or exotic animal (from feed and nutritional point of view). He has knowledge about principles of storage of feeds and can choose the best feeds preparation method as well as the best method of feeding in accordance with individuality of animal.
Responsibilities: In case of change in daily nutrients requirement the graduate can optimize the diet composition regarding the required condition status of animal. These knowledges can apply in practice and in research area.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	The characteristic of suitable nutritional sources for companion and exotic animal living ex situ.
2.	Guides of feeding of companion and exotic animals, as well as animals bred in ex situ conditions.
3.	Determination of nutrients requirement for these animals and regarding to condition and health status.
4.	Creating of suitable diets for animals bred ex situ and the comparison of nutrition in wild or natural environment.
5.	Composition and modification of diets.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Excursions, field practices, semestral work Individual work

GENERAL INFORMATION ABOUT THE COURSE #12		
1	The name of the course/module	Special Hygiene of Animals
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	2 semester
5	Number of ECTS credits	4
6	The total number of hours	115 hours
7	General description and purpose of the educational component	Inform students about the needs and requirements of individual species of livestock for the breeding environment in relation to the micro-climate, hygiene, welfare, production, reproduction and health.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The student of the course will gain knowledge about the needs and requirements of individual species of livestock for the breeding environment in relation to the micro-climate, hygiene, welfare, production, reproduction and health. They will gain practical and methodological knowledge about the importance of disease prevention related to the breeding environment and systems of breeding and handling of animals and can formulate appropriate recommendations for the implementation of practice.
Skills: The graduate of the course is able to analyze the factors of the breeding environment and their impact on individual species and category of livestock in terms of welfare, health and performance. Independently and proactively apply professional knowledge to breeding measures and improve the hygiene of breeding of individual types of livestock. Professionally present the results of own study and practice in breeding management.
Competences: Obtained knowledge through innovative and creative thinking is able to apply in improving the living and husbandry conditions of pets and cattle in practice.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Basic hygiene requirements for quality livestock environment in relation to thermoregulation, yield, health and welfare of animals according species and categories.
2.	Protecting farms against the introduction of infection diseases
3.	Prevention of production diseases - external and internal causes

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars, exercises	Excursions, field exercises, individual work, external study

GENERAL INFORMATION ABOUT THE COURSE #13		
9.	The name of the course/module	Animal Breeding
10.	Faculty/department	Faculty of Agrobiology and Food Resources
11.	Status of the educational component	Optional
12.	Semester	2 semester
13.	Number of ECTS credits	4
14.	The total number of hours	103 hours
15.	General description and purpose of the educational component	To equip the graduates with profound the theoretical and practical knowledge in the field of breeding and genetic improvement of animal characteristics
16.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: The graduate of the course will understand the theoretical and practical knowledge in the field of breeding and genetic improvement of animal characteristics. Skills: Based on the latest knowledge of modern livestock breeding, he can apply estimates of the genetic quality of animals. Competences: Can analyze genetic evaluation systems in livestock at the level of the herd and at the level of the whole population.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	General concepts, principles of selection, types of selection and selection procedures
2.	Breeding value estimation of livestock
3.	Breeding methods
4.	Selection indexes
5.	Basic principles of the breeding programmes
6.	Genomic selection and its use in animal breeding

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #14		
1	The name of the course/module	Biodiversity in Farm Animal Population
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	2 semester
5	Number of ECTS credits	4
6	The total number of hours	120 hours
7	General description and purpose of the educational component	Inform students about the importance of animal genetic resources in terms of food production and use in agriculture, assessment of genetic diversity and the need to protect it.
8	Prerequisites for studying the course/module, connection	N/A

	with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: the student will gain knowledge about the importance of animal genetic resources in terms of food production and use in agriculture, assessment of genetic diversity and the need to protect it.
Skills: the student can analyze and quantify the state of diversity of animal populations using methods based on the analysis of pedigree and molecular genetic data. The student can interpret the results of analyses correctly and is competent to assess the degree of threat to populations of animal genetic resources by loss of diversity.
Competences: the student proposes and applies ways to address the loss of genetic diversity in populations of animal genetic resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Biological diversity, gene pool and animal genetic resources.
2.	Management of animal genetic resources, their classification by risk of endangerment and conservation methods.
3.	Evaluation and monitoring of genetic diversity in animal population.
4.	Utilisation of pedigree information to assess the genetic diversity of the breed.
5.	Utilisation of molecular genetic information to assess the genetic diversity of the breed.
6.	Mating systems.
7.	Strategy for development of animal genetic resources.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #15

1	The name of the course/module	Feeding of Non-Ruminants
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	2 semester
5	Number of ECTS credits	6
6	The total number of hours	156 hours
7	General description and purpose of the educational component	To introduce students to the theoretical principles for feeding according to the requirements of energy and nutrients for different kinds and categories of non-ruminants - poultry, pigs, horses and fur-bearing animals.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: Student will take knowledge about nutrients and energy requirements for individual age categories of swine, horses and poultry. Will understand the principles of feed mixtures and feed rations formulation.
Skills: Student will understand the principles of precise feed rations formula for swine, horses and poultry.
Competences: After the subject graduation, student will be able to errors analyze in feeding and with software support apply the solution in praxis.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Theoretical principles for feeding according to the requirements of energy and nutrients for different kinds and categories of non-ruminants - poultry, pigs, horses and fur-bearing animals.
2.	The selection and dosing of components for the feed mixtures and diets.
3.	Feeding optimization according to economical considerations is achieved.
4.	Theoretical principles of animal feeding according to age, life weight, physiological status and production effects are given.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #16		
1	The name of the course/module	Meadow and Pasture Management
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	2 semester
5	Number of ECTS credits	6
6	The total number of hours	150 hours
7	General description and purpose of the educational component	Inform students about the composition and structure of the grass community, their relationship to the environment, the typology and management of grasslands, and the possibilities of using agroecological support in grassland management.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: After graduation, the student has knowledge of the composition and structure of the grass community. Their relationship to the environment. Masters the typology and management of grasslands. He knows the possibilities of using agri-environmental support in grassland management. Skills: The graduate is able to apply knowledge about biological and ecological characteristics of grasslands in their management and use depending on the classification of the stand. They will learn to determine the condition of the stand from a nutritional and moist point of view on the basis of knowledge of structural characteristics, to apply it in a differentiated approach to grassland management in the context of habitat conditions, floristic composition, and animal requirements for feed quality, resp. to compile a complex mix of perennial species of grasses and clover when establishing temporary stands. Competences: It is characterized by a high degree of independence and is able to define and creatively address the elimination of negative environmental impacts and management in the context of production and non-production aspects of grassland cultivation.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Production and ecological functions of grasslands.
2.	Composition and structure of the grass community.
3.	Grasslands and environment.
4.	Phytocoenology and typology of grasslands.
5.	Grass ecosystem.
6.	Grassland management - nutrition, regeneration, and sowing.
7.	Use of grasslands - mowing, grazing.
8.	Possibilities of using agri-environmental support in grassland management.
9.	Evaluation and ecological characteristics of grasslands.
1(	Compilation of temporary clover grass stands.
1	Project from differentiated grassland management.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #17		
1	The name of the course/module	Sustainable and Organic Animal Production
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	2 semester
5	Number of ECTS credits	6
6	The total number of hours	150 hours
7	General description and purpose of the educational component	Inform students about the principles and meaning of Farm Animal Husbandry in the sustainable agricultural systems with emphasis to the ecological point of view and design of breeding condition with high level of welfare.

8	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
Knowledge: Student will understand the principles and meaning of Farm Animal Husbandry in the sustainable agricultural systems with emphasis to the ecological point of view and design of breeding condition with high level of welfare. After completion of subject the student understands the animal welfare friendly breeding and husbandry systems. Skills: The graduate will be able to evaluate animal welfare at farm level by using modern assessment methods. They can socially as well as physically enrich breeding environment in livestock farming. Competencies: The graduate will be able to solve the environment enrichment tasks in farm animal husbandry, is able to analyse and asses the welfare level on farm and organise the organic animal production.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	Sustainable animal production.	
2.	Ecological principles of livestock farming.	
3.	Differences between conventional and organic livestock farming.	
4.	Farm animal biodiversity.	
5.	Conservation of endangered breeds of farm animals.	
6.	Evaluation of farm animal housing conditions.	
7.	Farm animal needs.	
8.	Importance of behavior for farm animals welfare.	
9.	Methods of behavior evaluation.	
10.	Farm animal welfare evaluation.	
11.	Alternative livestock farming systems.	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)		Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars		Practices, elaboration of reports from practises, elaboration of term project, self-study

GENERAL INFORMATION ABOUT THE COURSE #18		
1	The name of the course/module	Breeding of Horses
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	3 semester
5	Number of ECTS credits	6
6	The total number of hours	156 hours
7	General description and purpose of the educational component	Development of horse breeding and selection work in horse breeding, assessment of body composition and charactering major breeds of horses, identifying and describing different categories of horses, basic principles of technology breeding, rearing and training of horses, principles of new production systems operation, welfare in horse breeding, horse nutrition.
8	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
Knowledge: Student obtains knowledge needed for horse management and breeding of certain utility types. Abilities: Student will gain knowledge of the use of individual breeds of horses, evaluation of their exterior and performance as well as the correct management of horse breeding. Competence: The student will be able to apply the information in the field of breeding technology, nutrition and breeding of young horses. Basic knowledge of technique and technology of horse breeding will be obtained by the graudate.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	Horse breeding in Slovakia.	
2.	Domestic and foreign horse breeds.	
3.	Breeding records in horse breeding.	
4.	Stud farms in Slovakia and abroad.	
5.	Breeding programs in horse breeding.	
6.	Ethology and psychology of horses.	
7.	Basic horse training.	

8.	Testing horses' utility capabilities.
9.	Nutrition and feeding of horses.
10.	Horse gene reserves.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars, consultations	Excursion, Individual work

GENERAL INFORMATION ABOUT THE COURSE #19		
1	The name of the course/module	Breeding of Non-Traditional Birds
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	3 semester
5	Number of ECTS credits	4
6	The total number of hours	104 hours
7	General description and purpose of the educational component	Inform students about the basic principles of breeding, requirements and needs of promising, non-traditional bird species used for economic purposes.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: During the study, the student will gain the necessary information and understand the basic principles of breeding, requirements and needs of promising, non-traditional bird species used for economic purposes. For individual species, students will gain knowledge about the importance of their breeding, origin, domestication, breeds, production and reproductive characteristics, principles of breeding, breeding, fattening, nutrition and demands of these bird species on microclimatic and technological conditions of the breeding environment with emphasis on their health and well-being.
Skills: After completing the course, the student will be able to study the knowledge gained from modern breeding of these species of birds in the design and operation of breeding facilities in connection with providing a suitable breeding environment, nutrition and feeding technology of these birds.
Competences: The student is able to use the acquired knowledge through innovative, creative thinking and professional presentation of the results of their own study in improving the living conditions of captive, promising species of birds used for economic purposes.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Biology and breeding technology of Japanese quails, guinea fowls, turkeys, peacocks, ostriches, pigeons, muscovy ducks, geese.
2.	Possibilities of the reproductive process regulations.
3.	Characteristics and potential uses of the products.
4.	Regulation of breeding environment.
5.	Basics of non-traditional birds nutrition.
6.	Legislation determining housing conditions, labeling and registration..

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars, consultations	Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #20		
1	The name of the course/module	Small Animal Breeding Technology
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	3 semester
5	Number of ECTS credits	6
6	The total number of hours	156 hours

7	General description and purpose of the educational component	To inform students about Inform students about the use of highly effective biological material of selected species of small livestock - poultry and rabbits in intensive breeding systems, the organization of poultry and breeding work in the Slovak Republic, the technological and alternative technological breeding systems used, the requirements of individual species on the conditions in rearing, breeding and fattening.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The student will gain knowledge about the use of high-performance biological material of selected species of small livestock - poultry and rabbits in intensive breeding systems, the organization of poultry and breeding work in the Slovak Republic, the technological and alternative technological breeding systems used, the requirements of individual species on the conditions in rearing, breeding and fattening.
Skills: The graduate of the course will be able to apply the acquired knowledge in connection with the provision of microclimatic and technological conditions as well as prevention and health protection in the breeding of rabbits, chickens, turkeys, ducks and geese in intensive breeding conditions.
Competences: After completing the course, the student will learn the procedures for the use of intensification of reproductive processes and evaluation of performance characteristics of rabbits and poultry. He will acquire the ability to provide technology and breeding techniques in compliance with welfare conditions.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	The use of high-performance biological material of perspective species of small animals - poultry and rabbits.
2.	Selection and breeding.
3.	Development of high-performance populations.
4.	Insemination and reproductive process.
5.	Intensive systems of breeding.
6.	Technological systems of breeding.
7.	Alternative technologic systems of breeding.
8.	Evaluation of products according to EU legislation.
9.	Zoohygienics.
10.	Health and Safety.
11.	Welfare in production.
12.	Evaluation of performance.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #21

1	The name of the course/module	Animal Breeding Programmes
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	3 semester
5	Number of ECTS credits	4
6	The total number of hours	100 hours
7	General description and purpose of the educational component	Inform students about breeding program set up on biological, technical and economical base.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: Student gets knowledge about breeding program set up on biological, technical and economical base.
Skills: Student will understand continuity of knowledge of biological character from Animal Science, Genetics, of technical character about animal husbandry of different farm animal species a their economic impact and can critically analyze them.
Competences: Student is able to apply knowledge from Animal Breeding, Population Genetics and Biodiversity of Farm Animals and after completing the course prepared to set up breeding program in practical conditions.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Role of breeding programmes in populations of farm animals.
2.	Technical and organisational outlines of creation of breeding programme, effects affecting breeding programmes of different farm animal species.
3.	Effect of population size, farm structure, systems of use of sires on breeding programme design.
4.	Constitution of mating programmes for young sires testing, mating programmes for production of new generation of sires and mating programmes in production herds.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Individual work

GENERAL INFORMATION ABOUT THE COURSE #22		
1	The name of the course/module	Nutrition and Metabolic Disorders of Animals
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	3 semesters
5	Number of ECTS credits	4
6	The total number of hours	39 hours
7	General description and purpose of the educational component	The goal of the subject is to introduce of students to the impact of alimentary disproportions on the health of the animals, with the emergence, course and consequences of Metabolic Disorders and the way to avoid them. The student understands the principle of the development of metabolic disorders can assess its cause, is able to assess the metabolic profile test and can take appropriate precautions against the occurrence of metabolic disorders.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The student will gain knowledge about animal nutrition disorders and their consequences, the regulation of metabolic processes, the principles of metabolic disorders, the role of organs in metabolism, organ changes in metabolic disorders and adaptation syndrome.
Skills: Students will master and be able to apply the assessment of the condition of animals as BMI, assess the adequacy of nutrition in relation to condition and metabolic disorders, know the importance and based on the practical skills gained from laboratory exercises can evaluate the metabolic profile test.
Competence: Student after the acquired knowledge and skills can optimize the dietary side of animal nutrition, assess the condition of animals and evaluate the regular metabolic profile of animals.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Influence of nutrition on homeostasis of the organism.
2.	Disorders of genetic metabolism.
3.	Energy metabolism disorders.
4.	Disorders of fat metabolism.
5.	Carbohydrate metabolism disorders.
6.	Disorders of protein metabolism.
7.	Disorders of mineral metabolism.
8.	Disorders of acid-base balance
9.	Disorders of vitamin metabolism
10.	Hematological profile
11.	Metabolic profile test (MPT)

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	N/A

GENERAL INFORMATION ABOUT THE COURSE #23

1	The name of the course/module	Processing Technology of Supplementary Animal Products
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	3 semester
5	Number of ECTS credits	4
6	The total number of hours	104 hours
7	General description and purpose of the educational component	To equip the graduates with theoretical and practical knowledge about the market assortment and various processes and conservation styles of products originating from poultrykeeping, freshwater and marine fishery, hunting, beekeeping, rabbit farming and other non-traditional branches of animal production.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The graduate will gain an overview of the market assortment and various processes and conservation styles of products originating from poultry keeping, freshwater and marine fishery, hunting, beekeeping, rabbit farming and other non-traditional branches of animal production.
Skills: The student masters the basic processing procedures used in the processing of selected animal products. Graduate is able to control function and operation of processing lines for the small domestic animals slaughtering and the processing of table eggs. Graduate is able to classify and qualitatively evaluate the poultry, game, rabbits and fish carcasses, as well as table eggs and bee products.
Competences: Graduate is able to plan processing sequences and technological support needed for the processing of selected animal products.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Quality requirements for quality of poultry for slaughter and eggs.
2.	Finalization of market poultry types, processing of slaughter poultry, semi-finished and final products from poultry meat.
3.	Requirements for the production of table eggs, its quality and assortment.
4.	Fishery products processing, its evaluation and market assortment.
5.	Acquisition, processing and evaluation of meat from game animals and rabbits.
6.	Processing and evaluation of honey and other products from beekeeping.
7.	The nutritional value of foods, hygiene of acquisition, methods of preservation, protection against counterfeiting, packaging and finalization of meat and other food products.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Semestral work, Individual work

GENERAL INFORMATION ABOUT THE COURSE #24

1	The name of the course/module	Technologies in Feeding Industry
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Optional
4	Semester	3 semester
5	Number of ECTS credits	6
6	The total number of hours	156 hours
7	General description and purpose of the educational component	Inform students about the principles and nutritional effects of various methods of processing feed materials used in feed. Understand the problematics of industrial feed production and good manufacturing practice.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: The graduate will gain knowledge about the principles and nutritional effects of various methods of processing feed materials used in feed. Understand the problematics of industrial feed production and good manufacturing practice. Skills: Can analyze the physical structure of feed mixtures and feed rations, calculate the mixing index of individual components in the feed mixture, respectively. in the feed ration. Competences: Based on the analysis, he is able to optimize procedures for improving the quality of feed mixtures and feed rations, and optimize conditions for storage and handling of feed.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	The importance and trends in the feeding industry from the point of view of new technologies development of raw materials as components of the fodder mixtures and dosages..
2.	The principles and nutritional effects of physical, chemical and biological raw material prepartion (tastiness, digestibility, biological value, health quality, durability, physical structure).
3.	The physical-chemical properties of fodder in terms of the homogenity, stability and storage of fodder mixtures and dosages and pre-production treatment of fodder.
4.	The technological lines for conditioning, production, conservation, storage and fodder handling.
5.	In practical conditions valuating of physical characteristics of feed mixtures, valuating of homogenity and structure of total mixed rates.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, seminars	Excursions, field practices, Semestral work Individual work

GENERAL INFORMATION ABOUT THE COURSE #25		
1	The name of the course/module	Diploma Thesis Seminar
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	4 semester
5	Number of ECTS credits	4
6	The total number of hours	100 hours
7	General description and purpose of the educational component	The goal of the subject is to introduce students understands the structure of the diploma thesis, can determine a clear goal and methodology of the work. Based on the established hypotheses and the obtained results, formulate the conclusions of the diploma thesis.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: The graduate of the course understands the structure of the diploma thesis, can determine a clear goal and methodology of the work. Based on the established hypotheses and the obtained results, he can formulate the conclusions of the diploma thesis. Skills: The student is able to work independently, apply basic scientific methods and work with professional literature. Competences: By completing the course, student can use the acquired knowledge to master the issues addressed in the thesis in terms of professional and formal aspects.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Regular consultations with the supervisor of the diploma thesis in its processing.
2.	Work with professional and scientific literature, standards.
3.	Elaboration of graphic and tabular part.
4.	Statistical evaluation of results.

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Consultations	Individual work

GENERAL INFORMATION ABOUT THE COURSE #26

1	The name of the course/module	Engineering Practice
2	Faculty/department	Faculty of Agrobiology and Food Resources
3	Status of the educational component	Mandatory
4	Semester	4 semester
5	Number of ECTS credits	6
6	The total number of hours	150 hours
7	General description and purpose of the educational component	The aim is to complete the professional profile of the graduate in the study program, verify the acquired theoretical knowledge in practice, create an idea of the business and gain knowledge about the organization, management, operation and provision of practical tasks in various entities and organizations within the agri-food complex. The graduate of the course is able to solve practical tasks assigned to him, can apply knowledge of theoretical subjects under the supervision of agronomists or zootechnics on the farm, can analyze various situations on the farm.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: acquires knowledge of professional and managerial work in his specialization.
Skills: the graduate acquires and deepens skills and procedures in the field of practical activities related to the acquisition of basic elements in farm management, planning and production cycle in individual sections of plant and animal production
Competences: he is able to work as a manager and specialist according to the studied specialization, as well as a top manager and executive in all types of business entities in the field of agriculture and agri-food. The graduate will also be employed in research and education.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Individual professional practice the student will gain experience from specific zootechnical or agronomic practice in breeding and crop production in all types of business entities in the field of agriculture, agri-food, state administration and self-government institutions, in processing companies, in catering establishments, in research, etc.
2.	Management practice the student synthesizes and practically applies the acquired theoretical knowledge from the study in the analysis, design and practical management of the farm at all levels of the production process..

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Consultation / briefing	Professional individual practice, Management practice

TECH TECHNOLOGICAL UNIVERSITY, ISRAEL

1	**Criterion A: University profile**		
1.1	**Name of the University**	**TECH TECHNOLOGICAL UNIVERSITY, ISRAEL**	
1.2	**Classical or applied**	**Classical**	
2	**Criterion B: Profile of the educational program (Curriculum)**		
2.1	Number of Aquaculture disciplines	one	
2.2	The name of the educational program	Aquaculture	
2.3	Type of diploma	Master	
2.4	Total number of credits (ECTS)	N/A	
3	**Criterion C: Setting the educational program (Curriculum)**		
3.1	Duration of the program	2 semesters	
3.2	The purpose of the educational program	This Professional Master's Degree in Aquaculture offers a specific and specialized training, as well as necessary in these times, to be able to face the challenges that arise in the near future. The main objective of this program is to provide the professional of this sector with the necessary tools for a better optimization of resources. The training program covers the most important aspects of daily practice in this sector, so that the objective of improving all the parameters that lead to production optimization is within the student's reach. In addition, it brings together the greatest variability of examples and possibilities, so that it reliably approaches the complexity of the sector, which has a wide diversity of production models, making it necessary to have a global vision of the sector.	
4	**Criterion D: Characteristics of the educational program (Curriculum)**		
4.1	Subject area (field of knowledge, specialty, specialization (if available))	**Nature Science, Aquaculture**	
5	**Criterion E: Teaching and assessment**		
5.1	Teaching and learning methods	Lectures, seminars, practice; Interactive Summaries; Expert-Led Case Studies and Case Analysis	
5.2	Assessment	Testing & Retesting, Examinations	
6	**Criterion F: Software competencies**		
6.1	Integral competence	N/A	
6.2	General competences	N/A	
6.3	Professional competences	N/A	
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	1.This Professional Master's Degree provides students with specialized tools and skills to successfully develop their professional activity in the broad environment of aquaculture, working on key competencies such as knowledge of the reality and daily practice of the professional, and developing responsibility in the monitoring and supervision of their work, as well as communication skills within the essential teamwork. 2. Develop specialized knowledge to improve their capacity in the management of any field related to the Aquaculture sector. 3. After passing the assessments of the Professional Master's Degree in Aquaculture, the professional will have acquired the necessary skills for a quality and up-to-date praxis based on the most innovative didactic methodology. .	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	The program includes in its teaching staff leading experts in Aquaculture, who bring to this training the experience of their work. They are world-renowned professionals from different countries with proven theoretical and practical professional experience.	
8.2	Material and technical support	Sufficient material and technical resources, rich base for research and practice	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	**Aquaculture Production**	N/A	exam
9.1.2	**Advanced Physiology of Aquaculture Species. Fish, Molluscs, Crustaceans and Algae**	N/A	exam
9.1.3	**Nutrition in Aquaculture Farms**	N/A	exam

9.1.4	**Species Reproduction in Aquaculture**	N/A	exam
9.1.5	**Biotechnology and Genetics in Aquaculture**	N/A	exam
9.1.6	**Pathology Most frequent Diseases and Alterations in Aquaculture**	N/A	exam
9.1.7	**Aquaculture Facilities. Types, Design and Management**	N/A	exam
9.1.8	**Aquaculture Sector Regulations**	N/A	exam
9.1.9	**Structure and Economic Management**	N/A	exam
9.1.10	**Aquaculture Culture Models**	N/A	exam
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1			
9.2.2			
9.2.3			
9.2.4			
9.2.5			
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Qualifying Exam	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	**Aquaculture Production**
2	Faculty/department	Veterinary Medicine
3	Status of the educational component	Mandatory
4	Semester	1 semester
5	Number of ECTS credits	N/A
6	The total number of hours	150 hours
7	General description and purpose of the educational component	1. Analyze the history and evolution of aquaculture production for a better understanding of its current situation. 2. Examine the different criteria that determine water quality in Aquaculture. 3. Determine the parameters that determine water quality in Aquaculture. 4. Analyze the different types of crops that exist and the most frequent production systems in them. 5. Examine the different biosecurity measures existing within the different types of cultures. 6. Generate specialized knowledge on the different genetic resources that can be used to achieve culture improvement. 7. Establish the processes for handling and management of waste in Aquaculture. 8. Develop expertise in ways to control, manage and minimize the pollution produced by this activity.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Aquaculture
2.	Water Quality
3.	Water Quality Parameters in Aquaculture Cultures
4.	Types of Aquaculture
5.	Live Food Culture
6.	Aquaponics
7.	Biosecurity in Aquaculture Farms
8.	Immunology
9.	Handling and Waste Management in Aquaculture
10.	Aquaculture as a Source of Pollution and Pollution Prevention

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Lecture, seminar, Interactive Summaries; Expert-Led Case Studies and Case Analysis	Individual work

GENERAL INFORMATION ABOUT THE COURSE #2		
1	The name of the course/module	**Advanced Physiology of Aquaculture Species. Fish, Molluscs, Crustaceans and Algae**
2	Faculty/department	Veterinary Medicine
3	Status of the educational component	Mandatory
4	Semester	1 semester
5	Number of ECTS credits	N/A
6	The total number of hours	150 hours
7	General description and purpose of the educational component	1. Determine the physiological mechanism of action of the sensory organs. 2 Generate specialized knowledge on the relationship between oxygen uptake processes and the mechanisms of the cardiovascular system. 3. Delve into the metabolic processes and their results. 4. Determine the importance of osmotic and ionic balances. 5. Establish the importance of the endocrine system in the control of other physiological functions. 6. Analyze the causes of stress and the methods to solve them. 7. Determine more specifically the physiological processes in algae.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Sensory System I (Vision, Hearing and Balance, Cutaneous Sensors, Behaviour)
2.	Sensory System II (Nociception, Chemoreceptors, Special Adaptations)
3.	Cardiovascular System of Aquaculture Species
4.	Metabolisms of the Species used in Aquaculture
5.	Oxygen Uptake
6.	Osmotic and Ionic Balance
7.	Stress in Aquaculture Facilities
8.	Endocrine System
9.	Physiology of the Skin and Locomotion Anatomophysiology
10.	Applied Algal Physiology

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar, Interactive Summaries; Expert-Led Case Studies and Case Analysis	Individual work

GENERAL INFORMATION ABOUT THE COURSE #3		
1	The name of the course/module	**Nutrition in Aquaculture Farms**
2	Faculty/department	Veterinary Medicine
3	Status of the educational component	Mandatory
4	Semester	1 semester
5	Number of ECTS credits	N/A
6	The total number of hours	150 hours
7	General description and purpose of the educational component	1. Determine the nutritional requirements of fish, crustaceans and molluscs. 2 Manage the practical formulation of food for different life stages, such as the larval stage, fattening stage and reproductive stage. 3. Analyze the digestibility of key food components. 4. Establish the relevant aspects of the different forms of presentation of feed for Aquaculture cultures.

		5. Generate specialized knowledge on the supply of minerals, vitamins and other additives. 6. Analyze the advantages and possible disadvantages derived from the use and misuse of probiotics. 7. Examine live feed cultures and their use in Aquaculture.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Nutritional Requirements of Aquatic Organisms
2.	Practical Feed Formulation
3.	Feed Quality and Raw Material Selection
4.	Digestibility of Food Components
5.	Forms of Presentation of Feed for Aquaculture Cultures
6.	Supply of Minerals, Vitamins, and Other Additives
7.	Intestinal Microbiota
8.	Use of Probiotics in Aquaculture
9.	Live Feeding: Probiotics and Prebiotics
10.	Antinutritional Factors and Toxins in Feeds

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar, Interactive Summaries; Expert-Led Case Studies and Case Analysis	Individual work

GENERAL INFORMATION ABOUT THE COURSE #4

1	The name of the course/module	**Species Reproduction in Aquaculture**
2	Faculty/department	Veterinary Medicine
3	Status of the educational component	Mandatory
4	Semester	1 semester
5	Number of ECTS credits	N/A
6	The total number of hours	150 hours
7	General description and purpose of the educational component	1. Specify the physiological mechanism of action of the reproductive organs. 2 Generate specialized knowledge on hormone regulation in reproductive processes. 3. Determine the importance of sex determination and differentiation. 4. Analyze the effectiveness of environmental control on reproduction. 5. Determine the most commonly used fertilization methods. 6. Generate specialized knowledge on reproductive processes in algae. 7. Determine the usefulness of cryopreservation in breeding farms. 8. Examine the importance of diet and endocrine disruptors on reproductive processes.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Reproduction in Aquaculture Species
2.	Sex Determination and Differentiation in Aquaculture Species
3.	Reproductive Physiology I. Males
4.	Reproductive Physiology II Females
5.	Hormonal Regulation of Reproduction in Aquaculture
6.	Artificial Fertilization in Aquaculture
7.	Environmental Control of Reproduction in Aquaculture Facilities
8.	Cryopreservation

9.	Diet and Endocrine Disruptors in Reproduction
10.	Reproductive Physiological Characteristics

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar, Interactive Summaries; Expert-Led Case Studies and Case Analysis	Individual work

GENERAL INFORMATION ABOUT THE COURSE #5		
1	The name of the course/module	**Biotechnology and Genetics in Aquaculture**
2	Faculty/department	Veterinary Medicine
3	Status of the educational component	Mandatory
4	Semester	1 semester
5	Number of ECTS credits	N/A
6	The total number of hours	150 hours
7	General description and purpose of the educational component	1. Analyze the progressive innovation of aquaculture through selection and biotechnology. 2 Establish the genetic characteristics of Aquaculture species. 3. Analyze cloning techniques of Aquaculture species and their applications. 4. Determine the genetic selection techniques, crossbreeding, reproductive biotechnology and breeding programs present in the management of Aquaculture species. 5. Examine structural genomics and possible applications in Aquaculture. 6. Analyze functional genomics and possible applications in Aquaculture. 7. Evaluate the possibilities of transgenesis and gene editing in Aquaculture species.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Biotechnology, Genetics, and Selective Breeding in Aquaculture
2.	Genetics applied to Aquaculture Species
3.	Cloning and related Techniques in Aquaculture Species
4.	Crossing Strategies
5.	Genetic Selection: Breeding Programs
6.	Reproductive Biotechnology in Aquaculture Species
7.	Aquaculture Structural Genomics
8.	Aquaculture Functional Genomics
9.	Gene Transfer and Gene Editing
10.	Conservation of Genetic Resources of Aquaculture Species

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar, Interactive Summaries; Expert-Led Case Studies and Case Analysis	Individual work

GENERAL INFORMATION ABOUT THE COURSE #6		
1	The name of the course/module	**Pathology most frequent diseases and disorders in Aquaculture**
2	Faculty/department	Veterinary Medicine
3	Status of the educational component	Mandatory

4	Semester	1 semester
5	Number of ECTS credits	N/A
6	The total number of hours	150 hours
7	General description and purpose of the educational component	1. Examine the symptoms specific to each pathogenic agent. 2 Analyze the most frequent infectious diseases in the most common species. 3. Develop the functioning of the immune system in susceptible production species. 4. Generate specialized knowledge to carry out specific treatment for different pathologies. 5. Correct nutritional deficits in Aquaculture farms more efficiently. 6. Achieve better solutions to solve non-infectious pathologies. 7. Determine a biosafety protocol to reduce the risk of disease occurrence.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Pathology in Aquaculture
2.	Bacterial Diseases I
3.	Bacterial Diseases II
4.	Fungal Diseases
5.	Viral Diseases I
6.	Viral Diseases II
7.	Parasitic Diseases
8.	Nutritional Diseases
9.	Neoplasms
10.	Other Non-infectious Diseases

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar, Interactive Summaries; Expert-Led Case Studies and Case Analysis	Individual work

GENERAL INFORMATION ABOUT THE COURSE #7

1	The name of the course/module	**Aquaculture Facilities Types, design and management**
2	Faculty/department	Veterinary Medicine
3	Status of the educational component	Mandatory
4	Semester	2 semester
5	Number of ECTS credits	N/A
6	The total number of hours	150 hours
7	General description and purpose of the educational component	1. Designing facilities and water flow on inland farms. 2. Establish methods for oxygenation and aeration of water. 3. Develop specialized knowledge on the relationship between natural elements (wind, waves and currents) and marine facilities. 4. Increase management and organizational capacity according to the operation's objective. 5. Modernize facility maintenance plans. 6. Carry out a correct waste management. 7. Plan the final commercialization of the product.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	General Characteristics of the different types of Facilities
2.	Terrestrial Facilities Water
3.	Filtration and Oxygenation in Terrestrial Installations
4.	Marine Installations
5.	Management and Organization in the different types of Installations
6.	Maintenance of Facilities
7.	Growth
8.	Casualty Control
9.	Marketing of the Final Product
10.	Aquaculture and Sustainable Development

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar, Interactive Summaries; Expert-Led Case Studies and Case Analysis	Individual work

GENERAL INFORMATION ABOUT THE COURSE #8		
1	The name of the course/module	**Aquaculture Sector Regulations**
2	Faculty/department	Veterinary Medicine
3	Status of the educational component	Mandatory
4	Semester	2 semester
5	Number of ECTS credits	N/A
6	The total number of hours	150 hours
7	General description and purpose of the educational component	1. Establish the formal and material sources that generate the Aquaculture regulatory standards. 2. Select the regulations applicable to the geographical environment. 3. Determine the main policies and frameworks that promote the development of Aquaculture. 4. Examine the rights and duties deriving from the legal framework that regulates social, economic and labor conditions. 5. Enhance the use of resources and opportunities offered by official organizations in Aquaculture. 6. Analyze the importance of the activity of companies, foundations and entities that promote research, technological development and innovation projects in Aquaculture. 7. Generate capacity to adapt to new economic, legislative, technical and technological situations that may arise.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Legal Framework for Aquaculture
2.	Regulations related to Aquaculture
3.	Regulation of Aquaculture in the European Union
4.	International Organizations
5.	Food and Agriculture Organization of the United Nations (FAO)
6.	International Entities and Partnerships

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar, Interactive Summaries; Expert-Led Case Studies and Case Analysis	Individual work

GENERAL INFORMATION ABOUT THE COURSE #9		
1	The name of the course/module	**Structure and Economic Management**
2	Faculty/department	Veterinary Medicine
3	Status of the educational component	Mandatory
4	Semester	2 semester
5	Number of ECTS credits	N/A
6	The total number of hours	150 hours
7	General description and purpose of the educational component	1. Identify the techniques of economic-financial analysis. 2. Present and develop the concepts related to feasibility. 3. Define the rules of economic analysis. 4. Establish the foundations of financial analysis. 5. Identify the main economic and financial ratios to be considered. 6. Assess these ratios in the Aquaculture field. 7. Establish the equity parameters. 8. Generate the economic-financial debate in Aquaculture.
8	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Introduction
2.	The Quantitative and Qualitative importance of Aquaculture in the World
3.	Viability of the Aquaculture Enterprise
4.	Finance in the Aquaculture Company
5.	The Profit and Loss Account and Economic Flows in the Aquaculture Enterprise
6.	The Equity and Financial Analysis of the Aquaculture Business
7.	Economic Ratios to be considered in Aquaculture
8.	Economic Analysis in Aquaculture

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar, Interactive Summaries; Expert-Led Case Studies and Case Analysis	Individual work

GENERAL INFORMATION ABOUT THE COURSE #10		
1	The name of the course/module	**Aquaculture Culture Models**
2	Faculty/department	Veterinary Medicine
3	Status of the educational component	Mandatory
4	Semester	2 semester
5	Number of ECTS credits	N/A
6	The total number of hours	150 hours
7	General description and purpose of the educational component	1. Examine the production systems used in inland Aquaculture. 2. Analyze culture patterns of different inland species. 3. Determine the production systems used in marine Aquaculture. 4. Analyze the culture patterns of different marine species. 5. Examine the production systems used in ornamental Aquaculture. 6. Analyze culture patterns of different ornamental species. 7. Determine the details and differences between different fish species in order to take them into account in their culture methods. 8. Develop the most relevant aspects of other types of Aquaculture models, such as live feed culture.
8	Prerequisites for studying the course/module, connection	

	with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Inland Models I (Cyprinid Culture, Tilapia Culture)
2.	Continental Models II (Trout Farming, Salmon Farming)
3.	Marine Aquaculture Models I (Sea Bream Farming, Sea Bass Farming)
4.	Marine Aquaculture Models II (Turbot Farming, Tuna Farming)
5.	Mollusc Farming Models
6.	Crustacean Culture Model
7.	Ornamental Aquaculture Culture Models. Freshwater Species I (Viviparous Culture, Cultivation of South American Cichlids, Cultivation of African Cichlids)
8.	Ornamental Aquaculture Culture Models. Freshwater Species II (Cultivation of African Cichlids, Discus Fish Culture, Koi Culture, Culture of Other Freshwater Species)
9.	Ornamental Aquaculture Models. Saltwater Species (Clownfish Culture, Cultivation of Paracanthurus Hepatus, Cultivation of Pterapogon Kauderni, Macro and Microalgae Culture)
10.	Other Aquaculture Culture Models

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar, Interactive Summaries; Expert-Led Case Studies and Case Analysis	Individual work

VRIJE UNIVERSITY BRUSSELS

1	Criterion A: University profile	
1.1	Name of the University	**VRIJE UNIVERSITY BRUSSELS**
1.2	Classical or applied	Classical
2	**Criterion B: Profile of the educational program (Curriculum)**	
2.1	Number of Aquaculture disciplines	1
2.2	The name of the educational program	Marine and Lacustrine Science and Management
2.3	Type of diploma	MSc
2.4	Total number of credits (ECTS)	120
3	**Criterion C: Setting the educational program (Curriculum)**	
3.1	Duration of the program	4 semesters
3.2	The purpose of the educational program	The future of our oceans and lakes is a global concern, which explains the international appeal of this programme. With such diverse company, students will gain different perspectives, which we also emphasize with case studies on local and national policies and management practices in students' and professors' countries of origin. There's plenty of opportunity for practical experience too, thanks to laboratory and field training sessions, individual and group assignments, report presentations and discussion seminars, visits to marine research centres, excursions and internship... Not to mention individual master's thesis, which may be either field or laboratory based and includes governance or policy analyses. Students will benefit from the contacts and expertise of not one, but three high-quality Belgian universities: VUB, Ghent University and the University of Antwerp. The biology departments and research groups of all three are involved in developing and maintaining innovative and internationally recognised research programmes, along with a variety of international research networks. By exploring physical, chemical, geological, ecological and societal aspects, students will gain insight into the complexity of life and processes in marine environments and lakes, and the skills to study and manage them. This programme covers management and policy, as well as commercial aspects of aquatic ecosystems and law. With the expertise and experience gained in this master's programme, students will have the knowledge and capacities to contribute to the most up-to-date forms of education, pure and applied research and policy-supporting assignments.
4	**Criterion D: Characteristics of the educational program (Curriculum)**	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	
5	**Criterion E: Teaching and assessment**	
5.1	Teaching and learning methods	Generally, involves lectures, seminars, exercises, practicals, independent and external forms of study, research oriented activities and fieldworks. More details and specific teaching and learning methods could be found on regards to individual modules
5.2	Assessment	Different methods used depending on the module: Oral, Written, Multiple choice, Open questions
6	**Criterion F: Software competencies**	
6.1	Integral competence	Not defined
6.2	General competences	Not defined
6.3	Professional competences	Not defined
7	**Criterion G: Program Learning Outcomes**	
7.1	Program learning outcomes	1. Knowledge in the field of marine and lacustrine studies, advanced knowledge in one of the subdisciplines and in the interaction of the various subdisciplines within the broader field of application. 2. The ability to delineate, recognize and situate biological or geological elements in the context of the scientific domain, in particular in relation to aquatic ecosystems. 3. The ability to formulate a relevant research question concerning a complex problem in the field of marine and lacustrine studies, to develop a scientific research approach in

		conformity to accepted scientific methods and to bring this approach into practice. 4. The ability to formulate hypotheses concerning complex problems in the scientific domain and to evaluate them after a thorough literature study and data collection, to apply advanced knowledge of concepts, models, theories in order to solve concrete problems. 5. The ability to assume a responsible role in a pluridisciplinary team and, with overarching knowledge and insight, to develop collaboration with various sectors of society including the corporate sector (e.g. the harbour industry, tourism, fisheries, aquaculture). 6. Advanced and thorough practical skills in field research, experimental research, research in a laboratory context and in processing data, in order to solve scientific questions. 7. Advanced organisational skills in relation to research (teamwork, task division, development and logistics of a research approach). 8. Communicative skills regarding (personal) research results to specialists as well as nonspecialists, using various adapted media and formats. 9. A critical attitude with respect to the value, reliability and usefulness of non-selfgenerated data, with advanced skills in data-mining, analysis of data files, analysis of sources and literature study. 10. The ability to situate scientific problems, results of scientific research and technical views in an ethical and social perspective. 11. The ability to translate scientific views and results into a feasible and realistic management plan or to give an expertise-based contribution to a governance plan in (inter)national perspective. 12. The ability to formulate a proposal for a scientific project and to search the necessary financial resources. 13. The ability to function within an international professional environment keeping in mind the values of a multicultural society. 14. The ability to situate scientific insight, results of scientific research and technical achievements in a social perspective, against a political-historical (especially for the development-oriented finality), economical and governance-related background.	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	Teachers from Vrije University along with the teachers from Ghent University and Antwerpen University are conducting this course together	
8.2	Material and technical support	The university is equipped with all necessary tools and equipment to support the learning activities, but there is no any specific information in the websites	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Oceanography	4	End-of-term written exam (80% theory, 20% report on practical exercise)
9.1.2	Estuarine and Coastal Systems	5	Written examination without oral presentation • Closed book • Open-question
9.1.3	Freshwater ecology	5	Oral exam
9.1.4	Limnology	5	Written examination with open questions
9.1.5	Law and Ethics on Conservation of Aquatic Systems	3	First examination period: non-periodic evaluation (oral presentation 25%) and periodic evaluation (exam 75%) Second examination period: periodic evaluation (exam 100%)

9.1.6	In-situ and Remote Sensing Tools in Aquatic Sciences	5	Examination
9.1.7	Environmental modelling	3	Oral Exam determines 50% of the final mark. Practical Exam determines 50% of the final mark. Within the Oral Exam category, the following assignments need to be completed: • Oral examination with a relative weight of 1 which comprises 50% of the final mark. Note: The examination focuses on the practical implementation of ecosystem models as trained during the course. Within the Practical Exam category, the following assignments need to be completed: • Computer exercise with a relative weight of 1 which comprises 50% of the final mark. Note: The examination focuses on the practical implementation of ecosystem models as trained during the course
9.1.8	Seminars: Case Studies on Biodiversity Management	3	Evaluation is a combination of semi quantitative peer assessment (4 point scale, 70% of final mark) and evaluation by the lecturers (calibrating the peer assessment and giving 30% of marks) of a presentation, an executive summary, an annotated thematic glossary of biodiversity concepts, a layman’s summary or an extension project or any assignment bridging the gap between academia and society
9.1.9	Integrated Marine Coastal Ecology Field Course	3	The final grade is composed based on the following categories: LEC Presentation determines 100% of the final mark. Within the LEC Presentation category, the following assignments need to be completed: • Presentation with a relative weight of 1 which comprises 100% of the final mark

9.1.10	Governance and Policy in Development and Cooperation - Part I	3	N/A
9.1.11	Governance and Policy in Development and Cooperation - Part II	3	The final grade is composed based on the following categories: Oral Exam determines 34% of the final mark. PRAC Practical Assignment determines 33% of the final mark. SELF Practical Assignment determines 33% of the final mark. Within the Oral Exam category, the following assignments need to be completed: • Oral examination with a relative weight of 1 which comprises 34% of the final mark. Note: oral examination with written preparation Within the PRAC Practical Assignment category, the following assignments need to be completed: • Case study or project proposal with a relative weight of 1 which comprises 33% of the final mark. Note: For Level I a case study (from another country than the student's) is further elaborated by every student. For Level II a project proposal is written on a topic with direct relevance to development. This topic has a link to the Master thesis subject. Within the SELF Practical Assignment category, the following assignments need to be completed: • Assignement with a relative weight of 1 which comprises 33% of the final mark.
9.1.12	Internship	6	Job performance assessment report
9.1.13	Advanced applied statistics	3	The examen consists of several questions which are mainly practical orientated but needs to be solved written (not on a computer) In general there are three types of questions 1 Give definitions or explain background of techniques (without formulas) 2 interprete in a complete and

			correct way the output of statistical tests 3 identify correct experimental designs and statistical analysis in order to test particular 1 hypothesis In addition also PC exercices have to be made
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Integrated Field Course at sea	3	Job performance assessment, report
9.2.2	Integrated Limnological Field Course	3	Participation, assignment, report
9.2.3	Integrated Estuarine Field Course	3	Participation, assignment, report
9.2.4	Monsoon school	6	Not specified
9.2.5	Summer school	6	Not specified
9.2.6	Data and Information Management	3	Written examination with open questions, oral examination, assignment
9.2.7	Introduction to GIS	3	The final grade is composed based on the following categories: Written Exam determines 50% of the final mark. SELF Practical Assignment determines 50% of the final mark. Within the Written Exam category, the following assignments need to be completed: • Written exam (closed book) with a relative weight of 1 which comprises 50% of the final mark. Note: Examination requirements: Good general theoretical knowledge of the potential of GIS technology in the Earth sciences (based on theory lectures). Within the SELF Practical Assignment category, the following assignments need to be completed: Practical assignment with a relative weight of 1 which comprises 50% of the final mark. Note: Examination requirements: Through the practical assignment, students will have to demonstrate their theoretical knowledge and well as their practical skills in using GIS as a problem-solving tool. The objective of the assignment is to let each student discover the potential of GIS in his/her own field of interest. More in particular,

			students will have to define a useful application for which GIS analysis may offer (part of) the solution, develop a workflow to perform the analysis they have in mind, and demonstrate the proposed workflow on a study site for which they collect geospatial data needed to perform the analysis. The idea is that for this assignment students make use of the tools they have become acquainted with during the exercises, but also actively explore the potential of other tools that are available in the QGIS software environment that may be useful for the type of analysis they would like to perform. The workflow proposed and the findings of their analysis will be documented in a report of maximum 2000 words, based on which their work will be evaluated
9.2.8	Introduction to Marine and Lacustrine Biology	3	Oral examination
9.2.9	Biogeochemistry	3	Oral examination
9.2.10	Introduction to data mining	3	Written open-book examination containing resolution of exercises and open theoretical questions. The exam takes place over a period of 3 hrs and requires the use of a computer. A written report summarizing the results/answers and the methodology is requested at the end of the examination
9.2.11	Analysis of biological data	6	The final grade is composed based on the following categories: Oral Exam determines 70% of the final mark. PRAC Paper determines 30% of the final mark. Within the Oral Exam category, the following assignments need to be completed: • Oral examination with a relative weight of 1 which comprises 70% of the final mark. Note: There is an oral examination, based on one or two questions, which can be prepared in writing beforehand. Students are asked to discuss a scientific paper of their choice in which multivariate techniques were used.

			Within the PRAC Paper category, the following assignments need to be completed: • Statistical Report with a relative weight of 1 which comprises 30% of the final mark. Note: The students will write a short paper in which they will test a given hypothesis or a small set of complementary hypotheses using a dataset provided by the instructor. Depending on the size of the group, the students will be allowed to work together in groups of two or three.
9.2.12	Conservation genetics	3	Oral exam
9.2.13	Stable Isotope Geochemistry	3	Oral exam
9.2.14	Water quality	3	1. 40%: written - comphrehensive covering all course material 2. 20%: Review 1-page key findings in a scientific publication on WQ selected by student 3. 40% Presentation 12-minute Formal oral presentation of selected Case Study performed by two students collaborating on project followed by Q&A. Specified format in PowerPoint or Pdf
9.2.15	Applied Geomorphology	6	4. Written Exam determines 60% of the final mark. PRAC Presentation determines 20% of the final mark. PRAC Practical Assignment determines 20% of the final mark.
9.2.16	Natural Risk Management	3	Written reports on WPO activities 20% Group presentation 10% Group reports 20% Oral Exam 50%
9.2.17	Methods of Scientific Diving	3	Written exam
9.2.18	Marine Genomics	3	Written exam
9.2.19	Marine food web ecology	3	Oral exam
9.2.20	Ecology of coastal seas	3	Written exam with open questions
9.2.21	Marine extreme environment	6	• 60% written exam • 40% assignement

9.2.22	Lacustrine systems	3	Students will be evaluated based on a written state-of-the-art and a project proposal to obtain a PhD scholarship on a topic in limnological research. During an oral exam, the general knowledge of the students regarding the selected topic will be evaluated
9.2.23	Aquatic microbial ecology	6	Students need to pass each of the three individual parts, namely the bioinformatics exercise (10%), the literature assignment (20%), and the written exam (70% of the final score)
9.2.24	Marine Fisheries Ecology and Management	6	Oral Exam determines 70% of the final mark. Practical Exam determines 30% of the final mark
9.2.25	Integrated Coastal Zone Management	3	Oral Exam determines 60% of the final mark. PRAC Teamwork determines 40% of the final mark.
9.2.26	Environmental impact assessment	3	Assignment
9.2.27	Law of the sea and Protection of Oceans	3	Written exam with open questions
9.2.28	Marine Biodiversity	3	Oral examination
9.2.29	Aquatic ecotoxicology and environmental monitoring	6	Exam
9.2.30	Ecosystem based adaptation to global change	6	Exam
9.2.31	Physiology of aquatic organisms	6	Written with oral presentation
9.2.32	Integrated Practicals	3	Practical examination
9.2.33	Advanced Sedimentology	6	Written examination, report
9.2.34	Paleobiology of Micro-organisms	6	Work piece (report) 25%, written exam 75%
9.2.35	Integrated offshore exploration	6	Oral exam, assignment
9.2.36	Paleoclimatology and climate change	6	Written exam with open questions
10	**Criterion L: Form of attestation**		
10.1	The thesis work investigates a research topic that is in the realm of marine and lacustrine science and management. It is written in English and is divided into 3 components that have a different weight for the final evaluation: (1) literature review, (2) thesis main text, (3) presentation with defence. The Master thesis has a total of 30 ECTS and the 3 scores are merged into one final score. Each component must however correspond to at least 8/20 in order to apply the respective weighting. If a component is marked less than 8/20, then this is proposed as the final mark. The final mark is given on the basis of these rules by the jury / deliberation commission. At any stage of the work, each of the components must be free of any type of plagiarism. If after being informed about this, doubt remains, please contact lecturers or your promoter for further information. Plagiarism will be screened for and may have serious consequences if detected. Every effort must be done for language and quality	Master thesis (30 ECTS)	

	control, making use of spelling checking.	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Oceanography
2.	Faculty/department	**inter-university** programme organized by the Faculty of Sciences of Vrije Universiteit Brussel (VUB, Free University of Brussels), Universiteit Antwerpen (UAntwerpen, Antwerp University) and Universiteit Gent (UGent, Ghent University).
3.	Status of the educational component	Mandatory
4.	Semester	1
5.	Number of ECTS credits	4
6.	The total number of hours	120
7.	General description and purpose of the educational component	First an introduction will be given to the main physical processes responsible for the most important biological and chemical features and processes in oceans and seas as they take place in present times. Seafloor characteristics such as topography and bathymetry but also substrate features will be introduced together with the responsible geological and water column processes. Marine sedimentation, major ocean circulation systems but also waves and tides will be covered in this introductory part. The main focus of the second part of the course will be on chemical and biological oceanography. In the biological part first the main processes and drivers that affect ecological patterns, including aspects of habitat characterization, biogeochemical processes and gradients, structural and functional biodiversity, food web interactions, productivity and adaptations will be introduced on a variety of spatial and temporal scales. The fundamental global processes of primary and microbial production that fuel marine ecosystems will be discussed to understand their control mechanisms as well as their importance as driving force for both pelagic and benthic ecosystems from shallow to deep. Processes of benthic-pelagic coupling, phyto- and zooplankton distribution and interactions as well as benthic biodiversity and processes of ecosystem functioning will be illustrated based on specific case studies from a variety of ecosystems from the tropics to the poles, and from shallow to the deep. The chemical part consist of four modules: the first module will address overview of global change (esp. P,N,C) and drivers of oceanic change, and properties of water and seawater specific to chemical processes in the sea (not covered earlier). The second module will focus on major ions and conservative/trace elements in SW, and how these may are viewed in light of ocean sources circulation; global C cycle, CO_2 in the sea and the carbonate system and alkalinity (case study on ocean acidification). The third module will focus on oceanic box models and mass balance approach, tracers of oceanic water movement and particle transport, the nutrient P, N cycles and use of chemical tracers such as radionuclides and stable elements. The fourth module involves examples of chemical sources, sinks and processes in the sea with case studies of the oceanic Fe cycle and biogeochemistry, the global Hg cycle and biogeochemistry, and anthropogenic organic pollutants, and their distribution, biogeochemistry and impact in the global oceans (examples may include PCBs, DDT, PAHs). A practical exercise will illustrate how nutrient deliveries from rivers to seas can be quantified. Practically students will learn a simple method to perform a nutrient budget study, and apply it to the Scheldt River. Interpretation of results will include: identifying dominant transformation processes and estimating estuarine filtering capacity.
8.	Prerequisites for studying the course/module, connection with other educational components	General knowledge in ecology and chemistry.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
Not specified: General competencies and Insights in main oceanographic processes including physical chemical and biological aspects.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	N/A but the Key words are: Physical characteristics of oceans, marine biogeochemical cycles, primary production, heterotrophic processes, plankton and benthos, benthic pelagic coupling	
2.		
3.		

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures and practical exercise. Also online tools can be used to support the study	Practical exercise should be conducted and report generated for the final evaluation

GENERAL INFORMATION ABOUT THE COURSE #2		
1.	The name of the course/module	Estuarine and Coastal Systems
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Mandatory
4.	Semester	1
5.	Number of ECTS credits	5
6.	The total number of hours	140
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures and excursions	Assignments in groups

GENERAL INFORMATION ABOUT THE COURSE #3		
1.	The name of the course/module	Freshwater ecology
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Mandatory
4.	Semester	1
5.	Number of ECTS credits	5
6.	The total number of hours	150
7.	General description and purpose of the educational component	Selected contents on this introduction in freshwater ecology are about the distribution of water in the biosphere, the origin and age of lakes, the lake morphometry and catchment properties. The abiotic frame of standing or slow flowing aquatic systems is given by the characteristics of water, the salinity and ion composition, dissolved inorganic carbon, light under water, lake stratification and related oxygen conditions, redox reactions and nutrient cycling. The abiotic frame in rivers is given by the structural properties, catchment properties, physical characteristics, the chemical characteristics and daily and seasonal changes. The considered biotics are the phytoplankton, bacteria and viruses, benthic algae, waterplants, zooplankton, zoobenthos, fish, water birds and other vertebrates. Their relationship with the abiotics, functional groups and biotic interactions are discussed in the context of food web interactions. Emphasis is on shallow lakes and on concepts

		of various interactions. Students should be able to apply these general principles to case studies of various groups of organisms. The anthropogenic influences on biodiversity and on natural processes are worked out for effects of eutrophication, highly invasive exotic species and artificial water bodies. Current applied aspects of limnology deal with principles of biomonitoring ecological water quality, the restoration and rehabilitation of rivers and biomanipulation of shallow lakes. An overview of the governmental and administrative actors in the field of aquatic issues and policy is given.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After having successfully completed this course, you should :
- understand the physical-chemical properties of aquatic ecosystems in relation to their age, size, origin, location on earth and the chemical position of the water column and sediment
- explain the main processes of lake and river ecosystems in function of catchment properties, seasonal variations and horizontal and vertical gradients of biotic and abiotic components
- understand the way in which running and standing waters function as an ecosystem to organisms
- relate biotic interactions to natural, managed and man-made systems
- interpret and report field measurements in river and lake ecology
- situate these in a current relevance to the policy (standards, regulations, actions

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures and seminars, exercises and practicals	N/A

GENERAL INFORMATION ABOUT THE COURSE #4

1.	The name of the course/module	Limnology
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Mandatory
4.	Semester	2
5.	Number of ECTS credits	5
6.	The total number of hours	135
7.	General description and purpose of the educational component	1) Structure and function of continental aquatic ecosystems with equal attention to physical, chemical, and biological/ecological processes, and including basin hydrology. Physical limnology starting from first principles of basin morphometry, temperature, density stratification and wind strength. Chemical limnology with focus on redox conditions in the water column and on the lake bottom, and on nutrient balance with processes of input, loss, and recycling. 2) Elaboration of contrasts in the chemical and physical limnology of rivers, wetlands, lakes and ponds both in temperate Europe and in tropical, polar and high-mountain regions as determinants of local aquatic biology and ecology. 3) Advanced aquatic ecology with emphasis on the ecological role of diverse groups of aquatic biota; roles of stoichiometry, classic and alternative food chains in ecosystem functioning, and bottom-up vs. top-down controls on aquatic productivity.
8.	Prerequisites for studying the course/module, connection with other educational components	Registration for "Limnology" is allowed if one is registered for or has successfully accomplished "River & Lake Ecology" or after approval by the tutor of the course

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Demonstrate advanced multidisciplinary insight in the physical, chemical, hydrological and biological functioning of lakes and rivers at the system level, applicable to continental aquatic ecosystems of all types and regions worldwide.

2. Show ability to sketch the biology (and her seasonal patterns) and dominant nutrient-cycling processes of any arbitrary lake from a limited number of physical and chemical field measurements. 3. Display critical insight in evaluating the relevance and applicability of data gained from laboratory and mesocosm experiments to ecosystem functioning in the real world. 4. Demonstrate ability to process, combine, evaluate, and synthesize in a structured manner complex information from the primary scientific literature of multiple relevant sub-disciplines.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

2.	N/A
3.	
4.	
5.	
6.	

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures: Powerpoint presentations with figures and text Practical exercises: 2 afternoon sessions of field- and labwork on measuring techniques for dissolved oxygen, acidity (pH), alkalinity and transparency Seminar guided exercises: quiz in class Teamwork: analysis of data obtained in the practical exercises, reported on in a Powerpoint presentation Due to COVID19, alternative teaching methods may be implemented.	N/A

GENERAL INFORMATION ABOUT THE COURSE #5

1.	The name of the course/module	Law and Ethics on Conservation of Aquatic Systems
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Mandatory
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	1 Environmental ethics 2 General introduction on biodiversity law: institutional context of international biodiversity law, 1 sources of biodiversity law, legal regime of marine and aquatic natural resources, concepts 1 and measures in nature conservation 3 Marine and aquatic protected areas: overview of international, European and national law on 1 marine/aquatic protected areas (legal possibilities for the designation and management of 1 protected areas) 4 Species protection: overview of international and European law on the exploitation of marine 1 species (international trade, migratory species, specific protection of marine mammals, 1 fisheries) After this overview, all students are asked to give an oral presentation in small groups on a topic relating to marine or aquatic biodiversity law (on a topic of their choice).
8.	Prerequisites for studying the course/module, connection with other educational components	1. No basic knowledge is required. 2. To have the attitude to be willing to develop a critic, scientific and interdisciplinary attitude.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Demonstrate advanced multidisciplinary insight in the physical, chemical, hydrological and biological functioning of lakes and rivers at the system level, applicable to continental aquatic ecosystems of all types and regions worldwide.
2. Show ability to sketch the biology (and her seasonal patterns) and dominant nutrient-cycling processes of any arbitrary lake from a limited number of physical and chemical field measurements.
3. Display critical insight in evaluating the relevance and applicability of data gained from laboratory and mesocosm experiments to ecosystem functioning in the real world.
4. Demonstrate ability to process, combine, evaluate, and synthesize in a structured manner complex information from the primary scientific literature of multiple relevant sub-disciplines.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

2.	N/A
3.	
4.	
5.	
6.	

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
An overview of international and European law on the conservation of marine and aquatic biodiversity is given in ex cathedra lectures. There is frequent interaction with students. Microteaching consists of presentations by students	N/A

GENERAL INFORMATION ABOUT THE COURSE #6		
1.	The name of the course/module	In-situ and Remote Sensing Tools in Aquatic Sciences
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Mandatory
4.	Semester	2
5.	Number of ECTS credits	5
6.	The total number of hours	150
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
2.	N/A	
3.		
4.		
5.		
6.		

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar: coached exercises	N/A

GENERAL INFORMATION ABOUT THE COURSE #7		
1.	The name of the course/module	Environmental modelling
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Mandatory
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	Present day environmental problems (e.g. eutrophication, contaminant dispersal, climate change, ocean acidification) require a quantitative approach. To better understand how natural systems respond to such changing inputs and boundary conditions, biogeochemical models of varying complexity are being called upon. The central aim of this course is to learn how to develop and apply such models. In this course we will focus particularly on elemental cycling (Carbon, Nitrogen etc) and transport of contaminants within aquatic ecosystems (e.g. rivers, estuaries, lakes, oceans). Models are implemented in the open-source programming language R. Models in the environmental sciences. • What is a model? • Types of models • Model examples (e.g. North Sea, Scheldt estuary, ocean acidification) Construction of models • Balance equations, boundary conditions, transport formulation, kinetic rate laws • Reactive transport models (box models, 1D, 2D and 3D) • pH models, acid-base chemistry and CO2 uptake Model solution • steady-state solutions versus transient solutions • analytical versus numerical solution • numerical integration procedures

		Model applications • Causes of uncertainty in model predictions • Sensitivity analysis • Fitting models to data: parameter estimation, cost functions, estimators (least squares maximum likelihood) • Parameter uncertainty • Model selection
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	N/A	
2.		
3.		
4.		
5.		
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)	
Lecture, seminar: coached exercises	N/A	

GENERAL INFORMATION ABOUT THE COURSE #8		
1.	The name of the course/module	Seminars: Case Studies on Biodiversity Management
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Mandatory
4.	Semester	Biennial: 1st and 2nd semester of an odd academic year (e.g. 2013-2014)
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	This 'umbrella' course is intended to bridge the gap between academia and academic research on the one hand and the professional field on the other hand, and to prepare students to apply the expertise they have developed over 2 years. In this context this is specifically oriented towards Biodiversity Management in the widest sense. The course will make use of opportunities offered every year in Brussels and Belgium regarding attendance of workshops, meetings, presentations, or alternatively seminars will specifically be organized by inviting professionals in the field of biodiversity management, either viva voce or through Skype. Particularly alumni (active in the professional field) of the MSc Marine and Lacustrine Science and Management ('Oceans & Lakes') or its root programmes FAME, MareLac, ECOMAMA, will be in focus. Attendance of meetings or seminars will be accompanied by a discourse analysis by students in order to understand the priorities and the way these are expressed in non-academic professional sectors. At the same time the making of an executive summary, or a layman's summary or any product directed to extension work (awareness raising, advocacy, lobbying…) by student teams will be organized and peer-assessed. Methods to survey and retrieve information from respondents of various sectors and professions will be practiced or discussed. The choice of topics or case studies can be at any level of biodiversity management, whether field-based or policy-oriented or as a secondary priority to other sectoral activities (such as zoological parks, fisheries, retail, recreation and tourism, .)
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
This course explicitly contributes to the following competences of the Biology curriculum: General – Evaluate the societal relevance (I) – Evaluate the scientific relevance (II) - Report in various ways (III) Field specific –		

Problem solving as a thinking process (IV) - Extrapolation between different scientific fields (VI) - Recognize and work out bio-ethical implications (VII) The course is intended to facilitate transition from science and academia to professional approaches in biodiversity management by exposure to professional fields and actors.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar: coached exercises	N/A

GENERAL INFORMATION ABOUT THE COURSE #9		
1.	The name of the course/module	Integrated Marine Coastal Ecology Field Course
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Mandatory
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	The excursions focus on the ecology of three different types of coastal habitats: beach, rocky shore, and estuary at the French coast of the English Channel. Fieldwork during the excursion will take place at the Marine Station of the University of Lille in Wimereux at the French coast of the English Channel. Here, you will conduct small research projects in groups of 3-4 students on ecological problems (zonation, community structure) of a beach, rocky shore, and estuarine fauna, as well as physiology of macro-invertebrates. You will report your results in various ways, for example by presenting a scientific report, a poster or a power point presentation. Throughout the course of the field work, you will become a more and more autonomous researcher, gaining more expertise in designing your own experiments and sampling, in interpreting and presenting your results and in playing your part in environmental management.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
This course explicitly contributes to the following competences of the curriculum of Master of Marine and Lacustrine Science and Marine Management: General - Developing the own learning process - Learning to work in a team - Searching for data sources - Analysing and synthesising the learning material - Presenting and transferring the acquired knowledge Domain specific - Gaining fundamental scientific knowledge and insight in marine sciences - Developing laboratory skills - Planning and conducting marine research in an autonomous way - Understanding, judging and interpreting research results - Analytical and problem-solving thinking - Using research supporting tools (e.g. Biostatistics, GIS etc.) Learning targets and goals After finishing this course, the student should: be able to determine an optimal sampling strategy and experimental design to investigate a given marine ecological problem and to carry out research autonomously identify marine fauna and flora based on identification guides

be able to analyse the data obtained with the appropriate tools (e.g. statistical analysis) and critically discuss and report the results (both written and oral)

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Excursion	Participating in the fieldwork and Making presentation

GENERAL INFORMATION ABOUT THE COURSE #10		
1.	The name of the course/module	Integrated Field Course at sea
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (out of 3 field courses)
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	Different field courses will be organized from which the student can choose two. These field courses will focus on the diversity of different systems and processes respectively from the lacustrine and marine environment. For each system or process an introduction will be given on the environmental, geological and morphological characteristics, including exploration and measurements in the field in order to identify the specific environment. By means of practical exercises including observations, experiments and field sampling (analysis of transects, gradients, time series,..) different aspects of biosphere or geosphere processes in each of the systems will be studied and illustrated.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1 Be able to determine an optimal sampling strategy and experimental design to investigate a given ecological problem and to carry out research autonomously. 2 Identify fauna and flora based on identification guides. 3 Be able to analyse the data obtained with the appropriate tools (e.g. statistical analysis) and critically discuss and report the results (both written and oral).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lab works and individual data processing	Data processing and reporting

GENERAL INFORMATION ABOUT THE COURSE #11		
1.	The name of the course/module	Integrated Limnological Field Course
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (out of 3 field courses)

4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	An introduction will be given on the environmental, geological and morphological characteristics and history. Examples will be shown from exploration and measurements in the field in order to identify the specific environment. The students will go in the field to perform observations, to conduct field experiments and to collect field samples. Subsequently, the collected data will be analysed in the lab and interpreted in small groups, through which the different aspects of biosphere or geosphere processes in lakes will be studied and illustrated.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1 Be able to set up an optimal sampling strategy and experimental design to investigate the geological, ecological and biological status of a lake system and to carry out research
2 Be able to collect and analyse geological samples from lakes, integrating geological time, evolution of climate through time and interactions between geosphere and biosphere.
3 Be able to identify fauna and flora based on identification guides
4 Be able to analyse the data obtained with the appropriate tools (e.g. statistical analysis) and critically discuss and report the results (both written and oral).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A
2.	
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4.	
5.	

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Introductory lecture, field work, lab analysis and data processing in group. Teaching methods may need to be adjusted, should the COVID19 situation demand this.	Participation in field work, data processing and reporting

GENERAL INFORMATION ABOUT THE COURSE #12

1.	The name of the course/module	Integrated Estuarine Field Course
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (out of 3 field courses)
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	The objective of this multidisciplinary fieldtrip in estuaries is to offer students a broad overview of the biological and geochemical characteristics of estuarine systems. Estuaries are important transition zones between freshwater river systems and marine systems. Marine tidal waves propagate inland along the river channels creating diurnal cycles of variable water levels, but also salinity gradients by the progressive mixing of marine salty waters with river freshwaters. These very special environmental characteristics trigger unique plant and animal population and species distribution as well as biogeochemical functioning. This field-course focus on the characterization of phytoplankton, benthic organisms (macrobenthos and microphytobenthos), and basic biogeochemical variables such as nutrients, suspended solids, temperature, conductivity, pH, in the Scheldt Estuary. For 5 days, students will participate to a fieldtrip with visits to tidal marshes, sampling of water, sediments, and phytoplankton, perform laboratory analyses in small groups, analyze their results and finally discuss and present their findings.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. Knowledge in multidisciplinary estuarine studies (ref 1. Knowledge in the field of marine and lacustrine studies, advanced knowledge in one of the subdisciplines and in the interaction of the various subdisciplines within the broader field of application). 2. Advanced practical skills in the sampling, sample treatment and chemical and biological analyses of estuarine samples (ref 6. Advanced and thorough practical skills in field research, experimental research, research in a laboratory context and in processing data, in order to solve scientific questions). 3. Advanced skills for teamwork, task division, and result integration towards a research question (ref 7. Advanced organizational skills in relation to research (teamwork, task division, development and logistics of a research approach)). 4. Communicative skills regarding group research results towards peers (ref 8. Communicative skills regarding (personal) research results to specialists as well as nonspecialists, using various adapted media and formats).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
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5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Introductory lecture, field work, lab analysis and data processing in group. Teaching methods may need to be adjusted, should the COVID19 situation demand this.	Participation in field work, data processing and reporting

GENERAL INFORMATION ABOUT THE COURSE #13		
1.	The name of the course/module	Monsoon school
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (out of 2 field schools)
4.	Semester	1st and 2nd semester
5.	Number of ECTS credits	6
6.	The total number of hours	155
7.	General description and purpose of the educational component	After preparation in Belgium (assignments will be notified), a fieldwork area and foreign venue stay in a developing country or partner country will be visited. The preparation to the field and foreign venue stay entails that participants can report about it to fellow students and lecturers / organisers before departure. In order to bridge theory and academic training on the one hand to practice and feasibility on the other, this preparation must comprise (a) a state of the art in the scientific domain (the topic), (b) specific data or, on the contrary, identification of knowledge gaps in the research area or research data available, (c) the wider (possibly international) policy and governance context, (d) the socio-ecological system. Each of these will be determined by the specific destination and/or scientific and management problem. Information will be obtained from scientific peer-review literature, but also on basis of grey literature and local ecological knowledge. Participants will experience the practical constraints of research or research application in a real-world context of the selected destination The awareness that sample and data collection, training, research in the field must be motivated and sustainable with respect to the environment (no large scale, pointless sample collection, planning destructive or non-destructive observation, respecting animal welfare), with respect to actors and stakeholders, such as local communities, is part of the outcome in terms of participant or researcher attitude. The context is within local, national or international legislation and rules. Reporting and communication to an audience of academics, peers, policy makers as well as a lay audience via appropriate media will be amongst the skills of successful participants.
8.	Prerequisites for studying the course/module, connection with other educational components	Successful completion of the first year courses (within the MSc Marine and Lacustrine Science and Management), specifically 'Governance and policy in development and cooperation I' are required. If this has proven impossible, the titular lecturers must be consulted. Good health and some endurance are required, this entails work in a warm (tropical) environment, with a multicultural and demanding non-academic setting.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

This course contributes to most learning outcomes of the MSc Marine and Lacustrine Science and Management. The course is part of the university development cooperation objectives of the MSc programme Marine and Lacustrine Science and Management. Students are taught to apply their expertise beyond the boundaries of their discipline and in a societally relevant context. It comprises elements of theory and practice in a developing country (max. 12 days), with individual and group assignments. Lecturers and experts from the professional sector in various fields, amongst whom alumni of the MSc programme, contribute. Expertise from academia (research), governance and policy or NGO may be integrated. After preparatory work in Belgium, the course is taught in a developing country. A student who has successfully completed this course can connect a scientific question with either a global or a specific development-related aspect with the reality of a developing country or a partner country. The course has offered him or her the tools to develop a pragmatic approach, in cooperation or in dialogue with various stakeholders, in policy making, in governance or in society.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #14		
1.	The name of the course/module	Summer school
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (out of 2 field schools)
4.	Semester	1st and 2nd semester
5.	Number of ECTS credits	6
6.	The total number of hours	150
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #15		
1.	The name of the course/module	Governance and Policy in Development and Cooperation - Part I
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Mandatory
4.	Semester	1

5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	Within the wide field covered by the course title, specifically attention is paid to frameworks that facilitate or impede the translation of science to policy and governance. Target systems and areas for this course are the aquatic systems in developing countries but are expanded to other ecosystem types in developing countries depending on student audience. The course is given in the perspective of a scientist and addresses an audience of scientists and their expertise-based role. The course covers two different aspects : (1) a conceptual / theoretical part (context) and (2) a practical part. For the conceptual part, an overview (formal teaching) is given of the concept 'development' in a historical context and its relation to structures, policies and views today. Specific problems that may also be dealt with are: scientific uncertainty vs. governance and policy, commons and the public/private debate in environmental management, the scientist's responsibility and the value of science or scientific data. For the practical part surveys are made of relevant (inter)national bodies, agreements, treaties and other tools, donor agencies. This is done through interviews performed by defined student groups comprising at least two nationalities, with actors and stakeholders (policy makers, politicians, lawyers, the corporate sector, NGO, scientists in the development context,…). These interviews are preferably done on location. Attention will be paid to the post war European integration and its mechanisms. At every step and during every activity, the scientist's role will remain in focus. The work forms comprise: lectures, seminars by or interviews with societal sectors or actors. For the external seminars a wide coverage of political levels and geographical regions is offered (NGO, regional government, national government, EU,…). Since many students already have a professional background, this expertise can be introduced in debate and dialogue. For Level I a case study (from another country than the student's) is further elaborated by every student. For Level II a project proposal is written on a topic with direct relevance to development. This topic has a link to the Master thesis subject, either by content or by approach. It may however not be a PhD proposal. Much attention is paid to intellectual property rights and originality (and the pitfall of plagiarism). For level II, the country of the student must be central to the assignment.
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge obtained from programmes or fields in biology, bio-engineering, geography and geology are adequate.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

This course explicitly contributes to the following competences of the curriculum
(as defined by the Biology Department of the Vrije Universiteit Brussel):

General
- Evaluate the societal relevance (I)
- Evaluate the scientific relevance (II)
- Report in various ways (III)

Field specific
- Problem solving as a thinking process (IV)
- Extrapolation between different scientific fields (VI)
- Recognize and work out bio-ethical implications (VII)

The course objectives are not targeted to a scientific discipline, but intend to set the framework of successful translation of scientific data and scientific theory to governance and policy, with an emphasis on aquatic systems in developing countries, but not limited to these.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #16		
1.	The name of the course/module	Governance and Policy in Development and Cooperation - Part II
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Mandatory
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	Within the wide field covered by the course title, specifically attention is paid to frameworks that facilitate or impede the translation of science to policy and governance. Target systems and areas for this course are the aquatic systems in developing countries but are expanded to other ecosystem types in developing countries depending on student audience. The course is given in the perspective of a scientist and addresses an audience of scientists and their expertise-based role. The course covers two different aspects : (1) a conceptual / theoretical part (context) and (2) a practical part. For the conceptual part, an overview (formal teaching) is given of the concept 'development' in a historical context and its relation to structures, policies and views today. Specific problems that may also be dealt with are: scientific uncertainty vs. governance and policy, commons and the public/private debate in environmental management, the scientist's responsibility and the value of science or scientific data. For the practical part surveys are made of relevant (inter)national bodies, agreements, treaties and other tools, donor agencies. This is done through interviews performed by defined student groups comprising at least two nationalities, with actors and stakeholders (policy makers, politicians, lawyers, the corporate sector, NGO, scientists in the development context,…). These interviews are preferably done on location. Attention will be paid to the post war European integration and its mechanisms. At every step and during every activity, the scientist's role will remain in focus. The work forms comprise: lectures, seminars by or interviews with societal sectors or actors. For the external seminars a wide coverage of political levels and geographical regions is offered (NGO, regional government, national government, EU,…). Since many students already have a professional background, this expertise can be introduced in debate and dialogue. For Level I a case study (from another country than the student's) is further elaborated by every student. For Level II a project proposal is written on a topic with direct relevance to development. This topic has a link to the Master thesis subject, either by content or by approach. It may however not be a PhD proposal. Much attention is paid to intellectual property rights and originality (and the pitfall of plagiarism). For level II, the country of the student must be central to the assignment.
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge obtained from programmes or fields in biology, bio-engineering, geography and geology are adequate.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

This course explicitly contributes to the following competences of the curriculum
(as defined by the Biology Department of the Vrije Universiteit Brussel):

General
- Evaluate the societal relevance (I)
- Evaluate the scientific relevance (II)
- Report in various ways (III)

Field specific
- Problem solving as a thinking process (IV)
- Extrapolation between different scientific fields (VI)
- Recognize and work out bio-ethical implications (VII)

The course objectives are not targeted to a scientific discipline, but intend to set the framework of successful translation of

scientific data and scientific theory to governance and policy, with an emphasis on aquatic systems in developing countries, but not limited to these.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #17		
1.	The name of the course/module	Internship
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Mandatory
4.	Semester	During the year
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	During a few weeks (minimum 4) students participate actively in the daily functioning of potential employers, by which tasks are fulfilled related to their educational background. Tasks are situated at different levels but will give a realistic idea of the activities at the work floor. Diversity in tasks is aimed for as much as possible
8.	Prerequisites for studying the course/module, connection with other educational components	Students should have sufficient background knowledge on marine and lacustrine sciences. They should have already some practical skills in the field of marine and lacustrine sciences.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Each student gets an internship supervisor, external to the internship situation who will be responsible for the observance and evaluation of the student in mutual consultation of local supervisors associated with the employer.	N/A

GENERAL INFORMATION ABOUT THE COURSE #18		
1.	The name of the course/module	Data and Information Management
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (out of 12 courses)
4.	Semester	1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	Introduction to data- and information management in marine and lacustrine sciences. The participants get an overview of what data- and information management implies, and an introduction to some tools which are often used for information management.

8.	Prerequisites for studying the course/module, connection with other educational components	Basic biology, geology, chemistry, physics basic computing skills

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Data and information in global oceanography today (Collecting data, Research oceanography, Survey oceanography, Operational oceanography, International programs, agencies & organizations)
2.	Information technology & scientific communication (Computer technologies, Metadata, Information seeking in electronic environments, Information & technology programs & organizations)
3.	Information management principles (concepts, relational databases, data centres)
4.	From research proposal to derived products (data policies, data protocols, databases, distribution of data)
5.	Hands on exercises (both in IODE project office, MSaccess and database design at University)

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar: practical PC room classes	N/A

GENERAL INFORMATION ABOUT THE COURSE #19

1.	The name of the course/module	Introduction to GIS
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Geography
3.	Status of the educational component	Optional (out of 12 courses)
4.	Semester	1
5.	Number of ECTS credits	3
6.	The total number of hours	80
7.	General description and purpose of the educational component	Geographic information technology has vast potential for solving complex environmental and human management problems. Over the last 15 years geographical information systems (GIS) have evolved from research instruments to widely-used tools for environmental decision support, and interest in GI-technology continues to grow. In the course "Introduction to GIS" the most important principles of geographical information science are described. The course includes a review of commonly used models for representing and storing spatial information and discusses basic techniques for the analysis of spatial data. The theoretical part of the course is supplemented by five practical training sessions. Students need to demonstrate their capability to apply the acquired techniques in the context of a practical case study, using standard GIS software.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of the course the student should:

- have knowledge of different spatial data models and how these models are implemented in GIS software;
- have a proper understanding of how raster GIS and vector GIS software is used for spatial problem solving;
- master the concept of map algebra and how this concept is applied for multi-criteria analysis;
- be able to define an entity-relationship model for structuring a database and to translate the E-R model into a relational data model;
- be able to define a flowchart for solving a particular spatial problem, making use of available GIS functions;
- have developed the practical skills to perform spatial analysis using raster or vector GIS software.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	*Introduction* a. What is GIS? b. Spatial and non-spatial data c. Spatial data models: field approach, object approach, model transformations d. Digital representation of a spatial data model: raster and vector models, TIN-model
2.	*Spatial reference systems* a. Definition of a location on the Earth's surface b. Definition of a cartographic reference system

	c. Large-scale reference systems d. Coordinate transformation
3.	*Spatial analysis in raster GIS* a. Origins b. Spatial operations: local, focal and zonal operations c. Cartographic modeling d. Multi-criteria decision making e. Advantages and disadvantages of cartographic modeling
4.	Spatial analysis in vector GIS a. Introduction: the object-relational data model b. Basic principles of relational data management c. Querying of attribute data d. OpenGIS Simple Features specification e. Spatial operations: spatial querying, topological operations
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar: practical PC room classes	N/A

GENERAL INFORMATION ABOUT THE COURSE #20		
1.	The name of the course/module	Introduction to Marine and Lacustrine Biology
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (out of 12 courses)
4.	Semester	1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	This course will give an overview of the organisms present in marine and lacustrine biotopes with emphasis on the typical adaptations related to the environment.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge in biology

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1 To get knowledge on the biology of marine and lacustrine organisms. 2 To understand ecological processes in these environments.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Diversity of photosynthetic organisms (Cyanobacteria, photosynthetic protists, macroalgae, mangroves and seagrasses)
2.	Organisms of the sea: plankton versus nekto
3.	Processes in the open sea
4.	Organisms of the sea bed
5.	The diversity of benthic marine invertebrates
6.	Seaweeds, seagrasses, and benthic organisms
7.	Benthic life habits

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture	N/A

GENERAL INFORMATION ABOUT THE COURSE #20		
1.	The name of the course/module	Biogeochemistry
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology

3.	Status of the educational component	Optional (out of 12 courses)
4.	Semester	biennial: 2nd semester of an even academic year (e.g. 2012-2013)
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge in biology
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
The student has gained insight in the use of natural tracers (stable isotopes and radio-isotopes) as proxies of chemical, biological and geochemical processes occurring in natural systems (the focus will be mainly on aquatic systems).		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	Fundamental knowledge about stable isotopes: C, N, O, Si isotopic signatures as tracers of biogeochemical processes in natural systems; 13C/12C, 15N/14N, 16O/18O fractionation during biological processes; e.g. carbon fixation; nutrient uptake; trophic interactions	
2.	The carbon cycle and anthropogenic impact; changing carbon reservoirs and 13C/12C fractionation to track carbon translocations	
3.	Isotopic fractionation and the water cycle	
4.	The nitrogen cycle and anthropogenic impact, changing nitrogen reservoirs and 15N/14N and 180/16O fractionation to track nitrate transformations	
5.	Applications of tracers 13C/12C, 15N/14N and 30Si/28Si in isotope flux experiments	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)	
Lecture	N/A	

GENERAL INFORMATION ABOUT THE COURSE #21		
1.	The name of the course/module	Advanced Applied Statistics
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Mandatory
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	The purpose of the course is to introduce some frequently applied univariate and multivariate statistical methods in quantitative research for students with only elementary mathematical background. The theoretical part is focused on the application and the interpretation of the analysis. The practical exercises aim to get familiar with statistical programs and free software R in order to apply these techniques and discuss the results in a correct and extensive way. The techniques dealt with are parametric ANOVA, correlation analysis and non parametric alternatives, Multiple regression, and multivariate analysis like cluster techniques, MDS and PCA
8.	Prerequisites for studying the course/module, connection with other educational components	Basic statistical principles of distributions and probabilities. Excel
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
The most widely used uni- and multivariate statistical techniques in ecological orientated research		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	Fundamental knowledge about stable isotopes: C, N, O, Si isotopic signatures as tracers of biogeochemical processes in natural systems; 13C/12C, 15N/14N, 16O/18O fractionation during biological processes; e.g. carbon fixation; nutrient uptake; trophic interactions	
2.	The carbon cycle and anthropogenic impact; changing carbon reservoirs and 13C/12C fractionation to track carbon translocations	

3.	Isotopic fractionation and the water cycle
4.	The nitrogen cycle and anthropogenic impact, changing nitrogen reservoirs and 15N/14N and 18O/16O fractionation to track nitrate transformations
5.	Applications of tracers 13C/12C, 15N/14N and 30Si/28Si in isotope flux experiments

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical classes followed by PC classes to practice in Excel and R software (use of software, application and interpretation)	N/A

GENERAL INFORMATION ABOUT THE COURSE #22

1.	The name of the course/module	Introduction to data mining
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (out of 12 courses)
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	Basic statistical principles of distributions and probabilities. Excel

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

This course is about how to extract information from data and how informative data are generated. A selection of practical statistical and mathematical methods are applied to the kinds of problems encountered when studying environmental data. More specifically we want the students to develop a critical appreciation for the tasks of:

- Selecting / designing optimal experimental procedures
- Understanding, assessing and interpreting research results
- Promoting critical judgments in data analysis, model and method development
- Solving analytical problems in a quantitative manner with the aid of the spreadsheet EXCEL

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	**1. Theory** 1. Explanatory data analysis 2. Data distribution functions and transformations. 3. Univariate analysis and significance testing
2.	**Exercises with computer** Practical application of concepts and methods shown in the course

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #23

1.	The name of the course/module	Analysis of biological data
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (out of 12 courses)
4.	Semester	1
5.	Number of ECTS credits	6
6.	The total number of hours	166

7.	General description and purpose of the educational component	This is an applied statistics course specifically designed for biologists and environmental scientists with a focus on biological problems and statistical procedures used in the biological sciences. It contains a brief recapitulation of the fundamental elements of statistical inference, basic procedures such as ANOVA, correlation, regression and contingency tables. These foundations are complemented with an overview of more advanced methods including logistic regression, repeated measures ANOVA, mixed models, general- and generalized linear models as well as a range of non parametric methods. Finally, the course also includes an overview of multivariate analysis techniques including PCA, CCA, RDA and NMDS. Theory will be illustrated with specific biological examples from different research areas and complemented with hands-on practical experience with different statistical approaches in the flexible environment provided by the statistical packages available in the R platform. No prior knowledge of the R language is required to take this course. The emphasis is on performing statistical analyses in R not on programming.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic statistical principles of distributions and probabilities. Excel

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The student knows the principles of different types of basic and more advanced statistical approaches available to analyse biological data and is able to apply them. These include regression, correlation, contingency tables, ANOVA, logistic regression, General and Generalized linear models and basic multivariate techniques such as PCA, RDA and NMDS.

1.1.1 GENERAL COMPETENCES

The student can choose appropriate statistical methods to analyze biological data

1.1.2 GENERAL COMPETENCES

The student can correctly interpret results of statistical analyses

1.1.3 GENERAL COMPETENCES

The study can correctly perform statistical analyses in R

1.1.4 GENERAL COMPETENCES

The student understands the importance of - and knows the elements of - a correct experimental design, the experimental method and research ethics and is able to apply this knowledge to biological data.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	4. Have a working knowledge of the different types of basic and more advanced statistical approaches available to analyse biological data.
2.	5. Be able to choose appropriate statistical methods to analyze biological data
3.	6. Be able to correctly perform and interpret results of statistical analyses
4.	7. Be able to perform statistical analyses in R
5.	8. to have basic knowledge about experimental design, the experimental method and research ethics
6.	9. Ultimately, the skills acquired during this course should enable students to independently analyse and interpret biological data in their future professional career as well as in their Master or PhD projects

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #24

1.	The name of the course/module	Conservation genetics
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (out of 12 courses)
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	This course gives a brief theoretical and practical introduction to molecular methods used in ecology at population level, and in depth evolutionary genetics of natural populations and genetic structuring of populations. More detailed topics are on the evolution in small populations, population fragmentation, loss of genetic diversity in small populations, resolving taxonomic uncertainties, defining management units, case-studies on genetics and the management of wild populations.

8.	Prerequisites for studying the course/module, connection with other educational components	Basic statistical principles of distributions and probabilities. Excel

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The overall objective of the course is to introduce the students in the genetics of biodiversity (as compared to species and ecosystem diversity). Therefore, basic knowledge about DNA, genes and genomes are essential. This course will place emphasis on ecological genetics and on conservation genetics (impacts of habitat loss and fragmentation).
The objective of the course is to understand the genetics of populations, and the interaction of genetics with the reproductive biology of species, their effective population sizes, generation times, and with habitat fragmentation. Students should be able to apply these general principles to case studies on various groups of organisms.
Emphasis will be on marine and freshwater populations.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	10. Genetic drift and inbreeding
2.	11. Population fragmentation, gene flow and mating systems
3.	Intraspecific phylogeography
4.	Hybridisation and introgression

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, Seminar, Exercises or Practicals	N/A

GENERAL INFORMATION ABOUT THE COURSE #25

1.	The name of the course/module	Stable isotope geochemistry
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Chemistry
3.	Status of the educational component	Optional (out of 12 courses)
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	87.5
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	Basic statistical principles of distributions and probabilities. Excel

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General aims of the course: Understanding basic knowledge on natural stable isotope chemical processes and applications of stable isotope chemistry in earth sciences, biogeochemistry and environmental sciences.
Objectives: Ability to describe and explain, in a synthetic and comprehensive manner, the treated subjects and to apply them to a certain extend.
Specific Intended Learing Outcomes (ILO), as defined by the Oceans & Lakes program:
- ILO 1 Knowledge in the field of marine and lacustrine studies, advanced knowledge in one of the subdisciplines and in the interaction of the various subdisciplines within the broader field of application.
- ILO 2 The ability to delineate, recognise and situate biological or geological elements in the context of the scientific domain, in particular in relation to aquatic ecosystems.
- ILO 3 The ability to formulate a relevant research question concerning a complex problem in the field of marine and lacustrine studies, to develop a scientific research approach in conformity to accepted scientific methods and to bring this approach into practice.
- ILO 4 The ability to formulate hypotheses concerning complex problems in the scientific domain and to evaluate them after a thorough literature study and data collection, to apply advanced knowledge of concepts, models, theories in order to solve concrete problems.
- ILO 5 The ability to assume a responsible role in a pluridisciplinary team and, with overarching knowledge and insight, to develop collaboration with various sectors of society including the corporate sector (e.g. the harbour industry, tourism, fisheries, aquaculture).
- ILO 6 Advanced and thorough practical skills in field research, experimental research, research in a laboratory context and in processing data, in order to solve scientific questions.
- ILO 7 Advanced organisational skills in relation to research (teamwork, task division, development and logistics of a research approach).

- ILO 8 Communicative skills regarding (personal) research results to specialists as well as nonspecialists, using various adapted media and formats. - ILO 9 A critical attitude with respect to the value, reliability and usefulness of non-selfgenerated data, with advanced skills in data-mining, analysis of data files, analysis of sources and literature study. - ILO 10 The ability to situate scientific problems, results of scientific research and technical views in an ethical and social perspective.	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Introductory concepts: natural stable isotope systems (D/H, C, N, O, S), abundancies, ratios, delta-notation, fractionation mechanisms (physical and chemical, in equilibrium and kinetic), fractionation factors (alpha) and their temperature dependence, analytical methods, standards, delta-differences DELTA, and relations between delta, alpha, T and DELTA.
2.	Hydrogen- and oxygen isotopes in the hydrosphere: processes and applications. Introduction to the use of stable isotope ratios as tracers.
3.	Carbon- and oxygen isotopes in the sedimentary environment: processes and applications in palaeoclimatology and palaeo-environment reconstruction. Introduction to the use of stable isotope ratios as palaeothermometers
4.	Isotopic aspects of the biogeochemistry of carbon: fractionations in equilibrium, fractionations in biological processes, interactions between organic and inorganic reservoirs, applications in biogeochemistry, stratigraphy and geology of hydrocarbons.
5.	Isotope geochemistry of nitrogen and sulphur: fractionation mechanisms, biogeochemical cycles, reservoirs, applications.
6.	Isotope geochemistry of hydrogen, carbon, oxygen and sulphur in processes of weathering, sedimentation, diagenesis, hydrothermalism, metamorphism, magmatism. Applications in petrology, ore geology, stratigraphy, geotectonics, 'global change' research, etc.
7.	Illustrations of applications in material sciences, in biomedical and clinical research, in archaeology, in environmental sciences, etc
8.	Exercises, fundamental and application-oriented, on the relations between delta, alpha, T, and DELTA.
9.	Demonstrations and simple laboratory work on analytical techniques
10.	Tutorials and/or seminars on case studies

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, Seminar, Exercises or Practicals	N/A

GENERAL INFORMATION ABOUT THE COURSE #26		
1.	The name of the course/module	Water quality
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (out of 12 courses)
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	80
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- To achieve key insights into the major issues affecting water quality. e.g., in the EU and beyond, for freshwater and coastal seawater including water quality parameters, standards and characterization, nutrients (P and N), inorganic (metal) and organic pollution/impact on natural waters
- To examine key scientific/technical challenges & implementation status in EU WQ related Directives (e.g., WFD).
- To acquaint students to water (quality) resources management and water pollution control.
- To critically evaluate and integrate multidisciplinary scientific information on sources, sinks, and impacts of discharges to water from urban (wastewater, runoff, industry) and agricultural activities (runoff of nutrients, pesticides, etc…

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Module 1 Introduction to WQA – Topics, Scoring basis, Expectations on Case Study Presentations, Final Exam. (0.5 hr). Principles of Water Quality, Parameters and Standards (1 hr)

	Phosphorus cycle: Lakes/Rivers, sources, occurrence, eutrophication and limits, biogeochemical cycle and dynamics, P analysis. (1.5 hr).
2.	Module 2 Nitrogen cycle: Nitrate Directive, sources, occurrence, eutrophication, biogeochemical cycle, freshwater and marine, N analysis.(3 hr.)
3.	Module 3 Water quality paradigm for Europe, Water Framework Directive (WFD) Directive, implementation, measurements and monitoring, scientific challenges, global WQ guidelines, Environmental Quality Standards (EQSs), PS & PHS. (2 hr) EU Groundwater Directive, GQ quality. Monitoring, standards (1 hr).
4.	Module 4 Inorganic micro-pollutants (trace elements) in aquatic systems. Metal transport and fate in aquatic systems, EQSs, modelling metal speciation and adsorption on particles. (3 hr.)
5.	Module 5 Organic micro-pollutants (POPs – non-polar and polar organic pollutants, P/C properties, aquatic processes/fate, environmental quality standards, sampling and analysis, selected case studies – emerging contaminants. (3 hr).
6.	Module 6 Drinking Water and Chemical/Biological Water Quality Parameters and Standards (3 hrs).

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, Seminar, Exercises	N/A

GENERAL INFORMATION ABOUT THE COURSE #27		
1.	The name of the course/module	Applied Geomorphology
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Geography
3.	Status of the educational component	Optional (out of 12 courses)
4.	Semester	Biennial: 2nd semester of an odd academic year (e.g. 2013-2014)
5.	Number of ECTS credits	6
6.	The total number of hours	150
7.	General description and purpose of the educational component	This course aims at providing an in depth knowledge of the geomorphologic processes responsible for the genesis of the morphology in fluvial and arid environments. It deals with the study of geomorphologic processes through rationalising the interrelationships between environmental conditions, rock/sediment properties, transport agents and landscape forms. Focus is put on quantifying and modeling geomorphologic processes in order to understand the behaviour of complex geomorphologic systems. The lectures serve as a basis for the applications during practical's, lab session and for understanding specific case studies from the literature. Emphasis is put on the translation of knowledge to problem solving capacities especially related to the analysis of the impact of human actions on natural geomorphologic systems. The spatial approach is emphasized by using Google Earth, topographic maps and GIS.
8.	Prerequisites for studying the course/module, connection with other educational components	Students who want to enroll for this course, must have passed for 'Physical Geography'.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
• •The student has an in-depth knowledge on factors governing rock weathering and soil formation, gravitational mass movements, slope erosion and fluvial processes. •The student is able to use the his/her knowledge of fundamental physical processes to analyse the forces driving the making and evolution of the physical environment. •The student is able to analyse the functioning and spatio-temporal variation of a geomorphologic system through the application of existing analytical/mathematical models. •The student is able to study geomorphologic problems in their spatial context. •The student can discuss the impact of human intervention in a geomorphologic system. •The student has a theoretical knowledge of the techniques used to quantify geomorphologic processes. •The student develops the necessary skills and attitudes to understand and independently follow new developments in the science of geomorphology through the use of scientific literature. •The student is able to synthesize the acquired knowledge, and to report on it orally and in written reports. Development of a critical mind and the capacity of abstraction and synthesis form an integral part of this goal.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Introduction to applied geomorphology
2.	Weathering processes: a. Mechanical weathering b. Chemical weathering
3.	Mass movements
4.	Fluvial processes on slopes
5.	Fluvial processes in river channels
6.	Applications of geomorphologic concepts and relationships discussed in the course to specific case studies based on the application of rock mechanics and slope stability models and the analysis of GIS data. Results of practical's will be presented and critically discussed in oral or written reports to submit/present in the week following the practical.
7.	Introduction to laboratory techniques: granulometry, density, water content, organic matter content.
8.	One day field excursion (conditional). The excursion might be organized during a holiday or week-end day.
9.	The students present, in group of 2-3, the results of a personal reading project to be developed on one of the topic discussed in the course through a power point presentation and the animation of a practical activity. The project must include at least one scientific article presenting a case study based on field data and at least two complementary scientific papers related to the case study. The presentations are scheduled throughout the semester according to the lecture plan.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, Seminar, Exercises and practicals	N/A

GENERAL INFORMATION ABOUT THE COURSE #28		
1.	The name of the course/module	Natural risk management
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Geography
3.	Status of the educational component	Optional (out of 12 courses)
4.	Semester	Biennial: 2nd semester of an odd academic year (e.g. 2013-2014)
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	In the framework of global changes and increasing demographic pressure on natural resources, risk posed by natural or man-made hazards have dramatically increased over the last decades. The impact of a given hazard is never proportional to its energy but depends mostly on the vulnerability of the impacted population and the management of the crisis. Using case studies from modern crises, this course will illustrate the concepts of risks and vulnerability and the influence of global changes on the impact of hazards. The variable nature, spatial and temporal scales of hazards and vulnerability are generally described. The students will learn to differentiate the phases of a crisis, to identify the actors involved and to analyse the best practices before, during and after a crisis to avoid that a natural hazard turns into a human disaster. Guest speakers from various profesional sectors illustrate their specific approach of risk managment.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
• The student acquires an overview of the different elements playing a role on controlling the relationships between natural hazards and risks. He is be able to identify the role of different actors in managing a crisis and the best practices at the different phase of development of a disaster. The student is able to critically read the literature related to risk assessment and to propose practical solution when confronted to a specific case study. Through role play, the student has experience in defending the point of view of the different actors involved in a crisis and is aware of the difficulties of efficient organization and communication between these actors.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Introduction: risk, hazards and vulnerability; global trends
2.	Types of hazards: nature, intensity, spatial distribution and scale, return periods
3.	The human component of disasters: assessing vulnerbility
4.	Risk assessment and the crisis management cycle
5.	Disaster risk reduction strategies

6.	Group discussion around case studies based on reading assignments: each student is asked to read 1-2 pre-selected scientific papers and to give his opinion on the management of a presented crisis based on his reading.
7.	Group work on a selected case study: the students prepare in groups a presentation on a past natural crisis. They apply theoretical concepts and analytical scheme to highight the factors that contributed to the specific disaster.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, Seminar, Exercises and practicals	N/A

GENERAL INFORMATION ABOUT THE COURSE #29		
1.	The name of the course/module	Methods of scientific diving
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (out of 12 courses)
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	Aim of the course is to obtain a theoretical background in Scientific Diving. The learning outcomes are following the European Scientific Diving Panel (ESDP) Consultation Document Number 1 "Common Practices for Recognition of European Competency levels for Scientific Diving at work
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- Diving physics and physiology, the causes and effects of diving related illnesses and disorders and their management.
- The specific problems associated with diving to and beyond 20 m, calculations of air requirements, correct use of decompression tables.
- Equipment, including personal dive computers and guidelines as to their safe use.
- Emergency procedures and diving casualty management.
- Principles of dive planning.
- Legal aspects and responsibilities relevant to scientific diving in Europe and elsewhere.
- Diving first aid, including cardio-pulmonary resuscitation (CPR) and oxygen administration to diving casualties.
- SCUBA rescue techniques and management of casualties.
- The use and user maintenance of appropriate SCUBA diving equipment.
- Search methods.
- Survey methods, both surface and sub-surface, capable of accurately locating and marking objects and sites.
- The basic use of airbags and airlifts for controlled lifts, excavations and sampling.
- Basic rigging and rope work, including the construction and deployment of transacts and search grids.
- Underwater navigation methods using suitable techniques.
- Recording techniques.
- Acting as surface tender for a roped diver.
- Sampling techniques appropriate to the scientific discipline being pursued.
-

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	planning a scientific diving project
2.	tethered diving, including blue diving & photo/video
3.	photogrammetry
4.	airlift, transect and rope work
5.	size estimation underwater (e.g. fish)
6.	lift-bags & small-scale cartography
7.	archaeology techniques & search methods
8.	coral reef monitoring
9.	night diving

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Lectures, Seminar, Exercises and practicals	N/A

GENERAL INFORMATION ABOUT THE COURSE #30		
1.	The name of the course/module	Marine genomics
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 1 Global Change Impacts on Ecology and Biodiversity)
4.	Semester	1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	The course is divided in modules which outline the use of genomic approaches, from the ecosystem-level, gradually narrowing to species-, population and individual -levels. Theoretical aspects and commonly used techniques will be demonstrated using examples and practical exercises from the marine environment
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- 1 The graduated student understands the ecological and evolutionary processes acting at the genomic level in populations of marine organisms.
- 2 The graduated student has a good knowledge of the terminology used in the field of molecular ecology.
- 3 The graduated students understands the underlying principles of the commonly used molecular techniques, including preservation of tissues and specimens.
- 4 The graduated student is able to make a considerate choice of molecular techniques to address specific ecologically or evolutionary questions.
- 5 The graduated student has acquired the knowledge to correctly analyse and interpret molecular datasets from the individual to the community level

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	a) Community-level addresses the use of genome data in assessing community structure of marine ecosystems. Techniques discussed include amplicon sequencing, qPCR, metagenomics (+ metatranscriptomics, metaproteomics, metabolomics).
2.	b) Species-level offers an introduction to sequence alignment techniques, phylogenetics, species-delimitation, and phylogeography.
3.	c) Population-level addresses the factors influencing population structure such as genetic drift, dispersal, mutation and selection. These aspects will be addressed using traditional organelle (mtDNA) and co-dominant markers (e.g. microsatellites) as well as NGS-based genome reduction techniques (Radseq, GBS). Aspects of speciation in the marine realm will be addressed also.
4.	d) Individual-level: Heritability of physiological and morphological traits will be addressed using quantitative genetics, in combination with genome scans, QTL analyses and RNA-seq.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar, seminar: practical PC room classes	N/A

GENERAL INFORMATION ABOUT THE COURSE #31		
1.	The name of the course/module	Marine food web ecology
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 1 Global Change Impacts on Ecology and Biodiversity)
4.	Semester	1
5.	Number of ECTS credits	3
6.	The total number of hours	90

7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- 1 To know how to calculate and interpret biodiversity.
- 2 To get knowledge on the morphological adaptations of aquatic organisms.
- 3 To understand their functioning in order to maintain aquatic biodiversity in their environments

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	• structural biodiversity (spatial levels) and its calculation
2.	• functional biodiversity with a more detailed approach of key players in aquatic food webs: • primary producers: marine photosynthetic organisms (macroalgae, mangroves, seagrasses • and scleractinian corals), ecological roles and ecophysiology
3.	• zooplankton
4.	• benthos
5.	• toppredators and marine mammals in terms of their function, their organisation and their
6.	• morphological adaptations.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures	N/A

GENERAL INFORMATION ABOUT THE COURSE #32

1.	The name of the course/module	Ecology of coastal seas
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 1 Global Change Impacts on Ecology and Biodiversity)
4.	Semester	1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	This course will describe and explain processes related to rocky shores and soft substrate environments (sandy beaches, mudflats, subtidal shallow sandbanks, reef systems). Emphasis will be given on whole-ecosystem approach going from physical structure and functioning, physical-biological interactions, nutrient fluxes, food web structure, community dynamics, biodiversity threads, nature conservation and management
8.	Prerequisites for studying the course/module, connection with other educational components	Basics in marine biology, geology, chemistry and oceanography

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- This discipline contributes to a multidisciplinar training of a marine and lacustrine scientist.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures	N/A

GENERAL INFORMATION ABOUT THE COURSE #33

1.	The name of the course/module	Marine extreme systems
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology

3.	Status of the educational component	Optional (Major 1 Global Change Impacts on Ecology and Biodiversity)
4.	Semester	1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	Structure, origin and evolution of systems that can be found along ocean margins, the deep sea or in polar environments such as cold seeps, mud volcanoes, cold water corals, carbonate mounds, hydrothermal vents, abyssal plains and ice margins. Study of their geological features the ecological and biochemical processes, their ecosystem functions and biodiversity, the most important environmental drivers, their exploration, exploitation, threats (including anthropogenic activities and global change) and management.
8.	Prerequisites for studying the course/module, connection with other educational components	General knowledge of marine biological, marine geological and biochemical processes

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- 1 Students have advanced knowledge and insight in the ecology of margin systems and extreme environments, and how they evolve over time.
- 2 Students have insight in the aspects of management and societal context

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar, self-reliant study activities	N/A

GENERAL INFORMATION ABOUT THE COURSE #34

1.	The name of the course/module	Lacustrine systems
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 1 Global Change Impacts on Ecology and Biodiversity)
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	Physical and chemical limnology, community ecology, evolutionary history of selected lake biota, climate and environmental change, conservation, exploitation and management.
8.	Prerequisites for studying the course/module, connection with other educational components	Introductory courses chemistry, physics, limnology, ecology and biodiversity.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- 1 Students have advanced understanding of the functioning of inland aquatic ecosystems and the evolution of their biota.
- 2 Students are able to write a literature overview and design a research proposal for obtaining a PhD scholarship on a topic related to studying lacustrine systems.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, lecture, online discussion group	N/A

GENERAL INFORMATION ABOUT THE COURSE #35		
1.	The name of the course/module	Aquatic microbial ecology
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 1 Global Change Impacts on Ecology and Biodiversity)
4.	Semester	1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	This course unit will cover the microbial biodiversity occurring in natural marine ecosystems with emphasis on eubacteria, archaebacteria, cyanobacteria, micro-algae and protozoa that play a crucial role in the microbial balance of seas and oceans. Next to general overviews on microbial diversity, natural interactions and importance for ecosystem functioning, a number of lectures will be specifcially dedicated to methodological aspects of microbial sampling, isolation, enumeration and identification.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge of molecular biology, biochemistry and of the physical and chemical ecology of aquatic ecosystems

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- 1 Understanding functional microbial diversity in aquatic environments.
- 2 Understanding and explaining microbial interactions in aquatic ecosystems.
- 3 Deciding on methodological aspects for isolation and identification of aquatic microorganisms. 4 Summarizing and discussing published literature data.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	PROKARYOTES • General introduction to the taxonomic and functional diversity of aquatic prokaryotes • Sampling, isolation and identification of aquatic prokaryotes • Molecular diversity and dynamics of bacterial populations in seas and oceans
2.	PROTOZOA AND MICRO-ALGAE • General overview of the biodiversity of aquatic micro-algae and protozoa • Sampling, culturing and identification of aquatic micro-algae and protozoa • Functional diversity of aquatic micro-algae and protozoa • Biodiversity patterns of aquatic eukaryotic micro-organisms (e.g. seasonality, • biogeographical aspects) • Harmful Algal Blooms (HABs)
3.	GENERAL • Microbial interactions in marine ecosystems In addition to the scheduled lectures, students will receive one or more literature assignments. In this way, students have the opportunity to analyze and summarize the experimental design and major findings of published studies in the field of Marine Microbiology, and to present their own views before fellow students by means of an oral Powerpoint presentation.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, self-reliant study activities, online lecture	N/A

GENERAL INFORMATION ABOUT THE COURSE #36		
1.	The name of the course/module	Marine Fisheries Ecology and Management
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 2 Conservation Biology and Ecosystem Management)
4.	Semester	1 & 2
5.	Number of ECTS credits	6
6.	The total number of hours	178
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

ILO 1 Knowledge in the field of marine and lacustrine studies, advanced knowledge in one of the subdisciplines and in the interaction of the various subdisciplines within the broader field of application. ILO 5 The ability to assume a responsible role in a pluridisciplinary team and, with overarching knowledge and insight, to develop collaboration with various sectors of society including the corporate sector (e.g. the harbour industry, tourism, fisheries, aquaculture). ILO 6 Advanced and thorough practical skills in field research, experimental research, research in a laboratory context and in processing data, in order to solve scientific questions. ILO 7 Advanced organisational skills in relation to research (teamwork, task division, development and logistics of a research approach). ILO 11 The ability to translate scientific views and results into a feasible and realistic management plan or to give an expertise-based contribution to a governance plan in (inter)national perspective.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	1st semester: • oceanography • pelagic biological processes • benthic biological processes • coral reef ecology • the Southern Ocean • global change in the ocean • connectivity and larval dispersal
2.	2nd semester (M. Kochzius): • global status of marine fisheries • industrial fisheries • small-scale (artisanal) fisheries • fishing techniques • socio-economics of fisheries • management of fisheries • international seafood trade • stock assessment • fisheries ecology • overfishing and sustainability
3.	The practical part will focus on: • sampling techniques in fisheries research on board of a research vessel • analysis of the data collected during the excursion on the research vessel
4.	
5.	
6.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, self-reliant study activities, online lecture	N/A

GENERAL INFORMATION ABOUT THE COURSE #37		
1.	The name of the course/module	Integrated coastal zone management
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 2 Conservation Biology and Ecosystem Management)
4.	Semester	1 & 2
5.	Number of ECTS credits	6
6.	The total number of hours	178
7.	General description and purpose of the educational component	Aims and objectives: 1. To provide an overview of the constituents and theory (conceptual, analytical) underlying large-scale social-ecological systems (SES); 2. To understand diversity, redundance, stability, hysteresis and resilience in a functional ecological context and in a sustainability context; 3. To understand the ecological and social-ecological functioning of selected SES; 4. To zoom in on the mangrove forest as a SES and: 4A. To understand the ecological and social-ecological relationships within mangroves and between mangroves and adjacent ecosystems;

		4B. To understand the consequences of anthropogenic threats to this SES; 4C. To understand the scientific approaches and tools to monitor, manage and restore this SES.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Upon completion of the course a student must be able to understand the constituents of a SES and to track down the ecological consequences on different sublevels (environment, fauna and flora) of anthropogenically induced changes on tropical coastal biodiversity and ecosystems, and must be able to situate the environmental problems in a holistic context (relationship with socio-economical factors).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Understanding change and ecosystem management: - definitions linked to SES, systems ecology and adaptive cycles; - ecosystem services.
2.	Social-ecological change, governance and stewardship: - Ecological resilience and social-ecological resilience; - Social-ecological governance and transformations in ecosystem stewardship; - Adaptive management.
3.	Ecological and socio-ecological individual-based models Complexity at several levels in biology and ecology: - Feedbacks and feedback networks from cells to ecology - Dynamics and stationarity - Hysteresis and multistationarity - Thresholds - Spatial patterns - Rhythms - Waves - Chaos Mathematical basis for understanding complexity and change: - Equations - Simulations - Models
4.	Complexity and resilience in social insects Complexity and social-ecological resilience in forest systems Complexity and social-ecological resilience in dryland systems Complexity and social-ecological resilience in freshwater systems Complexity and social-ecological resilience in oceans and estuarine systems
5.	The mangrove forest as a SES, describing constituents and relationships), the links with man and integrated research. Part I Mangrove forests and their biocomplexity Distribution of mangrove forests; Faunal and floral biodiversity, incl. morphological, physiological and ethological adaptations to tropical environments and to intertidal and marine life; Ecological mutual benefits between between mangrove forests, and their adjacent tropical rainforests, seagrass beds and coral reefs; Food webs and trophic relationships; Part II Ethnobiology and anthropogenical impacts on mangroves and adjacent ecosystems Social, economical and cultural values and services of mangrove forests – mangroves as a model SES; Anthropogenically induced threats on one or more ecosystems and the consequences for the other ecosystems; Local vs. global patterns of change. Part III Scientific research tools Monitoring, modelling and experiments (incl. management, restoration and conservation); The use of remote sensing and GIS; Combinatory and multivariate analyses; Essentials of tropical habitat management Case-studies and management guidelines with respect to mangroves as a SES.
6.	

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, self-reliant study activities, online lecture	N/A

GENERAL INFORMATION ABOUT THE COURSE #38

1.	The name of the course/module	Environmental impact assessment
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 2 Conservation Biology and Ecosystem Management)

4.	Semester	1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	This course focuses on the principles and procedures of the Environmental Impact Assessment (EIA) process in the coastal and marine environment. While the course starts with introducing the origin and development of EIA in a worldwide context, the main focus is on the present day EIA process, starting from the early stages of a project EIA, through the impact prediction, evaluation, mitigation and public participation to the monitoring and auditing stages. Next to a theoretical introduction to EIA, the EIA process is illustrated through various coastal and marine examples (i.e. plenary), as well as through student interviews with real world stakeholders, marine managers and policy makers and consultants, united within selected EIA case studies (i.e. independent group work). The main findings of these interviews are communicated and discussed in plenary.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1 The student should be able to learn to work in a team.
2 The student should be able to analyse and synthesis the learning material.
3 The student should be able to present and transfer the acquired knowledge.
4 The student should be able to report in various ways.
5 The student should know about the need and benefits of a proper EIA and/or Strategic Environmental Assessment (SEA).
6 The student should be appropriately aware of the generic EIA process, including all different steps to be taken and possible feedback loops.
7 The student should be able to critically consider any coastal or marine project EIA in relation to the generic EIA process.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar, self-reliant study activities	N/A

GENERAL INFORMATION ABOUT THE COURSE #39

1.	The name of the course/module	Law of the Sea and Protection of Oceans
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 2 Conservation Biology and Ecosystem Management)
4.	Semester	1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	The course includes a general introduction to international law, as well as an overview of the different functions of the oceans and seas. Following a brief discussion on the history of the law of the sea and the main developments, the determination of baselines and the different maritime zones (internal waters and ports, territorial sea, contiguous zone, EEZ, continental shelf, high seas, the Area) are covered, including an analysis of their legal status, delineation and delimitation, the rights of states and the jurisdiction within each of these. Different functions and activities are discussed and the course focuses in-depth on the exploitation of natural resources (fisheries, non-living resources, ...) and marine environmental protection, covering general principles and mechanisms of international environmental law (principle of prevention, precautionary approach, polluter pays principle, EIA, ...) and zooming in on specific sources (land-based pollution, dumping, vessel-source pollution, pollution from seabed activities), aspects (prevention, remediation, liability) and issues (marine casualties, operational discharges, ballast water treatment, harmful anti-fouling, greenhouse gases, ...). In the end, an interactive game regarding marine spatial planning, under guidance of experts, is played to apply the rules and principles of the law of the sea and marine governance in practice.

8.	Prerequisites for studying the course/module, connection with other educational components	Having a general interest in the oceans and seas, as well as a willingness to develop a multidisciplinary and critical attitude
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
1 Having knowledge of marine governance mechanisms and international legal rule regulating the various uses of the oceans and seas 2 Understanding the legal system of the law of the sea, how this works within the international community and which governmental organisations are involved 3 Critically assessing international marine governance from a multidisciplinary perspective 4 Evaluating actual cases at sea within the framework of the law of the sea		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	N/A	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)	
Lecture, seminar: coached exercises	N/A	

GENERAL INFORMATION ABOUT THE COURSE #40		
1.	The name of the course/module	Marine biodiversity
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 2 Conservation Biology and Ecosystem Management)
4.	Semester	1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	This course aims to convey students to ecological (structural), functional and evolutionary aspects of marine biodiversity. Starting from basic biological knowledge, these aspects are teached at different levels of organisation (population, community, ecosystem). This course results in a broad knowledge of marine biodiversity that is essential to understand its role in the sustainable use and management of the marine environment.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge in biology
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
To understand large-scale patterns of biodiversity and the underlying processes from an ecological and functional point of view		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	biodiversity: definitions, factors and gradients • biodiversity patterns at different spatial levels, with emphasis on large-scale patterns • use of biodiversity for conservation management: need for indices • calculating and interpretation of biodiversity indices (practical exercises) • functional diversity • diversity versus productivity • diversity versus stress; stability of a community The practical part includes (1) guided exercises on calculating biodiversity and (2) critical report (2 pages) on an actual scientific paper on marine biodiversity.	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)	
Lecture, seminar: coached exercises	N/A	

GENERAL INFORMATION ABOUT THE COURSE #41		
1.	The name of the course/module	Aquatic ecotoxicology and environmental monitoring
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 3 Environmental Impact and Remediation)
4.	Semester	1

5.	Number of ECTS credits	6
6.	The total number of hours	168
7.	General description and purpose of the educational component	This course introduces the fields of aquatic ecotoxicology, environmental monitoring and the different steps in ecological risk assessment. It gives insight in (1) the factors that determine the distribution and mobility of chemicals in the environment. For instance, variables such as the pH, salt and temperature or the role of bacteria in redox processes are factors which will have a considerable influence on metal behaviour in soils or sediments. The next step (2) is understanding how contaminants move from the environment into organisms (bioaccumulation). Then (3) processes which result in internal deactivation will be explained to finally gain knowledge on (4) effects of chemicals on biota. These effects and the general risk assessments procedures are explored from sub-organismal level up to higher levels of organisation (individuals, populations, communities, ecosystems).
8.	Prerequisites for studying the course/module, connection with other educational components	At the start of this course the student should have acquired the following competences: an active knowledge of • English • general knowledge of the use of a PC and the Internet specific prerequisites for this course Students have a basic knowledge in biology, especially regarding some general ecological processes, and a have a basic knowledge in chemistry

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- Students have a basic insight into aquatic ecotoxicology. And environmental monitoring
- Students know the most important types of (micro) pollutants that might enter the aquatic environment and know their sources.
- Students have insight into the factors that affect the distribution, partitioning and bioavailability of pollutants in the aquatic environment
- Students know the range of chemical and biological tests and test systems that can be used to evaluate the effect of toxicants on the environment at different levels of biological organisation.
- Students know how environmental quality standards are derived and how a risk evaluation of new compounds is developed
- The students have insight in the distribution, analysis and effects of persistent organic pollutants (POPs)

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Examples of topics that will be discussed include: The effects of micro pollutants on biota; diagnosis; how biota differ in resistance and tolerance; methods to evaluate, reduce and remedy effects; case studies. The sources, distribution and behaviour in the environment, characteristics and degradation/transformation of persistent organic pollutants (POPs). Techniques to measure POPs in environmental and biological samples The development of water quality guidelines under the EU Water Framework Directive Risk evaluation of single compounds.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, skill training	N/A

GENERAL INFORMATION ABOUT THE COURSE #42

1.	The name of the course/module	Ecosystem based adaptation to global change
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 3 Environmental Impact and Remediation)
4.	Semester	1 & 2
5.	Number of ECTS credits	6
6.	The total number of hours	168

7.	General description and purpose of the educational component	This course gives an overview of (1) the coastal hazards that are related to global change, and (2) how these hazards can be mitigated by ecosystem-based coastal management. The coastal hazards include sea level rise, increasing frequency and intensity of storm surges, risk for tsunamis, coastal erosion. We will study the causes of these coastal hazards, their global geographical occurrence, and their consequences for human societies and coastal ecosystems. This will be illustrated with recent examples (e.g. tropical cyclones, temperate storm surges). The concept of hazard mitigation by coastal ecosystems will be introduced. Emphasis will be put on the role of coastal vegetations – such as tidal marshes, mangroves and dune vegetation – on (1) the mitigation of sea level rise (by sediment accretion), (2) the attenuation of wind-waves and currents (by friction), (3) the reduction of flood propagation during storm surges and tsunamis, (4) the reduction of coastal erosion. Examples will be given of recent research results, based on lab experiments, field studies, and model simulations of the mitigating effects of coastal vegetations on sea level rise and flood waves. The theoretical courses will be complemented with practical demonstrations of the mitigating effects of coastal vegetations, through an excursion.
8.	Prerequisites for studying the course/module, connection with other educational components	At the start of this course the student should have acquired the following competences: an active knowledge of • English a passive knowledge of • English general notion of the basic concepts of Before starting this course, the student should have a basic knowledge of ecology, geology, and physics on Bachelor level.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- Students understand how different ecosystem types can contribute to the mitigation of impacts or risks induced by climate change, including sea level rise, increasing frequency and intensity of storms, floods, droughts, risks for erosion.
- Students have insights in recent research results on ecosystem-based mitigation and adaptation options to global change.
- Students have knowledge of real-life implementations of programs for risk mitigation and adaptation based on nature based solutions.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Examples of topics that will be discussed include: The effects of micro pollutants on biota; diagnosis; how biota differ in resistance and tolerance; methods to evaluate, reduce and remedy effects; case studies. The sources, distribution and behaviour in the environment, characteristics and degradation/transformation of persistent organic pollutants (POPs). Techniques to measure POPs in environmental and biological samples The development of water quality guidelines under the EU Water Framework Directive Risk evaluation of single compounds.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Class contact teaching Lectures Seminars/Tutorials	Personal work Case studies In group Paper In group

GENERAL INFORMATION ABOUT THE COURSE #43

1.	The name of the course/module	Physiology of aquatic organisms
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 3 Environmental Impact and Remediation)
4.	Semester	2
5.	Number of ECTS credits	6
6.	The total number of hours	168
7.	General description and purpose of the educational component	Animal physiology can be defined as the study of the function of animals and their constituent parts. The ultimate goal of this subject is to understand the mechanisms that operate in living organisms at all levels, ranging from cell to the whole organism. This goal is a very ambitious one, for each living organism, a single cell, is

		incredibly complex. Next students will find out what the results of evolutionary adaptation can be as we discuss some of the marvellous adaptations to extreme environments.
8.	Prerequisites for studying the course/module, connection with other educational components	At the start of this course the student should have acquired the following competences: an active knowledge of • English • general knowledge of the use of a PC and the Internet specific prerequisites for this course Students must be familiar with the general principles of plant and animal physiology, and of evolutionary biology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- The student understands the current physiological diversity in aquatic organisms and how these limit physiological performance. Extra attention is paid to processes relevant for aquaculture.
- The student understands good laboratory practice and is acquainted with the techniques and methods used in fish physiology.
- The students understand how organisms have adapted to their environments.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	1. Introduction: Central themes in animal physiology 2. Energetics of living cells 3. Membranes, channels, transport 4. Ionic and osmotic balance 5. Gas exchange and acid base balance 6. Hormonal control 7. Energy metabolism, size and temperature 8. Extreme environments

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Class contact teaching ☐ Lectures ☐ Laboratory sessions	N/A

GENERAL INFORMATION ABOUT THE COURSE #43

1.	The name of the course/module	Integrated practicals
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 3 Environmental Impact and Remediation)
4.	Semester	2
5.	Number of ECTS credits	3
6.	The total number of hours	84
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	At the start of this course the student should have acquired the following competences: an active knowledge of • English specific prerequisites for this course Students have a basic knowledge in biology, especially regarding some general ecological processes, and have a basic knowledge in chemistry

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- After this course the student is able to perform a simple aquatic toxicity test applying the invertebrate Daphnia magna, assess the fitness and energy budget of an aquatic vertebrate, the common carp, under stressful circumstances, and understand nutrient flows and their consequences.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	1) a three-day acute aquatic toxicity test, applying the waterflea Daphnia magna 2) a three-day physiological test assessing the aerobic energy consumption and energy stores of the common carp at different temperatures 3) an ecological field course looking at nutrient cycling

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Class contact teaching ⍰ Practice sessions Personal work ⍰ Assignments In group Excursions	N/A

GENERAL INFORMATION ABOUT THE COURSE #44		
1.	The name of the course/module	Advanced sedimentology
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 4 Marine and Lacustrine Geosciences)
4.	Semester	2
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	This course is focused on the use of sediments for research purposes. It builds on the general principles of sediment production, transport, and deposition that were introduced at the Bachelor level.
8.	Prerequisites for studying the course/module, connection with other educational components	The student knows the basic concepts of sedimentology and stratigraphy, such as sediment production, transport and deposition. He/she knows the main depositional environments

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- 1 The student can design a research project based on sediments and sedimentary archives.
- 2 He/she is able to select the most appropriate techniques to analyze sediments for specific purposes.
- 3 He/she can combine and interpret data obtained using several independent techniques.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Sediment sampling techniques, in-situ sediment monitoring instruments, coring equipment. Analytical techniques in sedimentology. Core logging instrumentation: Multi-sensor core loggers, XRF and CT core scanners. Interpretation of multi-proxy sediment records, including age-depth modeling. Recent advances in sedimentology. Case-studies (seminars given by guest speakers).

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Group work, lecture, practicum, seminar	N/A

GENERAL INFORMATION ABOUT THE COURSE #44		
1.	The name of the course/module	Paleobiology of micro-organisms
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 4 Marine and Lacustrine Geosciences)
4.	Semester	1
5.	Number of ECTS credits	6
6.	The total number of hours	140
7.	General description and purpose of the educational component	Knowledge and insight of the most important groups of fossil micro-organisms and their evolution over Earth's history. Their use as proxies for the reconstruction of the palaeoenvironment, palaeogeography and palaeoclimate.
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge of phycology and protistology

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1 Advanced knowledge of the discussed fossil microorganisms and their identification criteria.
2 To possess a fundamental insight in their evolution during the Phanerozoic.
3 Apply this knowlegde to determine palaeoenvironmental parameters and to reconstruct the palaeogeography and palaeoclimatology.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	The palaeobiology of fossil microorganisms over Earth's history: morphology and general characteristics, life strategies, palaeoproductivity, fossilisation and taphonomy, diversity and palaeogeography, evolution, radiation, and extinctions. Fossil micro-organisms as proxies for the palaeo-environment: principles and case studies.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, practicum,	N/A

GENERAL INFORMATION ABOUT THE COURSE #45		
1.	The name of the course/module	Integrated offshore exploration
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 4 Marine and Lacustrine Geosciences)
4.	Semester	2
5.	Number of ECTS credits	6
6.	The total number of hours	150
7.	General description and purpose of the educational component	The sampling of sedimentary archives through drilling is a common technique for academic and economical goals, both onshore as offshore. The selection of the target site is taking in account many prerequisites, among which a thorough risk analysis. Therefore, a detailed site survey needs to be carried out. This course will zoom in on all aspects of such a site survey as well as the execution of the drilling, with special attention to the geophysical characterisation of the seafloor and the (shallow) subsurface. The objectives of this course contribute to the skill of unravelling the multidisciplinary and integrated exploration strategies of shallow shelf seas down to continental slopes. Since this is a practical course, there is a limit to the number of participating students (12 max) due to logistical reasons. Students who have this course as obligatory unit in their major, or students of the Master of Science in Geology, Major Basins & Orogens, will get priority
8.	Prerequisites for studying the course/module, connection with other educational components	Bachelor geology and has followed the course of exploration geophysics

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1 The student has acquired qualities in the drafting of a multidisciplinary offshore exploration strategy. 2 The student is aware of potential technical and environmental risks and can make a risk assessment for a drilling campaign. 3 The student possesses an overview of the most common marine surveying techniques and knows the basic skills for acquisition. 4 The student posesses the basic skills to process a geophysical dataset and to provide a first interpretation. 5 The student can integrate geophysical drilling data into a geophysical seabed survey project. 6 The student is familiar with the technical vocabularium and can report and present the technical results of a survey in a linguistically correct manner

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	1 Introduction: fundamental scientific and industrial objectives of seafloor research, as well as legal, ethical, logistical and budgetary aspects. Importance of a correct site survey prior to invasive drilling: risk assessment. Aspects of (subsea) navigation. 2 Visual & oceanographic observation techniques: ROV, ADCP, CTD 3 Basic principles and techniques regarding geophysical seafloor mapping: multibeam bathymetry & backscatter, sidescan sonar, AUV 4 Visual & oceanographic observation techniques: ROV, ADCP, CTD 5 Seismic profiling: single- vs. multichannel seismics. Advanced processing & interpretation 6 3D-4D seismics: acquisition, processing and interpretation (attributes) 7 Sampling techniques: long cores, vibrocoring, drilling 8 Geophyiscal characterisation of cores and boreholes 9 Integration of drilling and seismics: practical aspects

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Lecture, project, fieldwork, seminar: practical PC room classes	N/A

GENERAL INFORMATION ABOUT THE COURSE #46		
1.	The name of the course/module	Paleoclimatology and climate change
2.	Faculty/department	Faculty of Sciences and Bioengineering Sciences/ Biology
3.	Status of the educational component	Optional (Major 4 Marine and Lacustrine Geosciences)
4.	Semester	1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	The aim of this course is to provide the students with a basic understanding of the global climate system, as starting point for the teaching of advanced knowledge in late-Cenozoic climate history and the full range of natural climate variations on both short (years to centuries) and long (thousands to millions of years) time scales; and of how the long-term perspective gained from paleoclimate data can be exploited for better prediction of future climate change resulting from the interaction of natural and antropogenic climate drivers.
8.	Prerequisites for studying the course/module, connection with other educational components	Ba1 System Earth or equivalent.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1 The student has acquired general scientific and intellectual competences, competences in collaboration and communication, and social competences. 2 The student demonstrates basic knowledge of the functioning of the large-scale physical elements of the global climate system, and of potential and limitations of all important natural archives and techniques in paleoclimate reconstruction. 3 The student demonstrates advanced knowledge of the complete range of patterns, frequencies and natural mechanisms of climate change during the late-Cenozoicum, with emphasis on Quaternary ice ages and the Holocene. 4 The student demonstrates insight in the scales (both in space and in time) of operation of the various climate mechanisms, and their modulation through variable influences from and interactions between the atmosphere, geosphere, biosphere, hydrosphere and cryosphere. 5 The student displays an objective critical attitude towards new data, interpretations, theories and models of anthropogenic climate change in the context of the long-term perspective obtained from paleoclimate research. 6 The student demonstrates the ability to process, combine, evaluate, and synthesize in a structured manner complex information from the primary scientific literature of multiple relevant sub-disciplines.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	1 Overview of the structure and functioning of the world climate system with emphasis on components subject to variation at time scales of years and longer. 2 History and mechanisms of natural climate variation at all time scales (tectonics, Milankovitch factors, thermohaline circulation, bipolar see-saw, monsoons, solar activity, volcanoes, ENSO, NAO) with emphasis on the processes, their temporal and spatial scale of operation, periodicities in external forcing, feedback mechanisms and interactions between atmosphere, geosphere, biosphere, hydrosphere and cryosphere. 3 Overview of the principal archives and proxy indicators of climate change, their (potential) applications and characteristic limitations. 4 Historical perspective and scientific basis for anthropogenic climate change, with in-depth discussion of recent findings and the associated uncertainties.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Group work, lecture, seminar: coached exercises	N/A

DAUGAVPILS UNIVERSITY

1	**Criterion A: University profile**		
1.1	Name of the University	**DAUGAVPILS UNIVERSITY**	
1.2	Classical or applied	Classical	
2	**Criterion B: Profile of the educational program (Curriculum)**		
2.1	Number of Aquaculture disciplines	One	
2.2	The name of the educational program	Aquaculture	
2.3	Type of diploma	Master	
2.4	Total number of credits (ECTS)	120	
3	**Criterion C: Setting the educational program (Curriculum)**		
3.1	Duration of the program	4 semesters	
3.2	The purpose of the educational program	To equip the graduates with profound expertise and knowledge based on an interdisciplinary and holistic perspectives in modern biotechnology and the sustainable development of the aquatic environment	
4	**Criterion D: Characteristics of the educational program (Curriculum)**		
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Biology-Aquaculture	
5	**Criterion E: Teaching and assessment**		
5.1	Teaching and learning methods	Lecturers, seminars and practical classes; online education	
5.2	Assessment	Examinations; Master thesis	
6	**Criterion F: Software competencies**		
6.1	Integral competence	N/A	
6.2	General competences	N/A	
6.3	Professional competences	N/A	
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	1. The graduates should be able to demonstrate comprehensive and specialized knowledge and technical skills regarding the relevant biochemical, molecular and systemic biology approaches for the use of aquatic resources to develop new bioactive compounds; 2. The graduates should understand the process of discovery and development of molecules derived by marine organisms, and be able to develop innovative marine natural products to meet the needs of consumers in various markets; 3. The graduates should be able to demonstrate skills related to the management of biotechnological innovation projects, the transfer of R&D, and the protection of industrial and intellectual property in the aquatic biotechnology sector. 4. The graduates should demonstrate responsibility and autonomy for contributing to professional knowledge and practice for reviewing the strategic performance of team.	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	Sufficient human resources (education and research) from one of the leading European universities	
8.2	Material and technical support	Sufficient material and technical resources, rich base for research and practice	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Current Issues in Biology	3+3+3	Examinations
9.1.2	Methodology of Research in Biology: Field Research Methodology	6	Examination
9.1.3	Applied Biology and Bioeconomics: Wildlife Natural Resource Conservation and Protection	3	Examination
9.1.4	Applied Biology and Bioeconomics: Work Organization and Security in Biological and Clinical Laboratories	1.5	Examination
9.1.5	Aquaculture Technologies	9+9+9+9	Examinations
9.1.6	Practical Research in Biodiversity	9+9+9+9	Examinations
9.1.7	Environment Interpretation and Demonstrations	9	Examination
9.1.8	Methodology of Research in Biology: Laboratory Diagnostic Methods	6	Examination

9.1.9	Applied Biology and Bioeconomics: Bioresource Management	3	Examination
9.1.10	Applied Biology and Bioeconomics: Science Communication in Natural Sciences	1.5	Examination
9.1.11	Nature recreation Strategy	4.5+4.5	Examinations
9.1.12	Ecosystem Services	4.5+4.5	Examinations
9.1.13	Methodology of Research in Biology: Methodology of Interdisciplinary Research	6	Examination
9.1.14	Applied Biology and Bioeconomics: Bioeconomics	4.5+4.5	Examinations
9.1.15	Ecotoxicology and Research on Pollution	3	Examination
9.1.16	Methodology of Research in Biology: Data Analysis and Interpretation in Interdisciplinary Research	6	Examination
9.1.17	Nature Therapy	4.5	Examination
9.1.18	Project Elaboration and Management	4.5	Examination
9.1.19	Master Thesis	7.5+7.5+7.5+7.5	Thesis Defense
9.2	**Selective components**	**Number of credits**	**Final control form**
	N/A	N/A	N/A
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Master Thesis	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1.	The name of the course/module	Current Issues in Biology I
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	3
6.	The total number of hours	80
7.	General description and purpose of the educational component	The study course is envisaged for master students in the sphere of natural sciences. The aim of the course is improving the understanding of the fundamentals of modern biology, an object of research of this science, covering the organization of living matter at various levels as well as providing a notion of the major subbranches of biology, current trends of research, theories and their application in national economy. Study course objectives: 1. Developing a notion of Biology as a modern multi-branch science with broad research perspectives and a significant role in national economy; 2. Providing knowledge on life as the basic element of research in biology covering the organization of living matter at various levels – molecular, cell, tissue, organ, and organism; 3. Developing skill of identifying major subbranches of the science of biology, characterizing modern trends of research in them and applicability in national economy; 4. Developing thinking in biology analyzing various regularities of the sphere.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
Knowledge: 1. Know the basic principles of life, identify its organization levels and principles of classification. Skills: 2. Aware of the current issues of the basic branches of biology science, able to characterize their research object and significance in the overall development of the science. Competences: 3. Able to independently analyze research produced in various branches of biology being aware of their point and general regularities; 4. Able to characterize biology as a multibranch modern science and describe broad research perspectives.		

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Life and its basic elements
2.	Classification of living organisms
3.	Current issues of biophysics and biochemistry
4.	Development of systematic in biology
5.	Basic trends of taxonomy
6.	Botanic and zoological nomenclature
7.	Modern ecology structure and its elements
8.	Current issues of biogeography
9.	Current issues of the world ocean biology
10.	Land and mountain biology
11.	Current issues of zoology
12.	Diversity of organisms
13.	Botanic – recent trends and classical studies
14.	Current issues of parasitology
15.	Microbiology – insight into the specificity of modern research
16.	Current issues of mycology

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures and independent study.	Independent work is envisaged after each lecture and is related to deeper analysis of the lecture topic. Within the independent work, students produce analysis of the sources of literature.

GENERAL INFORMATION ABOUT THE COURSE #2		
1.	The name of the course/module	Methodology of Research in Biology I: Field Research Methodology
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	6
6.	The total number of hours	160
7.	General description and purpose of the educational component	The study course is aimed at updating students' understanding, knowledge, and practical skills in work with more frequently used present-day methods, facilities, and equipment used in field research, providing knowledge on legal acts, consolidating skills in planning and implementing research as well as analyzing and presenting data. Study course objectives: 1. Facilitating the acquisition of theoretical knowledge on practically applicable field research methods; 2. Providing the acquisition of knowledge on legal acts, CM regulations, ethical norms and other binding requirements in performing the course of field research; 3. Consolidating practical skills in application of field research methods; 4. Facilitating the consolidation of students' independent work skills in research planning, selecting appropriate methods, preparing field research equipment and its practical application, statistical analysis of the results.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: - understand the theoretical basis of field research; - demonstrate knowledge on contemporary field research methods; - aware of the facilities and equipment applicable in field research; - aware of legal acts and ethical norms, understand their application in field research. Skills: - able to plan research in compliance with the scientific basic positions, legislation, and ethical norms; - able to select and independently apply appropriate research methods, facilities, and equipment; - perform statistical analysis of the obtained data, interpret and approbate the results gained. Competences: - have a command of recent scientific developments, consider the necessity for performing particular field research;

- independently select appropriate research methods, prepare for field research on the basis of acquired knowledge, scientific literature and personal experience.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Introduction to field research methodology
2.	Field research elements
3.	Planning the field research
4.	Legal acts and documentation related to performing field research
5.	Selection and characteristics of the research site
6.	Methods of obtaining samples and ethical aspects
7.	Methods of research on static organisms
8.	Major methods of research on moving organisms
9.	Methods of research on organisms living in the soil
10.	Methods of research on invertebrates living on dry land
11.	Methods of research on vertebrates and invertebrates living in water
12.	Methods of research on reptiles and amphibians
13.	Methods of research on birds
14.	Methods of research on mammals
15.	Scientific facilities and equipment applicable in field research
16.	Research result analysis, interpretation, and presentation

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, practical assignments, and independent study.	During their independent work students: - learn in deep each lecture topic (see the syllabus and course description preparing questions for the academic staff member to discuss them in next class); - prepare for practical assignment classes – revise theory, select research method, elaborate research design, and prepare the necessary equipment; - prepare for test works. Students may use other sources of information not indicated in the course description, consulting the academic staff member.

GENERAL INFORMATION ABOUT THE COURSE #3		
1.	The name of the course/module	Applied Biology and Bioeconomics I: Wildlife Natural Resource Conservation and Protection
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	3
6.	The total number of hours	80
7.	General description and purpose of the educational component	The study course is aimed at improving students' understanding and knowledge of the current developments and achievements in the sphere of wildlife natural resources conservation and protection as well as developing practical skills in wild species conservation and reintroduction, by sustainable use of renewable nature resources and preserving biological diversity. Study course objectives: 1. Improving knowledge on wildlife natural resources and their conservation technologies as a broad and complex sphere of applied science of biology, emphasizing their significance and development options, their bond with ecology, zoology, genetics, and evolution. 2. Providing an opportunity of applying the acquired skills in practical work in the sphere of wildlife species conservation and reintroduction. 3. Facilitating the development of understanding about wildlife species nature protection zooculture, its present-day technologies. 4. Consolidating practical skills sustaining and investigating wild animals. 5. Facilitating the development of student independent work skills, including the provision of wildlife species research material, selection and application of appropriate methods. 6. Providing knowledge of legislation, CM regulations, ethical norms and other binding requirements related to wildlife natural resource use and conservation.
8.	Prerequisites for studying the course/module, connection	N/A

	with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
- aware of the significance of knowledge in biology in the sphere of wildlife natural resources sustainable use and biological diversity preservation;
- able to explain wildlife natural resource conservation principles, identify its classification principles;
- understand the role of scientific research and modern technologies in use and protection of wildlife natural resources.

Skills
- have a command of wildlife natural resource conservation current developments and achievements;
- able to discuss the perspectives of protecting wildlife natural resources;
- able to analyze opportunities of sustainable use of wildlife natural resources;
- formulate ideas and suggestions for the sustainable development of wildlife natural resources, taking into consideration their conservation aspects;
- have a command of performing scientific research and elaboration of projects in the spheres of sustaining and protecting wildlife natural resources.

Competences
- independently assess problem situations and make decisions justifying their actions with previously acquired knowledge and personal experience.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Wildlife natural resources and their sustainability
2.	Invertebrate species resource sustainability support
3.	Fish species resource sustainability support
4.	Amphibian species resource sustainability support
5.	Reptile species resource sustainability support
6.	Bird species resource sustainability support
7.	Wild mammal species resource sustainability support
8.	Wildlife natural resources conservation perspectives

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, practical assignments, and independent study.	Independent work is envisaged after each lecture and is related to deeper analysis of the lecture topic. Within the independent work, students produce analysis of the sources of literature.

GENERAL INFORMATION ABOUT THE COURSE #4

1.	The name of the course/module	Applied Biology and Bioeconomics I: Work Organization and Security in Biological and Clinical Laboratories
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	1.5
6.	The total number of hours	40
7.	General description and purpose of the educational component	The study course is aimed at providing knowledge and practical skills necessary for organizing work and providing safety in biological and clinical laboratories. Study course objectives: 1. Facilitating theoretical knowledge acquisition on generally accepted principles in organizing work and safety in biological and clinical laboratories. 2. Providing knowledge acquisition on legislation regulations concerning work and safety organization in biological and clinical laboratories. 3. Consolidating practical skills in organizing work and providing safety in biological and clinical laboratories. 4. Facilitating students' independent work skill development including skills of working with scientific literature and legislation acts.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
- aware of current work organization principles in clinical and biological laboratories;
- aware of work safety requirements in clinical and biological laboratories;
- aware of legislation requirements in clinical and biological laboratory work organization;

- aware of quality control principle introduction and observation in clinical and biological laboratories. Skills - able to organize work in clinical and diagnostic laboratory; - able to elaborate respective documentation in accordance with legal acts organizing work in clinical and diagnostic laboratories; - able to analyze and apply respective legal acts for organizing work in laboratory; - able to elaborate and apply quality system program and analyze its application results; - able to independently make decisions within their competence in organizing work in laboratory. Competences - have a command of laboratory work organization theoretical framework and related legal acts; - perform high quality work in laboratory.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Introduction to work organization in clinical and biological laboratories
2.	Introduction to safety measure provision in clinical and biological laboratories
3.	Sample taking, recording, and identifying principles in clinical and biological laboratories
4.	Work process organization principles from taking samples to issuing results to clients
5.	Quality diary designing
6.	Internal and external quality control organizing principles
7.	Work safety measure provision principles

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; seminars, and independent study.	Independent work is envisaged after each lecture and is related to deeper analysis of the lecture topic. Within the independent work, students produce analysis of the sources of literature.

GENERAL INFORMATION ABOUT THE COURSE #5		
1.	The name of the course/module	Aquaculture Technologies I
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	9
6.	The total number of hours	240
7.	General description and purpose of the educational component	The aim of the study course is improving students' understanding and knowledge of contemporary developments and achievements in aquaculture as well as developing practical skills of applying the principles of biological management and smart technologies in the branch of aquaculture, with sustainable use of renewable natural resources and preservation of biological diversity. The study course objectives: 1. Improve knowledge on bioculture as a broad and complex sphere of applied science in biology emphasizing the significance of aquaculture and its development opportunities, their relation to ecology, genetics, and evolution, provide an opportunity to use the acquired skills in practice in the sphere of aquaculture. 2. Facilitate the formation of understanding of aquaculture, its history and kinds, modern aquaculture products and technologies. 3. Improve knowledge on fresh water natural and artificially produced ecosystem major functional abiotic elements and their interaction applying the acquired skills in independent research of water ecosystem aquaculture. 4. Develop skills of producing physiological experiments of aquaculture facilitating students' competence in producing scientific research and elaborating projects in various spheres of aquaculture.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: - aware of bioculture as a broad and complex sphere of applied science of biology that can provide for sustainable food system functioning and preservation of biological diversity; - know the basic principles of sustainable development (nature, economics, society); - understand the necessity for the development of aquaculture, to avoid the use of the natural populations of hydrobionts; - understand the role of scientific research, industrial technologies and modern biotechnologies in the development of

fishing industry branches; - have a command of the principles of biological management and smart technologies that are used in fishing industry and ecotourism; Skills: - aware of the current developments and achievements in aquaculture; - can discuss the trends and perspectives of aquaculture development; - can analyze the opportunities of sustainable use of biological resources of water; - make suggestions for raising efficiency of the added value of fishing industry and aquaculture products; - formulate ideas and suggestions for rational use and sustainable development of biological resources of water with respect to economic, social, and environmental aspects. Competences: - independently assess problem situations and make decisions justifying their actions with previously acquired knowledge and personal experience; - perform scientific research and elaborate projects in various spheres of aquaculture.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Introduction to the fundamentals of bioculture
2.	Bioculture typology
3.	Domestication in bioculture
4.	Enhancing the efficiency of biocultures
5.	Haul and aquaculture, history and production
6.	General principles of aquaculture
7.	New species of aquaculture
8.	Quality of water and its impact on the cultivated species
9.	Aquaculture economic action environment aspects
10.	Regional specifics of aquaculture
11.	Physiology of aquaculture objects and life cycles
12.	Domestication and gene pool in aquaculture
13.	Fresh water hydroecosystems
14.	Populations of hydrobionts in fresh water ecosystems
15.	Hydrobiont adaptation to aquatic environment
16.	Research methods in aquaculture
17.	Physical and chemical parameters of water
18.	Bioindication and eutrophication
19.	Fresh water ecosystem diversity
20.	Statistical methods in aquaculture
21.	Hydrobiont respirometric
22.	Research on the speed of hydrobionts' growth in aquaculture
23.	Research on the efficient temperature of organisms in aquaculture
24.	Ethological research on the impact of stress in aquaculture

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, laboratory assignment, and independent study.	Independent work is envisaged after each lecture and is related to deeper analysis of the lecture topic. Within the independent work, students produce analysis of the sources of literature.

GENERAL INFORMATION ABOUT THE COURSE #6		
1.	The name of the course/module	Practical Research in Biodiversity I
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	9
6.	The total number of hours	240
7.	General description and purpose of the educational component	The study course is aimed at developing in real conditions skills of practical research in biodiversity and acquiring the experience of collecting material in the course of field work and applying contemporary research methods, equipment, and facilities. Study course objectives: 1. Providing the opportunity of putting to practice students' knowledge of biological diversity and consolidating practical skills in application of field research methods; 2. Providing the opportunity of practical application of Latvian and European legal act, ethical norm and other binding requirements in the course of field research; 3. Facilitating the consolidation of students' independent work skills in research

		planning, selecting appropriate methods, preparing field research equipment and its practical application.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge:
- understand the theoretical basis of field research and their practical application;
- demonstrate knowledge on contemporary field research methods;
- aware of the facilities and equipment applicable in field research;
- aware of legal acts and ethical norms, understand their application in field research.

Skills:
- able to plan and perform research in compliance with the scientific basic positions, legislation, and ethical norms;
- able to select and independently apply appropriate research methods, facilities, and equipment.

Competences:
- able to independently select appropriate research methods, prepare for field research on the basis of acquired knowledge, scientific literature and personal experience;
- able to perform field research in various subbranches of biology, forestry and environmental science.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Field research methods in zoology
2.	Field research methods in botanic
3.	Field research methods in bryology
4.	Field research methods in mycology, lichenology
5.	Data acquisition in parasitology
6.	Ecology research and its specificity
7.	Application of cartographic material and various GIS technologies in research
8.	Methods of inventory and monitoring
9.	Field work legal and ethical norm implementation

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; seminars, practical assignment, and independent study.	Independent work is envisaged after each lecture and is related to deeper analysis of the lecture topic. Within the independent work, students produce analysis of the sources of literature.

GENERAL INFORMATION ABOUT THE COURSE #7

1.	The name of the course/module	Environment Interpretation and Demonstrations
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	9
6.	The total number of hours	240
7.	General description and purpose of the educational component	The study course is aimed at acquisition of methods of the analysis and assessment of theoretical and practical environmental parameters, opportunities of their application in planning and implementing nature recreation events. Study course objectives: 1. facilitating the acquisition of theoretical knowledge with practical application, necessary for planning and implementing recreation events; 2. providing the acquisition of application of modern technical options and scientifically based methods in the process of nature recreation; 3. consolidating practical skills in planning recreation events; 4. facilitating the development of students' independent work skills, including skills in planning research work, selecting appropriate methods, preparing field research equipment and practical use.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After completing the course, students will be able to independently plan and realize environment interpretation and nature recreation events based on the analysis of environmental parameters, environment accessibility, abilities and needs of people involved in these events.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Introduction to environment interpretation
2.	The essence and philosophy of environment interpretation. Introduction to environmental psychology
3.	Environmental parameters, their review, methods of acquisition, general methods of their analysis and application
4.	Basic principles of environment interpretation. environment interpretation and human needs pyramid
5.	Nature recreation event planning
6.	Specificity of environment investigation for people with special needs and children of diverse age
7.	Planning nature recreation events in forest, preparatory stage and realization
8.	Planning nature recreation events by water, preparatory stage and realization
9.	Nature recreation events in urban environment – "life islands in the stone jungle"
10.	Environment quality in urban environment, major parameters, monitoring stations, statistical results, their interpretation
11.	Significance of environmental parameters in the process of environment interpretation and planning and realization of nature recreation processes
12.	Communication events and process depiction in mass media, in the process of environment interpretation and nature recreation event organization
13.	Creative and individual approach to planning and organization of recreation and environment interpretation events
14.	Principles of designing informative materials on environment interpretation and practical approach
15.	Selection of environment interpretation and nature recreation sites based on environment accessibility, its parameters
16.	Work in groups to implement individual nature recreation projects. Each group elaborates project design, collects data, produces data analysis and presents the results

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, practical assignment, and independent study.	After lectures and practical assignments students independently build knowledge and practical skills within the regarded topics, elaborate in groups environment interpretation or nature recreation project design, summarize data, produce analysis and present the result gained.

GENERAL INFORMATION ABOUT THE COURSE #8		
1.	The name of the course/module	Current Issues in Biology II
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	3
6.	The total number of hours	80
7.	General description and purpose of the educational component	The study course is aimed at improving students' knowledge and understanding of the major current developments and problematic issues in theory of biodiversity as well as developing the skills of assessing problem situations and making decisions based on the acquired knowledge and personal experience. Study course objectives: 1. Improving knowledge on the impact of climate changes and human action on global biodiversity and public health; 2. Facilitating the growth of understanding of the functioning of ecosystems – the ecological, evolutionary, and genetic processes in them; 3. Developing skills of formulating ideas and suggestions for protecting biological diversity and stimulating the public health and prophylaxis of diseases as well as analyzing scientific research and elaborating projects in the sphere of nature protection and public health facilitation; 4. Facilitating students' participation in discussions, developing their skills of critically analyzing the current global processes as well as discussing the opportunities of dealing with problems related to biodiversity within one's competence.
8.	Prerequisites for studying the course/module, connection with other educational components	Current issues in biology I

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: - aware of the negative impact of climate changes and human action on biodiversity and public health; - know the ecological, evolutionary, and genetic processes within ecosystems and understand the impact of these processes on biodiversity formation; - have a command of the methods of biodiversity preservation and dealing with public health problems. Skills: - aware of the current developments and problematic issues of theory of biodiversity and able to discuss them with colleagues and wider public; - formulate ideas and suggestions for protecting biodiversity and facilitating public health and prophylaxis of diseases. Competences: - independently assess problem situations and make decisions based on the prior knowledge and personal experience; - analyze scientific research and apply the acquired skills in elaborating projects in the sphere of nature protection and public health facilitation.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Changes in biosphere: reduction of biodiversity and climate changes in ecosystems richer in species
2.	Biodiversity elements. Biodiversity kinds – taxonomic, functional, and phylogenetic Biodiversity. Macroevolution and macroecology. Adaptations, species development and extinction
3.	Impact of anthropogenic factors on the diversity of species. Invasive species and global warming
4.	Dynamic of phenological processes and long-term impact on ecosystems and branches of economy
5.	Genetic processes in ecosystems. Genetics of nature protection. Use of climate changes in energetics. Climate policy and legislation
6.	Impact of climate changes on food chains. Biological diversity protection measures, methods, and legal norms
7.	Spread of infectious diseases in ecosystems. Biodiversity and public health in the context of climate changes
8.	Modelling the spread and diversity of plant and animal species. Biodiversity monitoring

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #9		
1.	The name of the course/module	Methodology of Research in Biology II: Laboratory Diagnostic Methods
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	6
6.	The total number of hours	160
7.	General description and purpose of the educational component	The study course is aimed at providing knowledge and practical skills of working with most important modern methods applied in laboratory diagnostics. Study course objectives: 1. Facilitating the acquisition of theoretical knowledge on practically applicable laboratory diagnostics methods; 2. Providing the acquisition of knowledge on legal acts and regulations concerning laboratory diagnostics; 3. Consolidating practical skills in application of laboratory diagnostics methods; 4. Facilitating the consolidation of students' independent work skills including work with scientific literature and legal act investigation.
8.	Prerequisites for studying the course/module, connection with other educational components	Methodology of research in biology I: field research methodology

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: - have a command of the theoretical fundamentals of modern laboratory diagnostics; - have a command of the facilities, methods, materials, algorithms applied in laboratory diagnostics; - have a command of the requirements for work safety in the sphere of laboratory diagnostics; - have a command of legislation requirements in the sphere of laboratory diagnostics; - have a command of quality control kinds and principles applied in laboratory diagnostics; - have a command of organizing principles of laboratory diagnostics and the economic basis of laboratory functioning. Skills: - able to select appropriate laboratory testing methods; - able of practical acquisition, preparing, and testing of samples; - able of processing, analyzing, and interpreting laboratory testing results; - able to organize quality control system and assess quality control results; - able to independently make decisions at various stages of laboratory examination within one's competence. Competences:

- have a command of theoretical fundamentals of laboratory diagnostics and related legal acts; - perform complete process of laboratory diagnostics and can predict and eradicate possible causes for errors in laboratory diagnostics.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Introduction to laboratory diagnostics
2.	Laboratory diagnostics aims, objectives, and present-day achievements
3.	Laboratory work organization and security
4.	Facilities, materials, and instruments applied in laboratory diagnostics
5.	Sample acquisition and preparation for examination
6.	Laboratory diagnostics methods
7.	Interpretation of test results obtained in laboratory diagnostics
8.	Quality control organization. Problem situation analysis
9.	Possible errors in diagnostics and averting their causes

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, laboratory assignments, and independent study.	Independent work is envisaged after each lecture and is related to deeper analysis of the lecture topic. Within the independent work, students produce analysis of the sources of literature.

GENERAL INFORMATION ABOUT THE COURSE #10

1.	The name of the course/module	Applied Biology and Bioeconomics II: Bioresource Management
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	3
6.	The total number of hours	80
7.	General description and purpose of the educational component	The study course is aimed at updating the understanding of managing natural ecosystems most widespread in Latvia and individual species protection measures, methods applied, significance in the sustainable development of biotopes, inclusion in nature protection plans, as well as providing a notion of ecosystem development after performing the management measures. Study course objectives: 1. Developing the notion of managing natural ecosystems most widespread in Latvia. 2. Providing knowledge on methods applied in natural ecosystem management. 3. Identifying problems related to natural ecosystem management. 4. Developing biological way of thinking by analyzing various regularities of the sphere.
8.	Prerequisites for studying the course/module, connection with other educational components	Applied biology and bioeconomics I: work organization and security in biological and clinical laboratories Applied biology and bioeconomics I: wildlife natural resource conservation and protection

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
1. Able to account for methods applied in natural ecosystem management.
Skills
2. Have a command of natural ecosystem management specificity.
Competences
3. Independently analyze the usefulness, efficiency, and sustainability of management measures;
4. Able to characterize ecosystem management process, planning, execution, efficiency monitoring.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Specificity of ecosystems
2.	Stagnant water ecosystems, specificity of their management
3.	Protected species in stagnant water ecosystems, ecological requirements to them
4.	Flowing water ecosystems, specificity of their management
5.	Protected species in flowing water ecosystems, ecological requirements to them
6.	Marshland ecosystems, specificity of their management
7.	Protected species in marshland ecosystems, ecological requirements to them
8.	Forest ecosystems, specificity of their management
9.	Protected species in forest ecosystems, ecological requirements to them

10.	Grassland ecosystems, specificity of their management
11.	Protected species in grassland ecosystems, ecological requirements to them
12.	Other ecosystems and species in Latvia, specificity of their management
13.	Procedures of planning the measures of management
14.	Legal acts referable to measures of management
15.	Integration of measures of ecosystem management in nature protection plan
16.	Assessment of the efficiency of measures of ecosystem management

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; seminars, and independent study.	Independent work is envisaged after each seminar and is related to in-depth analysis of the topics. Independent work comprises the analysis of literature sources.

GENERAL INFORMATION ABOUT THE COURSE #11		
1.	The name of the course/module	Applied Biology and Bioeconomics II: Science Communication in Natural Sciences
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	1.5
6.	The total number of hours	40
7.	General description and purpose of the educational component	The study course is aimed at improving students' understanding of the theoretical aspects of science communication as well as developing practical skills in applying various means of science communication. Study course objectives: Developing the understanding of the role of scientific information in the society and scientific research. Providing basic knowledge on principles of using various kinds and forms of science communication and their application in natural sciences. Updating the competence of efficient application of various science communication methods with different target audiences. Developing practical skills of independent analysis of scientific literature and facilitating the understanding of the basic principles of preparing scientific articles. Developing practical skills of presenting research topics for diverse target audiences and perfecting the skills of presentation in public.
8.	Prerequisites for studying the course/module, connection with other educational components	Applied biology and bioeconomics I: work organization and security in biological and clinical laboratories Applied biology and bioeconomics I: wildlife natural resource conservation and protection

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge Demonstrate knowledge on basic principles of applying various kinds and forms of science communication and options of their use in natural sciences. Have a command of major methods of acquiring scientific information. Have a command of the basic principles of preparing scientific and popular science papers. Have a command of the basic principles of efficient public presentation. Have a command of major channels of spreading information and essential methods of communication. Skills Able to apply various methods of science communication Able to independently search for scientific information Able to prepare information on scientific topics and adjust it to using it in various target audiences Able to provide efficient publicity for various science communication activities Competences Aware of the significance of science communication in promotion of science processes, developments and achievements in broader public. Able to analyze and critically assess scientific information. Able to discuss research issues adjusting to various target audiences.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	The role of scientific information in the society and scientific research
2.	Basic principles of efficient science communication and peculiarities of science communication in natural sciences
3.	Basic principles of selecting and analyzing scientific information

4.	Preparing, presenting of scientific information, adjusting to various target audiences
5.	Basic principles of preparing high quality scientific papers
6.	Major channels of spreading information and their efficient use

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; seminars, and independent study.	Students' independent work is organized individually and/or in groups. Independent work assignments: Selecting and analyzing information on the chosen topic in natural science. Preparing scientific presentations for non-specialist audience and scientist audience. Elaboration and presentation of science communication activity scenario on a topic related to natural sciences.

GENERAL INFORMATION ABOUT THE COURSE #12		
1.	The name of the course/module	Aquaculture Technologies II
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	9
6.	The total number of hours	240
7.	General description and purpose of the educational component	The aim of the study course is improving students' understanding and knowledge of contemporary developments and achievements in genetics as well as developing practical skills producing research and practical work in genetics and biotechnologies in aquaculture. The study course objectives: 1. Improve knowledge on genetic processes of cultivated aquaculture organisms and gain understanding of genetic processes in reproducible, introduced, artificial, exploitable fish and other hydrobiont populations. 2. Facilitate the formation of understanding of fish biotechnology methodology and genetic research methods in aquaculture. 3. Improve knowledge on fresh water natural and artificially produced ecosystem major functional abiotic elements and their interaction applying the acquired skills in independent research of water ecosystem aquaculture. 4. Develop skills of applying genetic methods in aquaculture, result interpretation and analysis. 5. Develop skills of using the acquired data to solve issues of nature protection and aquaculture.
8.	Prerequisites for studying the course/module, connection with other educational components	Aquaculture technologies I

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: - acquire theoretically deepened knowledge on genetic processes in cultivated aquaculture organisms; - acquire understanding of genetic processes in reproducible, introduced, artificial, exploitable fish and other populations; - gain knowledge on fish biotechnology methodology; - acquire knowledge on methods of genetic research in aquaculture Skills: - skills of applying genetic methods in aquaculture, their interpretation; - skills of extracting DNA from cultivated aquaculture organisms and analysing them; - applying genetic research methods in biotechnology in aquaculture; - skills of using the acquired data in dealing with nature protection and aquaculture issues. Competences: - can independently formulate, organize, and analyze scientific and applied research in genetics and biotechnologies in aquaculture; - demonstrate understanding of the applicability of the acquired results in aquaculture.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Genetics and biotechnology, their historical development and role in contemporary aquaculture
2.	Genome, nucleus and mitochondrion DNA. Composition of chromosomes. Variability and evolution of caryotype
3.	Genetic control of fish and other aquaculture object feature formation

4.	Interaction of genotype and environmental factors. Epigenetics
5.	Physical and chemical characteristics of DNA and their use in modern genetic and biotechnological methods in aquaculture
6.	Phenotypal polimorphism, mechanisms
7.	Mutations and their kinds. Polyploidism with fish. Methods of detecting mutations
8.	Genetic processes in fish natural populations. Elementary evolution processes in populations
9.	Genetic processes in reproducible, introduced, artificial, exploitable fish and other populations
10.	Polymerase chain reaction, their kinds and use in genetics and biotechnologies in aquaculture
11.	Methods of detecting genetic polymorphism and use of genetic markers in aquaculture
12.	Genetic monitoring in modern aquaculture
13.	Methodology of field genetic research in aquaculture
14.	Methodology of genetic experiment in aquaculture. Method of phenotypal polymorphism analysis
15.	Methods of extracting DNA (manual and automatic, invasive and noninvasive) from various fish samples
16.	Analysis of DNA quality and quantity with spectrophotometric
17.	Analysis of DNA quality and quantity with electrophoresis
18.	Biochemical markers. Analysis of fish isoenzyme polymorphism. PCR reaction mixture preparation, various PCR kinds and apparati
19.	Detecting fish DNA polymorphism by various methods
20.	Fish cariotype analysis, FISH method
21.	Fish ploidy analysis
22.	Genetic monitoring

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, laboratory assignment, and independent study.	Doing their independent work, students: - learn in deep each lecture topic according to the syllabus and course plan, preparing questions for the academic staff member to discuss them in next class or seminar; - make a presentation on a topic suggested and prepare to defend it; - prepare for tests. Students may use other sources of information not indicated in the course description, consulting the academic staff member.

GENERAL INFORMATION ABOUT THE COURSE #13		
1.	The name of the course/module	Practical Research in Biodiversity II
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	9
6.	The total number of hours	240
7.	General description and purpose of the educational component	The study course is aimed at developing knowledge and practical skills for working with most frequently used up-to-date methods, equipment, facilities, and software applied in laboratory work with the material collected in the course of field work. Study course objectives: 1. Facilitating the acquisition of knowledge on practically applicable methods of processing the collected material and methods of keeping organisms in situ; 2. Providing knowledge acquisition on legal acts, CM regulations, ethical norms and other binding requirements in relation to methods of processing the collected material and methods of keeping organisms in situ; 3. Consolidating students' practical skills of applying methods of processing the collected material in the course of field research; 4. Facilitating the development of students' independent work skills including skills of selecting and applying methods appropriate for the processing of the collected material.
8.	Prerequisites for studying the course/module, connection with other educational components	Practical research in biodiversity I

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge: - understand the theoretical basis of processing the material obtained in the course of research; - demonstrate knowledge on contemporary methods of processing the material; - aware of the facilities and equipment applicable in processing the material; - aware of legal acts and ethical norms, understand their application in processing the material. Skills: - able to process the collected material in compliance with the scientific basic positions, legislation, and ethical norms; - able to select and independently apply appropriate research methods, facilities, and equipment; - able to select appropriate methods for statistical analysis of the collected data. Competences: - aware of the current developments in science, assess the need for performing certain means of processing the material; - able to independently select appropriate methods of processing the material on the basis of acquired knowledge, scientific literature and personal experience; - able to process the material collected in field research, summarize, analyse, and present the acquired data.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Methods of processing the material in zoology
2.	Methods of processing the material in research on vascular plants
3.	Methods of processing the material in research on moss
4.	Methods of processing the material in lichenology
5.	Methods of processing the material in parasitology
6.	Keeping living organisms in situ
7.	Digitalization of the collected data, databases
8.	Preserving collections
9.	Observing legal and ethical norms in compiling collections and keeping living organisms in situ
10.	Opportunities of applying the collection data in scientific research

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; seminars, practical assignment, and independent study.	During their independent work students: - learn in deep each seminar and practical assignment topic (see the syllabus and course description) preparing questions for the academic staff member (to discuss them in next class); - prepare for practical assignment classes – revise theory, select the method of processing the material, and prepare the necessary equipment. Students may use other sources of information not indicated in the course description, consulting the academic staff member.

GENERAL INFORMATION ABOUT THE COURSE #14		
1.	The name of the course/module	Nature Recreation Strategy I
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	4.5
6.	The total number of hours	120
7.	General description and purpose of the educational component	The study course is aimed at providing a notion of the role of nature in human's physical, intellectual faculty improvement and health recreation developing practical skills in using nature recreation methods. The study course objectives: 1. Facilitate the acquisition of theoretical knowledge on practically applicable nature recreation methods. 2. Provide the notion of the opportunities of organizing nature recreation events and their legal framework. 3. Consolidate the practical skills of using nature recreation methods. 4. Facilitate the strengthening of students' practical work skills including skills of independent work organization, planning, selecting appropriate methods and their practical application.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		

Knowledge: - understand the theoretical fundamentals of nature recreation; - demonstrate knowledge of the nature resources that can be used for recreation; - have a command of nature recreation methods; - aware of the legal acts and ethical norms, understand their application in nature recreation. Skills: - able to plan recreation events in compliance with legislation and ethical norms; - able to select and independently use appropriate recreation methods, equipment, and facilities; - able to estimate the efficiency of recreation events. Competences: - have a command of recreation events, able to assess the necessity for particular recreation events; - independently select appropriate recreation events on the basis of the previously acquired knowledge and personal experience; - implement recreation events using nature resources assessing their efficiency.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	The idea of nature recreation. Options of applying the knowledge and skills acquired
2.	The history of nature recreation events
3.	Skills of nature recreationist
4.	NGOs, local government and state institutions, their role in nature recreation idea development
5.	Planning nature recreation events
6.	Legal acts and documents referred to nature recreation
7.	Sites of nature recreation events. Their choice and characteristics
8.	Ethical aspects of nature recreation events
9.	Nature recreation events appropriate for people of various age and physical ability
10.	Review of various health recreation events in the open air
11.	Bees and apitherapy
12.	Domestic animal use in nature recreation (felinotherapy, canistherapy, etc.)
13.	Dolphin therapy
14.	Reittherapy
15.	Using nature resources for health recreation
16.	Sports activities in the open air, their classification, characteristics and survey
17.	Nature recreational investigation, animals, plants, dry land biotopes, aquatic biotopes
18.	Nature resource protection and sustainable use for recreation

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, and independent study.	Doing their independent work, students: - learn in deep each lecture topic according to the syllabus and course plan, preparing questions for the academic staff member to discuss them in next class or seminar. Students may use other sources of information not indicated in the course description, consulting the academic staff member.

GENERAL INFORMATION ABOUT THE COURSE #15		
1.	The name of the course/module	Ecosystem Services I
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	4.5
6.	The total number of hours	120
7.	General description and purpose of the educational component	The study course is aimed at improving students' understanding and knowledge of ecosystems in Latvia, including EU protected biotopes and species, their protection and sustainable use principles in nature recreation and national economy preserving biological diversity, developing skills of assessing the impact of ecosystem services on ecosystems. The study course objectives: 1. improving knowledge of ecosystems in Latvia emphasizing the significance of nature protection and creating understanding of legislation of Latvia and EU in the sphere of species and biotope protection and use; 2. facilitating understanding formation on trends of using nature resources in spheres related to nature recreation; 3. developing skills of assessing and analyzing the impact of ecosystem services on

		ecosystem elements; 4. facilitating students' participation in discussions on nature protection priorities and compromise between social and nature protection needs.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge:
- have a command of ecosystems, habitats, and biotopes occurring in Latvia;
- have a command of legislation of Latvia and EU regulating species and biotope protection in Latvia as well as nature resource use, understand liabilities of Latvia in the sphere of nature protection and its use;
- understand the status of nature protected territories and limitations in them;
- aware of the notion of ecosystem services and trends of their use.

Skills:
- have a command of protected biotopes and other nature elements that are located beyond protected territories;
- able to discuss current trends of nature protection and their necessity;
- able to prove the need for elaborating nature protection plans;
- make suggestions for the criteria of species and biotope protection status change;
- formulate ideas and suggestions for the use of methods of limiting invasive species and their implementation necessity.

Competences:
- independently assess problem situations and make decisions justifying their actions with previously acquired knowledge and personal experience;
- able to work in groups elaborating nature protection plans.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Peculiarities and characteristics of ecosystems
2.	Protected biotopes of EU significance, their identification and quality assessment trends
3.	Protected and rare species, their general survey
4.	Legislation regulating nature protection and its resource use
5.	Liabilities and general policy in the sphere of nature protection and use of its resources
6.	Protected territories, their status, limitations, functional zoning
7.	Protected biotopes and other nature elements beyond protected territories with limitations on their use
8.	Nature protection plans, their necessity and elaboration process
9.	Species protection plans, their necessity and elaboration process
10.	Invasive species as a hazardous factor for nature protection and its resource use
11.	Ecosystem services, their general characteristics and current developments
12.	Ecosystem services and their planning in protected nature territories

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, practical assignments, and independent study.	Doing their independent work, students: - learn in deep each lecture topic according to the syllabus and course plan, preparing questions for the academic staff member to discuss them in next class or seminar; - make a presentation on a topic suggested and prepare to defend it. Students may use other sources of information not indicated in the course description, consulting the academic staff member.

GENERAL INFORMATION ABOUT THE COURSE #16

1.	The name of the course/module	Current Issues in Biology III
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	3d
5.	Number of ECTS credits	3
6.	The total number of hours	80
7.	General description and purpose of the educational component	The study course is envisaged for master students in the sphere of natural sciences. The aim of the course is improving the understanding of the current developments of molecular biology and genetics, trends of scientific research, research facilities. Study course objectives: 1. Developing a notion of molecular biology and genetics as contemporary branch of

		science spreading in various directions, with broad research perspectives and great significance in national economy; 2. Providing knowledge on basic elements of studying genetic information covering the organization of living matter at various levels – molecular, cell, tissue, organ, and organism; 3. Identifying major subbranches of molecular biology and genetics, characterizing modern trends of research in them and applicability in national economy; 4. Developing thinking in biology analyzing various regularities of the sphere.
8.	Prerequisites for studying the course/module, connection with other educational components	Current issues in biology I Current issues in biology II

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge:
1. Able to explain current trends in genetic and molecular biology research, covering the organization of living matter at various levels – molecular, cell, tissue, organ, and organism.
Skills:
2. Aware of the current developments in the subbranches of genetics and molecular biology, able to characterize their research object and significance in the general development of science.
Competences:
3. Able to independently define major subbranches of genetics and molecular biology characterizing modern research trends in them and application in national economy realizing their main idea and general regularities;
4. Able to characterize genetics and molecular biology as a multibranch modern science and describe broad research perspectives.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Physical and chemical qualities of polymers, their use in various molecular biological research
2.	Current developments in mitochondrial DNA research
3.	Current developments in ribosomal RNA research
4.	Current developments in gene engineering
5.	Current developments in transgene organism formation, cloning of plants and animals
6.	Problems of ageing of organisms and their molecular mechanisms in a contemporary perspective
7.	Current problems in systematics and taxonomy
8.	Current developments in molecular systematics
9.	Theoretical models of sustainable use of biological resources and their practical examples
10.	Current developments in research on population dynamics
11.	Informative and energetic models of biological diversity
12.	Stability and evolution of biocenoses – theory and practice
13.	Current problems of environmental protection
14.	Current developments in ecogenotoxicology
15.	Current developments in diagnosis of molecular diseases
16.	Current developments in research on oncogenesis and its molecular mechanisms

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, and independent study.	Independent work is envisaged after each lecture and is related to deeper analysis of the lecture topic. Within the independent work, students produce analysis of the sources of literature.

GENERAL INFORMATION ABOUT THE COURSE #17

1.	The name of the course/module	Methodology of Research in Biology III: Methodology of Interdisciplinary Research
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	3d
5.	Number of ECTS credits	6
6.	The total number of hours	160
7.	General description and purpose of the educational component	The study course is aimed at familiarizing students with the advantages, opportunities, and contemporary application of interdisciplinary research. Study course objectives: 1. Facilitating the acquisition of theoretical knowledge on methodology of interdisciplinary research and its application; 2. Consolidating practical skills in the sphere of interdisciplinary research;

		3. Facilitating the consolidation of students' independent work skills including work with scientific literature and legal act investigation.
8.	Prerequisites for studying the course/module, connection with other educational components	Methodology of research in biology I: field research methodology Methodology of research in biology II: laboratory diagnostic methods

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge:
- have a command of interdisciplinary research methodology, conditions of its application;
- have a command of the significance of interdisciplinary research methodology in contemporary science and respective applied branches;
- have a command of the role of interdisciplinary research in innovation development;

Skills:
- able to use knowledge in the sphere of interdisciplinary research performing various tasks in natural sciences;
- able of processing, analyzing, and interpreting scientific literature in the sphere of interdisciplinary research;
- able of organizing work performing various kinds of research;
- able to independently make decisions organizing various kinds of research.

Competences:
- able of prognosis of gains and disadvantages applying various methods of interdisciplinary research;
- able to analyze and interpret research results.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Introduction to methodology of interdisciplinary research: principles, opportunities, and application necessity
2.	Notion of research. Kinds of research, application of various kinds of research
3.	Specificity of research methods in natural sciences
4.	Research design making
5.	Data collection methods in natural sciences
6.	Data analysis methods in natural sciences
7.	Limitations of interdisciplinary research method application

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, and independent study.	Before each class students study the literature for the respective topic. During the course students independently make a presentation and prepare for mid-term examinations and final examination. Independent work is envisaged after each lecture and is related to deeper analysis of each lecture topic. Students analyze literature for each topic. During the course students independently make a presentation and prepare for mid-term examinations (3 test works) and final examination. Test work 1. Idea and advantages of interdisciplinary research. Test work 2. Selecting and applying methods of interdisciplinary research. Test work 3. Analysis and interpretation of the results of interdisciplinary research.

GENERAL INFORMATION ABOUT THE COURSE #18

1.	The name of the course/module	Applied Biology and Bioeconomics III: Bioeconomics
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	3d
5.	Number of ECTS credits	4.5
6.	The total number of hours	120
7.	General description and purpose of the educational component	The study course is aimed at familiarizing students with the tasks of Bioeconomics nowadays, strategy in Latvia, strategy in bioeconomics for sustainable Europe and its role in innovation development. Study course objectives: 1. Facilitating the acquisition of theoretical knowledge on the practical application of knowledge in Biosystematics and practical outcomes.

		2. Providing knowledge on legal act regulations concerning the strategy of Bioeconomics in Europe. 3. Consolidating practical skills in the application of Biosystematics ideas. 4. Facilitating students' practical work skill development, including skills in work with scientific literature and legal acts investigation.
8.	Prerequisites for studying the course/module, connection with other educational components	Applied biology and bioeconomics I: work organization and security in biological and clinical laboratories Applied biology and bioeconomics I: wildlife natural resource conservation and protection Applied biology and bioeconomics II: bioresource management Applied biology and bioeconomics II: science communication in natural sciences

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
- have a command of aims, objectives, and significance of Bioeconomics
- have a command of the achievements of Bioeconomics, their role in the development of economics
- have a command of legislation in Latvia and Europe in the sphere of Bioeconomics
- have a command of the notion of innovations and the role of innovations in economics
- have a command of the role of Bioeconomics in the development of innovations

Skills
- able to apply knowledge in the sphere of Bioeconomics for designing certain niche products
- able to process, analyze, and interpret scientific literature in the sphere of Bioeconomics
- able to organize work in the sphere of Bioeconomics
- able to independently make decisions in various issues related to Bioeconomics

Competences
- have a command of the legal acts related to Bioeconomics in Latvia and worldwide
- able to prognosticate gains of Bioeconomics in various spheres of biology and biotechnologies

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Introduction in Bioeconomics: aim, objectives, interdisciplinarity
2.	Achievements in Bioeconomics nowadays, examples
3.	Bioeconomics strategy
4.	Innovations, their definition, examples
5.	Bioeconomics role in innovation development
6.	The role of biology and Bioeconomics in innovation development

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, and independent study.	Before each class, students study the literature for the respective topic. During the course they make a presentation and prepare for mid-term tests and final examination. Independent work is envisaged after each lecture and is related to in-depth analysis of the lecture topic. Students perform the analysis of literature sources. Within their independent work, students prepare a presentation and get ready for mid-term tests (3 tests) and final examination. Test 1. Aim, objectives, achievements of Bioeconomics. Test 2. Strategy of Bioeconomics in Latvia and Europe. Test 3. Notion of innovations, the significance of innovations in the development of bioeconomics.

GENERAL INFORMATION ABOUT THE COURSE #18

1.	The name of the course/module	Aquaculture Technologies III
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	3d
5.	Number of ECTS credits	9
6.	The total number of hours	240
7.	General description and purpose of the educational component	The aim of the study course is improving students' understanding and knowledge of infectious and non-infectious hydrobiont diseases in Latvia and worldwide as well as developing skills of assessing the epizootic situation in aquaculture object as well as acquire practical skills in diagnosing hydrobiont parasitic diseases. The study course objectives:

		1. Improve knowledge on infectious diseases of hydrobionts (viral, bacterial, parasitic and mycosis), their diagnostic and prophylaxis. 2. Improve knowledge on uninfectious (alimentary) diseases and their impact on hydrobiont organisms. 3. Develop skills of performing the assessment of the health condition of aquaculture objects taking into consideration various factors of influence in economics and/or water reservoir. 4. Facilitate the formation of understanding on various methods of hydrobiont disease diagnostics enhancing students' competences in diagnosing parasitic diseases.
8.	Prerequisites for studying the course/module, connection with other educational components	Aquaculture technologies I Aquaculture technologies II

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge:
- aware of hydrobionts' health as a complex part of the branch of applied science of biology that can secure sustainable quality food system functionality;
- understand the necessity of observing aquaculture technologies for providing prophylaxis of hydrobiont diseases;
- have a command of aquaculture object disease diagnosing methods and their applicability in daily practice;
- know the hydrobiont zoonotic disease agents and aware of risks for human health.

Skills:
- have a command of aquaculture object disease diagnosing current developments and achievements;
- can analyze risks of hydrobiont disease spread;
- can carry out primary diagnostic of hydrobiont diseases;
- can relate the biology of host and parasite;
- make suggestions for the improvement of the episootic situation in fishing industry.

Competences:
- independently assess problem situations and make decisions justifying their activities with previously acquired knowledge and personal experience;
- perform scientific research and elaborate projects in various spheres of acquaculture.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Basic notions of pathology
2.	Protective reactions of organism
3.	Diseases caused by fish viruses
4.	Diseases caused by fish bacteria
5.	Diseases caused by fish mycosis
6.	Fish invasive diseases
7.	Fish parasites pathogenic for humans
8.	Fish alimentary/uninfectious diseases
9.	Fish disease diagnostics
10.	Crayfish organism protective reactions
11.	Crayfish infectious/uninfectious diseases
12.	Crayfish disease diagnostic and prophylaxis
13.	Designing the results of hydrobiont disease testing
14.	Recording and accounting hydrobiont diseases

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, laboratory assignments, and independent study.	Doing their independent work, students: - learn in deep each lecture topic according to the syllabus and course plan, preparing questions for the academic staff member to discuss them in next class or seminar; - make a presentation on a topic suggested and prepare to defend it; - prepare for tests. Students may use other sources of information not indicated in the course description, consulting the academic staff member.

GENERAL INFORMATION ABOUT THE COURSE #19

1.	The name of the course/module	Practical Research in Biodiversity III
2.	Faculty/department	Biology

3.	Status of the educational component	Mandatory
4.	Semester	3d
5.	Number of ECTS credits	9
6.	The total number of hours	240
7.	General description and purpose of the educational component	The study course is aimed at developing knowledge and practical skills for working with most frequently used up-to-date molecular biology, parasitology, and genetics methods, equipment, facilities, and software. Study course objectives: 1. Facilitating the acquisition of knowledge on practically applicable methods of processing the collected material in molecular biology, parasitology, and genetics laboratories; 2. Providing knowledge acquisition on legal acts, CM regulations, ethical norms and other binding requirements in relation to work in molecular biology, parasitology, and genetics laboratories; 3. Consolidating students' practical skills of working with equipment, facilities, and software in molecular biology, parasitology, and genetics laboratories; 4. Facilitating the development of students' independent work skills including skills of selecting and applying methods appropriate for the processing of the collected material.
8.	Prerequisites for studying the course/module, connection with other educational components	Practical research in biodiversity I Practical research in biodiversity II

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge:
- understand the theoretical basis of processing the material in molecular biology, parasitology, and genetics laboratories;
- demonstrate knowledge on contemporary methods of processing the material;
- aware of the facilities and equipment applicable in processing the material;
- aware of legal acts and ethical norms, understand their application in processing the material.

Skills:
- able to process the collected material, by molecular biology, parasitology, and genetics methods, in compliance with the scientific basic positions, legislation, and ethical norms;
- able to select and independently apply appropriate research methods, facilities, and equipment.

Competences:
- aware of the current developments in science, assess the need for performing certain means of processing the material;
- able to independently select appropriate methods of processing the material on the basis of acquired knowledge, scientific literature and personal experience;
- able to process the material obtained in molecular biology, parasitology, and genetics research, and summarize the acquired data.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Legal acts, ethical norms and other binding requirements in relation to work in molecular biology, parasitology, and genetics laboratories
2.	Equipment of genetics and molecular biology laboratories
3.	Laboratory methods in genetics and molecular biology laboratories
4.	Software applicable in the analysis of the genetic material
5.	Equipment of parasitology laboratory
6.	Methods of processing the material in parasitology
7.	Software applicable in the analysis of the parasitology material
8.	Interdisciplinary research in molecular biology

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; seminars, practical assignments, and independent study.	During their independent work students: - learn in deep each seminar and practical assignment topic (see the syllabus and course description) preparing questions for the academic staff member (to discuss them in next class); - prepare for practical assignment classes – revise theory, select the method of processing the material, and prepare the necessary equipment. Students may use other sources of information not indicated in the course description, consulting the academic staff member.

GENERAL INFORMATION ABOUT THE COURSE #20		
1.	The name of the course/module	Nature Recreation Strategy II
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	3d
5.	Number of ECTS credits	4.5
6.	The total number of hours	120
7.	General description and purpose of the educational component	The study course is aimed at stimulating students' creativity and systemic thinking acting in accordance with hardly predictable environmental changes when there is a need for making new, sustainable, socially responsible decisions to balance biological resources and human recreation needs. The study course objectives: 1. Providing students with up-to-date knowledge in applied biology simultaneously uniting theoretical knowledge with practical skills. 2. Developing students' competence of organizing and performing activities based on the investigation of biological diversity. 3. Facilitating innovation development by guiding recreational activities. 4. Facilitate the strengthening of students' practical work skills including skills of independent work organization, planning, selecting appropriate methods and their practical application.
8.	Prerequisites for studying the course/module, connection with other educational components	Nature recreation strategy I

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge:
- understand the theoretical fundamentals of nature recreation and are able to put them to practice;
- demonstrate knowledge of the nature resources that can be used for recreation, are able to use them;
- have a command of nature recreation methods.

Skills:
- able to plan recreation events in compliance with sustainable development principles;
- able to select and independently use appropriate recreation methods;
- able to estimate the efficiency of recreation events and their impact on the environment.

Competences:
- have a command of recreation events, able to organize them and assess their impact on human and surrounding environment;
- independently select appropriate nature recreation biotopes, able to asses them and analyse the gains and losses;
- implement nature recreation events.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Significance and basic principles of designing the plan of potential recreation place management
2.	Assessment of nature recreation efficiency for achieving sustainable results
3.	Assessment of the impact and risks for nature objects and territories used in recreation
4.	Recreation related project compatibility criteria for local development strategy for each activity included in the plan of action
5.	Border areas as major trends of tourism and recreation development
6.	Development priority and finance planning relation in the sphere of nature recreation
7.	Sustainable development and monitoring process in the sphere of nature recreation
8.	Climate changes and biological diversity: impact on recreation objects
9.	Observing environment requirements and preserving nature diversity not to reduce the options for meeting the recreation needs for future generations

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, and independent study.	Before each class students familiarize with the topic of the class and respective scientific and academic literature. Independent work is envisaged after each seminar and is related to in-depth analysis of lecture topics. Within the independent work, students do analysis of literature sources. Students within their independent work prepare for mid-term examinations (two tests) and final examination. Test 1. Assessment of nature recreation event efficiency.

	Test 2. Climate changes and biological diversity: impact on recreation objects. Observing environmental requirements and preserving nature diversity not to reduce the options for meeting the recreation needs for future generations.

GENERAL INFORMATION ABOUT THE COURSE #21		
1.	The name of the course/module	Ecosystem Services II
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	3d
5.	Number of ECTS credits	4.5
6.	The total number of hours	120
7.	General description and purpose of the educational component	The study course is aimed at improving students' understanding, knowledge, and practical skills of sustainable use of ecosystems in Latvia, including the assessment of the impact on EU level protected biotopes and species. The study course objectives: 1. improving the knowledge and practical skills of ecosystem services in Latvia in spheres related to nature recreation; 2. developing skills of planning concrete actions related to nature recreation and assessment of their impact on nature; 3. forming an insight into possible variations of cooperation among state, local government, NGOs, businessmen and private persons in planning concrete actions related to ecosystem services; 4. facilitating students' participation in discussions on compromises concerning social, commercial, and nature protection needs.
8.	Prerequisites for studying the course/module, connection with other educational components	Ecosystem services I

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge:
- have a command of biotopes occurring in Latvia and related ecosystem services;
- have a command of legislation of Latvia and EU regulating ecosystem service provision in Latvia;
- understand the principles of assessing the impact of ecosystem services;
- aware of the need for various infrastructure elements for ecosystem service provision and the need for assessing their impact;
- aware of the nature protection plan structure and integration of ecosystem services in it.

Skills:
- have a command of innovative ecosystem service implementation perspectives in Latvia and worldwide;
- able to discuss ecosystem service provision opportunities and justification in different types of biotopes;
- able to assess the impact of ecosystem services on various biotope types;
- make suggestions for introduction of ecosystem services in concrete territories or biotope types;
- formulate ideas and suggestions for limiting the impact of ecosystem services in territories essential for nature protection.

Competences:
- independently assess problem situations and make decisions justifying their actions with previously acquired knowledge and personal experience;
- able to work in groups assessing the opportunities of ecosystem service implementation and their negative/positive impact.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Current and innovative ecosystem services in grassland biotopes
2.	Principles and conditions of selecting grassland biotopes for ecosystem services implementation
3.	Current and innovative ecosystem services in forest biotopes
4.	Forest biotopes appropriate for ecosystem services, conditions of their implementation
5.	Current and innovative ecosystem services in marsh biotopes
6.	Principles of selecting marsh biotopes and conditions for ecosystem service implementation
7.	Current and innovative ecosystem services in aquatic biotopes
8.	Principles of selecting aquatic biotopes and conditions for ecosystem service implementation
9.	Assessment of the impact of ecosystem services implementation and intensity limitations in nature protected territories
10.	Infrastructure elements required for the implementation of ecosystem services, opportunities of their use
11.	Integration of ecosystem services in nature protection plan, required justification
12.	Perspectives of implementing innovative ecosystem services

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, practical assignments, and independent study.	Doing their independent work, students: - learn in deep each lecture topic according to the syllabus and course plan, preparing questions for the academic staff member to discuss them in next class or seminar; - elaborate practical assignments on a topic suggested and prepare to defend them. Students may use other sources of information not indicated in the course description, consulting the academic staff member.

GENERAL INFORMATION ABOUT THE COURSE #22		
1.	The name of the course/module	Current Issues in Biology IV: Ecotoxicology and Research on Pollution
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	4th
5.	Number of ECTS credits	3
6.	The total number of hours	80
7.	General description and purpose of the educational component	The study course is aimed at developing an active and creative attitude towards the study process, improve knowledge on contemporary ecotoxicology principles and trends, facilitating students' abilities to analyze and assess the hazardous impact of pollutants and related risks as well as developing skills of practical assessment of the risk of the substance impact and master the principles of management of the environment. Study course objectives: 1. Improving knowledge on methods of estimating the toxicity of substances and research methods in ecotoxicology; 2. Facilitating the development of understanding about the major ways of substance impact and major pollutants of the environment, their sources in the environment and qualities; 3. Facilitating the development of understanding about the character of substance metabolism in living organisms; 4. Improving the methods of analyzing the risks of substance impact and principles of risk estimation as well as the fundamentals of the methods of estimating toxicity of substances.
8.	Prerequisites for studying the course/module, connection with other educational components	Current issues in biology I Current issues in biology II Current issues in biology III

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: - aware of ecotoxicology as a broad and complex sphere of the science of chemistry that is equally significant for the acquisition of environmental science and biology; - know the basic principles of sustainable development (nature, economy, and society); - understand the necessity for developing ecotoxicology to protect human and other living organisms as well as environment from the impact of alien substances; - understand the role of scientific research, industrial technologies, and modern biotechnologies and related risks. Skills: - have a command of current developments and achievements of ecotoxicology; - can discuss the trends and perspectives of ecotoxicology development; - can analyze risks of environmental pollution and their reduction options; - formulate ideas and suggestions for rational use of environmental resources and sustainable development taking into consideration economic, social, and environmental aspects. Competences: - independently assess problem situations and perform SWOT analysis; - make decisions, argumenting their actions with prior knowledge and personal experience; - perform scientific research and elaborate projects in various spheres of ecotoxicology.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Estimating the hazard of environmental pollution
2.	History of research on genotoxins. Organism reactions to the impact of genotoxins
3.	Cancerogenic, mutagenic, and teratogenic substances in the environment

4.	Chemical mutagen impact features
5.	Genotoxic chemicals in food products, tobacco, transport gas emissions etc.
6.	Physical factor impact on functions of organisms and heredity
7.	Living organisms as a source of environmental pollution. Toxic substances of natural origin
8.	Biomarkers in ecotoxicology. Ecotoxic factor research methodology

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, laboratory assignments, and independent study.	Doing their independent work, students: - learn in deep each lecture topic according to the syllabus and course plan, preparing questions for the academic staff member to discuss them in next class or seminar; - make a presentation on a topic suggested and prepare to defend it; - prepare for tests. Students may use other sources of information not indicated in the course description, consulting the academic staff member.

GENERAL INFORMATION ABOUT THE COURSE #23		
1	The name of the course/module	Methodology of Research in Biology IV: Data Analysis and Interpretation in Interdisciplinary Research
2	Faculty/department	Biology
3	Status of the educational component	Mandatory
4	Semester	4th
5	Number of ECTS credits	6
6	The total number of hours	160
7	General description and purpose of the educational component	The study course is envisaged for students without prerequisite knowledge in statistics that covers the major part of intra-subject and inter-subject research designs and is focused on dispersion analysis (ANOVA, ANCOVA, MANOVA, MANCOVA), regression and association/correlation analyses with acquisition of practical statistical testings calculating real examples of data processing.
8	Prerequisites for studying the course/module, connection with other educational components	Methodology of research in biology I: field research methodology Methodology of research in biology II: laboratory diagnostic methods Methodology of research in biology III: methodology of interdisciplinary research

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Upon completing the course, students are able to make a research design, calculate the necessary sampling volume, select the kind of statistical analysis, produce statistical data analysis, interpret and present results. The acquired knowledge and skills may be applied to analyze data from various research spheres.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Research design from the position of data processing
2.	Introduction to statistics. Basic notions and descriptive statistics
3.	One sampling research designs
4.	Two sampling research designs
5.	Introduction to dispersion analysis (ANOVA)
6.	Introduction to covariance analysis (ANCOVA)
7.	Multi variable analysis (MANOVA)
8.	Multi variable analysis with covariate (MANCOVA)
9.	Two-way dispersion analysis (two-way ANOVA)
1(	Mixed design analysis (mixed ANOVA)
1:	Regression analysis
1:	Kinds of associations and correlations
1:	Individual research design elaboration
1	Group work to implement individual research projects. Each group elaborates a research design, collects data, produces data analysis, and presents the results

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Face-to-face teaching; lectures, seminars, practical assignments, and independent study.	After lectures and practical assignment completion, students elaborate their individual research design, summarize data, produce the analysis and present the obtained results and the selected kind of analysis.

GENERAL INFORMATION ABOUT THE COURSE #24		
1	The name of the course/module	Applied Biology and Bioeconomics IV: Bioeconomics
2	Faculty/department	Biology
3	Status of the educational component	Mandatory
4	Semester	4th
5	Number of ECTS credits	4.5
6	The total number of hours	120
7	General description and purpose of the educational component	The study course is aimed at updating students' understanding and knowledge on current developments and achievements in the sphere of bioecenomics as well as developing practical skills of applying principles of biological economy and smart technologies in diverse contemporary branches, sustainable use of renewable nature resources preserving biological diversity. Study course objectives: 1. updating knowledge on recent smart economy trends in agriculture, forestry, fisheries, power industry, and tourism industry; 2. facilitating the understanding of the role of modern biotechnologies in the development of biopharmacy, biomedicine, and biofood industry branches; 3. developing skills of formulating ideas and suggestions for rational use of renewable resources and sustainable development, taking into consideration the economic, social, and environmental aspects as well as analyzing scientific research and elaborating projects in bioeconomics spheres; 4. facilitating students' involvement in discussions on the opportunities of reducing greenhouse effect gas emission, developing their ability of critical analysis of the necessity for using non-renewable nature resources, making suggestions for raising the added value of national economy, industry, and medicine products.
8	Prerequisites for studying the course/module, connection with other educational components	Applied biology and bioeconomics I: work organization and security in biological and clinical laboratories Applied biology and bioeconomics I: wildlife natural resource conservation and protection Applied biology and bioeconomics II: bioresource management Applied biology and bioeconomics II: science communication in natural sciences Applied biology and bioeconomics III: bioeconomics

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
- aware of the climate change trends and the problem of preserving biological diversity;
- know the basic principles of sustainable development (nature, economics, and society);
- understand the necessity for developing bioeconomics to avoid using fossil resources replacing them by environmental friendlier and sustainably usable nature resources;
- understand the role of scientific research, industrial technologies and modern biotechnologies in the development of biopharmacy, biomedicine, and biological food production with a strong innovation potential;
- have a command of the principles of biological economy and smart technologies applied in agriculture, forestry, fisheries, power industry, and tourism.

Skills
- have a command of current trends and achievements in bioeconomics
- able to discuss the opportunities of reducing greenhouse effect gas emission;
- able to critically analyze the necessity for using non-renewable nature resources;
- make suggestions for raising the added value of national economy, industry, and medicinal products
- formulate ideas and suggestions for rational use of renewable resources and sustainable development taking into consideration economic, social, and environmental aspects.

Competences
- independently assess problem situations and make decisions justifying actions with previously acquired knowledge and personal experience;
- analyze scientific research and use the acquired skills in product elaboration in various branches of bioeconomics.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Smart economy and management for sustainable development. High technology (high-tech) use
2.	Agroecology, biological agriculture, regenerative agriculture and permaculture. Innovative solutions in forestry and woodworking
3.	Smart governance of aquacultures and fisheries. Smart power industry. Solutions of raising energy efficiency

4.	Biorefinement conception and technologies. Smart management of waste, sorting and processing
5.	Principles of biological agriculture and legal acts regulating the sphere. Comparing biological and conventional food and competitiveness
6.	Biotechnologies applied in innovative food production. Impact of GMO, GMM, and GM food on human health and environment. Safety and traceability of food
7.	Biopharmacy, biomedicinal products, analogues of biomedicinal products. Organisms used in biopharmacy. Biomedicinal product kinds, indications, mechanisms, and production technologies
8.	Gene engineering technology and monoclonal antibody technology. Vaccine industry. Therapeutic and prophylactic vaccines. Recent trends in producing vaccines. Vaccination calendar
9.	Biomedicine and its trends. Biomaterials. Regenerating medicine, cell therapy and gene therapy, tissue bioengineering
10.	Smart medicine: case internet technologies, personalized medicine, distanced health care (telemedicine). Biomedicine engineering, recent trends and achievements
11.	Ecotourism, its basic principles, ecotourism resources, ecotourism guide. Legal regulations of ecotourism
12.	Ecotourism relatedness to various kinds of tourism. Major organizational aspects of ecotourism

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, and independent study.	Doing their independent work, students: - learn in deep each lecture topic according to the syllabus and course plan, preparing questions for the academic staff member to discuss them in next class or seminar; - make a presentation on a topic suggested and prepare to defend it; - prepare for tests. Students may use other sources of information not indicated in the course description, consulting the academic staff member.

GENERAL INFORMATION ABOUT THE COURSE #25		
1.	The name of the course/module	Aquaculture Technologies IV
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	4th
5.	Number of ECTS credits	9
6.	The total number of hours	240
7.	General description and purpose of the educational component	The aim of the study course is improving students' understanding and knowledge of the management of aquatic biological resources as well as developing practical skills of working with various aquaculture objects and their cultivation technologies, sustainably using renewable nature resources and producing aquaculture products. The study course objectives: 1. Improve knowledge on management of aquatic biological resources emphasizing the significance of aquaculture, its development opportunities, relation to ecology, genetics, and evolution, providing an opportunity of putting the acquired skills to practice in the sphere of aquaculture. 2. Facilitate the understanding of aquaculture objects and their cultivation technologies. 3. Improve knowledge on producing aquaculture products applying the acquired skills in independent research on hydrobionts. 4. Develop skills of producing toxicological and ethological experiments in aquaculture enhancing students' competences in scientific research and elaboration of projects for raising the efficiency of aquaculture products.
8.	Prerequisites for studying the course/module, connection with other educational components	Aquaculture technologies I Aquaculture technologies II Aquaculture technologies III

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: - aware of water biological resource management as a broad and complex applied science of biology sphere that can secure sustainable food system functionality and biological diversity preservation; - understand the necessity for aquaculture technology development in order to avoid the use of hydrobiont natural populations; - understand the role of scientific research, industrial technologies and modern biotechnologies in the development of

fishing industry branches; - have a command of the principles of biological management and smart technologies used in fishing industry and ecotourism sphere. Skills: - are aware of current developments and achievements in aquaculture objects and technologies; - can debate on the trends and perspectives of aquaculture cultivation technology development; - can analyze the opportunities of sustainable use of water biological resources; - formulate ideas and suggestions for water biological resource management and sustainable use taking into consideration the economic, social, environmental aspects. Competences: - independently assess problem situations; - make decisions with argumentation from previously acquired knowledge and personal experience; - perform scientific research and elaborate projects in various aquaculture spheres.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Water biological resources and their role in the structure of nature resources
2.	Fresh water and sea biological resources and their significance in human life
3.	Water biological resource sustainable management and its principles
4.	Nature protection for water biological resource preservation
5.	Water biological resource reproduction and renewal
6.	Fish nursery organization principles. Aquaculture types
7.	Full cycle carp pond management technological processes
8.	Other fish species and crayfish cultivation in ponds
9.	Cultivation in recirculation systems
10.	Combined fish management and fish cultivation in polyculture
11.	Transporting live fish
12.	Water quality and its supply technologies and equipment
13.	Mechanic filtering technologies and equipment
14.	Warming and cooling technologies and equipment
15.	Aeration and oxygenation technologies and equipment
16.	Biological purification technologies and equipment
17.	Recirculation system components and functioning principles
18.	Incubation system technologies and equipment
19.	Kinds of aquaculture products
20.	Aquaculture products quantitative and qualitative perspectives
21.	Water biological resource management
22.	Aquaculture objects
23.	Aquaculture cultivation technologies
24.	Aquaculture products

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, laboratory assignments, and independent study.	Doing their independent work, students: - learn in deep each lecture topic according to the syllabus and course plan, preparing questions for the academic staff member to discuss them in next class or seminar; - make a presentation on a topic suggested and prepare to defend it; - prepare for tests. Students may use other sources of information not indicated in the course description, consulting the academic staff member.

GENERAL INFORMATION ABOUT THE COURSE #26		
1.	The name of the course/module	Practical Research in Biodiversity IV
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	4th
5.	Number of ECTS credits	9
6.	The total number of hours	240

7.	General description and purpose of the educational component	The study course is aimed at providing knowledge and practical skills for the assessment of the condition of various habitat and species populations, selection and application of management and protection measures as well as assessment of the acquired results. Study course objectives: 1. Facilitating the acquisition of knowledge on practically applicable methods of habitat and species assessment; 2. Providing knowledge acquisition on protected biotope management and species protection measures and legal acts regulating them; 3. Consolidating students' practical skills of implementing measures of biotope management and species protection as well as assessing the results of these measures; 4. Facilitating the development of students' independent work skills including skills of elaborating plans of nature protection.
8.	Prerequisites for studying the course/module, connection with other educational components	Practical research in biodiversity I Practical research in biodiversity II Practical research in biodiversity III

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge:
- understand the principles of habitat and species assessment;
- demonstrate knowledge on protected biotopes and species in Latvia;
- have a command of species and biotope protection measures;
- know legal acts and ethical norms applied in nature protection measure implementation.

kills:
- able to plan and perform species and biotope protection measures;
- able to select and independently use the criteria of the number of species and biotope quality and apply them in practice;

Competences:
- are aware of current issues of nature protection, assess the necessity to perform concrete species or their habitat protection events;
- independently select appropriate species population assessment methods based on the acquired knowledge, scientific literature, and personal experience;
- assess the efficiency of the implemented nature protection measures.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Review of EU protected habitats and species, legal acts regulating them, commitments
2.	Biotope directive statement in article 17, its significance in nature protection system
3.	Systems of monitoring living organisms and their habitats
4.	Bird directive and the special protection status of these species
5.	Plans of nature protection, their structure and necessity assessment
6.	Plans of species protection, their structure and necessity assessment
7.	Measures of biotope management, their planning, implementation, and significance
8.	Legal regulation to be considered planning particular biotope management measures
9.	Grassland biotopes, their significance and management measures
10.	Forest and marsh biotopes, their significance and management measures
11.	Water biotopes, their significance and management measures
12.	Assessment of biotope management measure efficiency
13.	Nature protection plan management, competences and knowledge necessary for a manager
14.	Competences of experts and tasks to perform in the framework of elaborating the nature protection plan
15.	Cooperation among various institutions and involvement in nature protection plan elaboration
16.	Public involvement in nature protection task execution

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; seminars, practical assignments, and independent study.	During their independent work students: - learn in deep each seminar and practical assignment topic (see the syllabus and course description) preparing questions for the academic staff member (to discuss them in next class); - prepare for practical assignment classes – revise theory, select the method of processing the material, and prepare the necessary equipment. Students may use other sources of information not indicated in the course description, consulting the academic staff member.

GENERAL INFORMATION ABOUT THE COURSE #27

1.	The name of the course/module	Nature Therapy
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	4th
5.	Number of ECTS credits	4.5
6.	The total number of hours	120
7.	General description and purpose of the educational component	The study course is aimed at improving students' understanding and knowledge on sustainable use of nature and biological resources as well as developing practical skills of elaborating a nature therapy plan for patients of different age groups. The study course objectives: 1. Improve knowledge on the opportunities of using nature resources for therapeutic goals and with nature therapy methods and techniques. 2. Facilitate the understanding of legislation binding for nature therapy and the legal basis of professional action. 3. Consolidate the practical skills of working with patients of different age groups and with different diagnoses. 4. Encourage students' participation in discussions, develop their skill of critical analysis of various therapy methods and techniques as well as discuss opportunities for their improvement and updating.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge:
- understand the theoretical fundamentals of nature therapy;
- aware of the legal acts and ethical norms, understand their application in nature therapy;
- have a command of nature therapy methods and techniques;
- demonstrate knowledge of the specificity of nature therapy process and differences for patients of various age groups and individual approach to concrete diagnosis.

Skills:
- have a command of nature therapy methods and techniques and can select most appropriate ones for diagnosis in each age group;
- can estimate the efficiency of methods and techniques and therapy result;
- formulate ideas and suggestions for supplementing and improving methods in accordance with the contemporary opportunities.

Competences:
- independently estimate patients' diagnoses and take decisions justifying their actions by previously acquired knowledge and personal experience;
- perform scientific research and implement it in nature therapy and related spheres.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Notion of nature therapy or ecotherapy. Reviewing nature resources and their application options for the purpose of nature therapy. Designing and writing a nature observation diary
2.	Theoretical framework for various nature therapy methods and techniques. Indications for using nature therapy. Drawing a survey questionnaire for nature therapy patients
3.	Professional action in nature therapy and its legal basis. Rehabilitation therapist and recreation therapist. Human security aspects in the framework of nature therapy. Analysis of nature therapy related legal acts
4.	Use of nature materials in meditative therapies: aroma therapy, colour and sound therapy. Yoga therapy as a method of healing and health prophylaxis. Healing meditation and yoga in the open air
5.	Climate therapy and medical climatology. Heliotherapy, aerotherapy, hydrotherapy, thalassotherapy, balneotherapy, speleotherapy
6.	Options of using various plants and animals in human therapy and recreation. Homeopathy and fitotherapy. Peloidtherapy. Gathering plants with healing qualities and preparing for medical treatment
7.	Landscape therapy, its elements and their dynamics. Using garden and park landscape space in human recreation and rehabilitation. Forest therapy. Present day issues of Latvian rehabilitation gardens and parks
8.	Use of nature materials for developing large motoric skills for children and adults. Ideas for forming various coverings and obstacles in nature: the example of a path of sensations (barefoot)
9.	Use of nature materials for developing small motoric skills for children and adults. Ideas for selecting and forming various sensoric objects: Montessori school example
10.	Canis therapy organization principles and techniques. Canis therapy practical class
11.	Reittherapy organization principles and techniques. Reittherapy practical class
12.	Specifics of nature therapy process for children and adults: differences of methods and techniques for working individually or in groups. Multidisciplinary professionals team building. Elaborating a nature therapy plan for an individual person

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; seminars, practical assignments, and independent study.	Doing their independent work, students: - learn in deep each seminar and practical assignment class topic according to the syllabus and course plan, preparing questions for the academic staff member to discuss them in next class or seminar; - prepare for practical assignment classes – revise theory on each method of therapy and prepare the necessary materials; - make a presentation on a topic suggested and prepare to defend it; - prepare for tests. Students may use other sources of information not indicated in the course description, consulting the academic staff member.

GENERAL INFORMATION ABOUT THE COURSE #28		
1.	The name of the course/module	Project Elaboration and Management
2.	Faculty/department	Biology
3.	Status of the educational component	Mandatory
4.	Semester	4th
5.	Number of ECTS credits	4.5
6.	The total number of hours	120
7.	General description and purpose of the educational component	The study course is aimed at theoretical and practical acquisition of principles of planning, elaborating, managing, and assessing various kinds of projects. Study course objectives: 1. acquiring practical and theoretical knowledge in the sphere of project idea development, implementation, and assessment 2. providing knowledge on legal acts regulating various project realization 3. developing practical skills of project elaboration and assessment 4. facilitating students' independent work skill consolidation, including skills of working with scientific literature and legal act investigation
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge - aware of the project types, their significance and usefulness - have a command of project elaboration stages - have a command of project realization specificity Skills - able to select appropriate project types for particular needs - able to organize work in project elaboration process - able to organize project management procedure Competences - have a command of legal acts related to elaboration and realization of various project types - perform complete project elaboration and management process

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Introduction to project elaboration and management
2.	Project classification
3.	Project structure
4.	Project assessment
5.	Investigation of legal regulations in relation to project elaboration and management
6.	Project proposal drafting
7.	Project realization

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Face-to-face teaching; lectures, seminars, and independent study.	Before each class students familiarize with the topic of the class and appointed scientific and academic literature. Within the course students prepare a presentation and get ready for mid-term tests and final examination. Independent work takes place after each lecture and envisages in-depth analysis of each lecture topic. Within their independent work students perform the analysis of literature sources, prepare a presentation and get ready for mid-term tests (3) and final examination. Test 1. Project classification. Test 2. Project elaboration principles. Test 3. Project realization principles.

UNIVERSITY OF KLAIPEDA

1	**Criterion A: University profile**		
1.1	**Name of the University**	**UNIVERSITY OF KLAIPEDA**	
1.2	Classical or applied	Classical	
2	**Criterion B: Profile of the educational program (Curriculum)**		
2.1	Number of Aquaculture disciplines	One	
2.2	The name of the educational program	Marine Biotechnology	
2.3	Type of diploma	Master	
2.4	Total number of credits (ECTS)	120	
3	**Criterion C: Setting the educational program (Curriculum)**		
3.1	Duration of the program	4 semesters	
3.2	The purpose of the educational program	To equip the graduates with profound expertise and knowledge based on an interdisciplinary and holistic perspectives in modern biotechnology and the sustainable development of the marine environment	
4	**Criterion D: Characteristics of the educational program (Curriculum)**		
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Natural Sciences, Mathematics, and Statistics	
5	**Criterion E: Teaching and assessment**		
5.1	Teaching and learning methods	Lectures, seminars and practical classes; online education; EU Joint Master Program (JMPMB)	
5.2	Assessment	Examinations; Master thesis	
6	**Criterion F: Software competencies**		
6.1	Integral competence	N/A	
6.2	General competences	N/A	
6.3	Professional competences	N/A	
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	1. The graduates should be able to demonstrate comprehensive and specialized knowledge and technical skills regarding the relevant biochemical, molecular and systemic biology approaches for the use of aquatic resources to develop new bioactive compounds; 2. The graduates should understand the process of discovery and development of molecules derived by marine organisms, and be able to develop innovative marine natural products to meet the needs of consumers in various markets; 3. The graduates should be able to demonstrate skills related to the management of biotechnological innovation projects, the transfer of R&D, and the protection of industrial and intellectual property in the marine biotechnology sector. 4. The graduates should demonstrate responsibility and autonomy for contributing to professional knowledge and practice for reviewing the strategic performance of team.	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	Sufficient human resources (education and research) from one of the leading European universities	
8.2	Material and technical support	Sufficient material and technical resources, rich base for research and practice	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Genomics, Proteomics and Metabolomics for Marine Biodiversity Prospecting	6	Single written exam; report; oral presentation
9.1.2	Marine Microbiome and Metagenomics	6	Single written exam; report; peer assessment; oral presentation
9.1.3	Culture Collection and Biobanks	8	Exam; E-portfolio
9.1.4	Marine Biodiversity for Marine Natural Products	4	Single written exam; report; oral presentation
9.1.5	Blue Biotechnology Business and R&D Management	6+6	Presentation; project; report; written exams
9.1.6	Marine Natural Products: Classes, Biological	6	Single written exam; practical exam/lab test; E-portfolio; oral presentation

9.1.7	Chemical Libraries	6	Single written exam; practical exam/lab test; report; oral presentation
9.1.8	Screening of Bioactivity	6	Single written exam; practical exam/lab test; report; oral presentation
9.1.9	Internship	6	Report
9.1.10	Academic Research Integration	14	Practical exam/lab test; report/project exam; peer assessment; oral presentation; poster presentation
9.1.11	Master Thesis	30	Thesis Defence
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Biological Profiling of Marine Natural Products	4	Single written exam; E-portfolio; report/project exam
9.2.2	Optimization of Marine Natural Products	4	Single written exam; E-portfolio; report/project exam
9.2.3	Marine Natural Products for Health and Wellness and Food	4	Single written exam; E-portfolio; report/project exam; oral presentation
9.2.4	Advanced Characterization Methods for Marine Natural Products Identification	4	Single written exam; E-portfolio; report/project exam
9.2.5	Bioreactor Design and Management	4	Single written exam; E-portfolio; report/project exam
9.2.6	Microorganism Biomass and Metabolite Production	4	Single written exam; E-portfolio; report/project exam
9.2.7	Microalgal Biotechnology	4	Single written exam; E-portfolio; report/project exam
9.2.8	Seaweed Production	4	Single written exam; E-portfolio; report/project exam
9.2.9	Design of Biorefinery Processes	4	Single written exam; E-portfolio; report/project exam
9.2.10	Marine Biomass Functional Ingredients Extraction	4	Single written exam; E-portfolio; report/project exam
9.2.11	Functionalization of Marine-Derived Biomaterials	4	Single written exam; E-portfolio; report/project exam; oral presentation
9.2.12	Marine Whole-Cell Factories	4	Single written exam; E-portfolio; report/project exam
9.2.13	Aquaculture Systems and Seafood Processing	4	Single written exam; oral exam; report/project
9.2.14	Fish Nutrigenomics	4	Single written exam; oral exam; report/project
9.2.15	Health and Welfare in Aquaculture	4	Single written exam; oral exam; report/project

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Genomics, Proteomics and Metabolomics for Marine Biodiversity Prospecting
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	6
6.	The total number of hours	60
7.	General description and purpose of the educational component	The course will provide a theoretical and practical background in genomics, proteomics and metabolomics techniques. Basic computer skills for large-scale data management will be provided.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		

In successful completion of this course, students should be able to: - Efficiently combine a wide range of aspects and knowledge about genes, chromatin, chromosomes and (meta) genomes of marine (and freshwater) organisms. - Skilfully handle the main genome analysis tools. - Accurately select the most relevant DNA sequencing techniques for marine bioprospecting. - Interpret and justify fundamental concepts in Marine Genomics and Metagenomics. - Design a highly detailed workflow for marine Proteomics analysis. - Design a highly detailed workflow for marine Metabolomics analysis. - Manage the capacity to characterize efficiently the marine genetic diversity.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Organization and anatomy of genomes
2.	Alignment and comparison of genomes
3.	Basic bioinformatics tools and databases for genome analysis
4.	Next-generation Sequencing Data Analysis Tools
5.	Global vision of regulatory processes: specific metabolic routes and cross-talks
6.	Genome mining methods based on NGS: comparative genomics, phylogeny, resistance / target, regulators, cell culture and metagenomes
7.	Classical genome mining: search for enzymes and metabolic pathways involved in the biosynthesis of secondary metabolites
8.	Genomics applications to marine biotechnology
9.	Global analysis of the cellular transcriptome (qRT-PCR, microarrays, RNA-seq)
10.	Applications of proteomics and metabolomics to marine biotechnology
11.	Workflow in Proteomics: sample preparation, parameters, tools, revelation and analysis of results
12.	Workflow in Metabolomics
13.	Proteomics and Metabolomics Applications to marine biotechnology

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching, case studies and expert seminars; lectures, problem-based learning, computer sessions, seminars.	N/A

GENERAL INFORMATION ABOUT THE COURSE #2		
1.	The name of the course/module	Marine Microbiome and Metagenomics
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	6
6.	The total number of hours	59
7.	General description and purpose of the educational component	The course will provide hands-on training of the state-of-the-art microbiome and metagenomics techniques applied to the marine environment and biodiscovery. The students will have the opportunity to work on a complete workflow ranging from sample preparation to third generation sequencing and data analysis using advanced bioinformatic tools.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
In successful completion of this course, students should be able to: - Design a highly detailed workflow for marine metagenomics analysis. - Accurately organize biological information in structured or unstructured databases. - Aptly select the most appropriate tools for the analysis of patterns and traits in sequences and strings. - Efficiently propose skills on 3D structural studies of macromolecules and small molecular weight compounds. - Support in silico rational, structure-based, drug design and high throughput virtual screening of large chemical datasets. - Choose meaningful genetic datasets from noisy databases. - Conclusively argue on machine learning and deep learning pipelines in big genomic datasets - Interpret and judge patterns, trends, and correlations as well as to combine genomic data from large GWAS, exome or full genome sequencing.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Preparation of genomic libraries for high-throughput DNA sequencing

2.	Next-generation sequencing of marine metagenomes
3.	Next-generation sequence analysis: bioinformatic data formats, quality assessment and upstream data analysis
4.	Genome assembly and annotation programs and workflows; basics of pangenomics
5.	Microbiome insight: metataxonomic analysis of marine samples for microbial population analyses
6.	Metagenome assembly and annotation, taxonomic binning, gene quantification and metagenomes comparison
7.	Introduction to functional metagenomics

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, laboratory work, and computer sessions.	N/A

GENERAL INFORMATION ABOUT THE COURSE #3		
1.	The name of the course/module	Culture Collections and Biobanks
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	8
6.	The total number of hours	80
7.	General description and purpose of the educational component	The most outstanding methodological approaches for conducting bioprospecting of cultivable aquatic organism will be provided. Essentially, the basis of collecting and preserving microorganism and microalgae collections will be covered, together with managing marine biobanks services.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to:
- Propose the most proper strategies for aquatic culturable microorganism bioprospecting.
- Assemble microorganism culture collections.
- Construct small scale biomass production units.
- Prepare DNA barcodes and create operational taxonomic units.
- Revise traditional taxonomic identification vs omics tools.
- Assess marine biobank roles and applications.
- Comprehensively interpret ethics, legacy, and risk management in biobanking.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Bioprospecting of aquatic culturable organism: bacteria, fungus, protists and microalgae; techniques for isolation, identification and purification
2.	Characterization and proliferation techniques to obtain axenic clonal cultures from natural samples
3.	Microorganisms and microalgae culture collections establishment
4.	Cryopreservation methods for microorganisms and microalgae
5.	Small scale biomass production for R&D
6.	DNA barcoding: generating clean DNA barcodes, tools to assign taxonomic names to DNA barcodes, and to cluster DNA barcodes into Operational Taxonomic Units
7.	Biobanking information technology
8.	Marine Biobanks: Marine Biological Resources for commercial R&D
9.	Marine Biobanks: Strain Deposit Services: Public or open deposit, restricted or private deposit and patent deposit

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, laboratory work, and computer sessions.	N/A

GENERAL INFORMATION ABOUT THE COURSE #4

1.	The name of the course/module	Marine Biodiversity for Marine Natural Products
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	Diverse sampling and processing techniques of marine organisms in the water column and benthic environment will be used to identify the main groups of microorganisms, algae and invertebrates of interest in MNPs. International regulations and protocols on the use of marine genetic resources and biodiversity will be worked on.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
In successful completion of this course, students should be able to: - Evaluate and measure marine biodiversity with a wide range of scales. - Formulate the factors which control patterns of marine biodiversity such as geological and evolutionary history. - Appraise and interpret the key conservation issues for marine biodiversity. - Efficiently arrange Bioprospecting and collection of marine samples campaigns. . Judge ethics and legality on access and utilization of genetic resources.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	The oceans as the last frontier of biodiversity: habitats to prospect new MNPs	
2.	Main groups of organisms and microorganisms as a source of Natural Products: Bacteria (actinobacteria, cyanobacteria, proteobacteria, firmicutes), microalgae, macroalgae, invertebrates (poriferous, cnidarians, molluscs) and procordates (tunicates). Symbiotic microorganisms	
3.	Microbiomes in aquatic and extreme environments	
4.	Bioprospecting strategies and collection of marine samples: scuba-diving surveys, ROVs and submersibles, water column and sediment sampling	
5.	International regulations on access and utilization of marine genetic resources	
6.	International treaty on marine biodiversity beyond national jurisdiction (BBNJ)	
7.	Nagoya protocol implementation and management	

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, laboratory work, boat work, case studies.	N/A

GENERAL INFORMATION ABOUT THE COURSE #5		
1.	The name of the course/module	Blue Biotechnology Business & R&D Management I
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	6
6.	The total number of hours	60
7.	General description and purpose of the educational component	Students will reach an R&D strategic view rather than as a collection of development projects as a tool to translate innovation initiatives into a business plan generating innovative and entrepreneurial ideas in the blue biotechnological business. The transfer innovation to real market will be address using the Business Model canvas.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
In successful completion of this course, students should be able to: - Interpret the dynamics of business and markets related to the biotechnology sector. - Interpret insight into business opportunity development and the commercial realities faced by the industry through experiences shared by successful marine biotechnology entrepreneurs. - Discriminate among a wide range of internal organizational structures within the biotechnological sector to better meet the companies' internal needs while catering for varied economic sectors such as agri-food, pharmaceutical and aquaculture companies. - Appropriately propose and defend a business plan for a biotechnological development. - Estimate and evaluate business situations related to the management and organization of biotechnology companies. - Design the best course of action to implement an innovation plan that supplies greater strategic value to the organization.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Business Strategy in the biotechnology company Internal and External analysis. Diagnosis, structure and implementation
2.	The implementation of innovation: from the idea to the market introduction of new products and services
3.	Developing a Business plan in Blue Biotechnology sector
4.	Employability: entrepreneurship, intra-entrepreneurship, biotechnology consultancy. Exploitation of business and entrepreneurial opportunities
5.	Developing an innovative and creative organization
6.	Employability workshops: creativity and innovation in R&D&I; leadership and teamwork; preparation for a job interview in Biotechnology
7.	Innovation strategy and value creation for the companies in the biotechnology environment
8.	The innovation process and biotechnological product development: from the idea to the market
9.	Business Model Canvas. Assessing business model design. Business Model Innovation
10.	Innovative thinking and creating value
11.	Analysis of the biotechnological business environment: markets, products and networks
12.	Strategic alliances as a tool for business growth in the Blue Biotechnology sector

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, business-project, case study, simulation and roleplay.	N/A

GENERAL INFORMATION ABOUT THE COURSE #6		
1.	The name of the course/module	Blue Biotechnology Business & R&D Management II
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	6
6.	The total number of hours	60
7.	General description and purpose of the educational component	As a future manager involved in blue biotechnology innovation, students have to develop a crucial role to the blue sector organization's competitive advantage, growth and profitability. A comprehensive exploration of the world of R&D&I and how it can drive competitive intelligence in technology transfer processes will be provided.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
In successful completion of this course, students should be able to: - Interpret the dynamics of the biotechnological application to the transfer of R&D outcomes to companies and society. - Prepare the basics of the application, planning, management of biotechnological R&D&I projects selecting the appropriate concepts and terms. - Support the main steps for the development of goods and services in the field of Blue Biotechnology. - Select technological assets with a high probability of transfer for exploitation in the market. - Support the legal mechanisms to protect the outcomes of R&D&I through the most proper modalities of industrial and intellectual property.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Marine Biotechnology Pipeline

2.	Management of biotechnology R&D&I projects: drafting, planning, execution, and budget
3.	Introduction to technology transfer
4.	Industrial and Intellectual Property Rights
5.	Patents and Inventions
6.	Complementary protection certificates
7.	Technology transfer models in Europe and the USA
8.	Management of R&D&I focused on technology transfer
9.	Agreements and contracts for the assignment or licensing of technology
10.	Technology transfer through the creation of companies and the formation of consortiums
11.	Relevance of technology watch and competitive intelligence in technology transfer processes
12.	R&D&I networks in Blue Biotechnology
13.	Understanding of the role of intellectual assets and property in innovation and business strategy
14.	Concepts of IPR; Types of IP: patents
15.	Trademarks, copyright & related rights, industrial design, traditional knowledge, geographical indications
16.	IP as a factor in R&D and of relevance to blue biotechnology

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminar, discussions, case study, problem base learning.	N/A

GENERAL INFORMATION ABOUT THE COURSE #7		
1.	The name of the course/module	Marine Natural Products (MNPs): Classes, Biological Activity and Biosynthesis
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	6
6.	The total number of hours	60
7.	General description and purpose of the educational component	The immense biodiversity and chemodiversity of marine natural products will be presented, including ways of analyzing their structure using spectral methods. The methods of bioprospecting and synthesis of these products will be discussed, including the search for biological activity in relation to their structure.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
In successful completion of this course, students should be able to: - Interpret the major structural classes associated with key marine natural products (MNPs): lipids, peptides, sugars, terpenes, alkaloids, hybrids. - Convincingly argue on biodiversity and chemodiversity approaches, biogenetic source, and isolation source. - Conduct precursor directed biosynthesis and appraise total synthesis vs biomimetic synthesis and biosynthesis. - Assess biological activities and chemical structure of MNPs. - Design OSMAC (one strain many compounds) strategies to explore the Biochemical Diversity of Secondary Metabolites. - Evaluate the physiological and economic impacts of marine toxins. - Propose examples of marine emergent toxins.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Overview of the chemical richness of diverse marine living resources; Marine Natural Products: role in the discovery of leads for the development of drugs
2.	Major structural classes associated with key marine natural products like peptides, sugars, terpenes, alkaloids, hybrids etc.
3.	Differences between biogenetic source and isolation source
4.	Biodiversity and Chemodiversity
5.	OSMAC (one strain many compounds) strategy: Exploring Biochemical Diversity of Secondary Metabolites
6.	Advantages and disadvantages of total synthesis vs biomimetic synthesis and biosynthesis
7.	Relations between biological activities and chemical structure of MNPs (Structure-activity relationships (SARs))
8.	Marine toxins and their physiological and economic impacts

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminar, laboratory work.	N/A

GENERAL INFORMATION ABOUT THE COURSE #8		
1.	The name of the course/module	Chemical Libraries
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	6
6.	The total number of hours	60
7.	General description and purpose of the educational component	Chemical libraries design and compounds database manage will be covered as tools for high-throughput screening and other processes for new added-value molecules development. The most outstanding chemoinformatics tools will be provide to research on Structure-Activity Relationships for better understanding of complex structures of chemical compounds.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to:
- Construct substructure searches in large compound databases.
- Assess and interpret diversity and compound selection based on the needs of the given experiment.
- Select existing chemical libraries and propose compound & library design.
- Efficiently manage Chemoinformatics tools (Quantitative Structure-Activity Relationships (QSAR).
- Choose biology oriented chemical synthesis or chemical synthesis (including divergent and diverted total syntheses), to produce bioactive natural product analogues and congeners.
- Revise existing strategies and compare late-stage modification strategies.
- Combine computational methodologies to explore marine natural products (MNPs) and support similarity searching and pharmacophore identification.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Introduction to in silico representation of chemical information
2.	Overview of Rational Drug Design, Ligands and Targets
3.	Quantitative structure-activity relationship (QSAR) (Hansch equation, Craig plot, Topliss scheme, Free Wilson approach). 3D QSAR approach (CoMFa). Use of chemoinformatics tools for QSAR rational approach
4.	Definition of a chemical library
5.	Presentation of existing chemical libraries
6.	Molecular Drawing with ChemDraw and Interactive Visualisation (hands-on molecular drawing)
7.	Data Mining in Chemical Databases Design, Structured Query Language (SQL), Cloud Computing, Cambridge Structural Database
8.	The Protein Data Bank (PDB)
9.	Use of Ligand Explorer
10.	Design SMILES - Simplified Molecular Input Line Entry Specification
11.	Molecular Modelling Tools – Force fields
12.	Structural Homology Modelling Tools
13.	Computer-Aided Drug Design Tools
14.	Hands-on training on building a ligand from similar ligands
15.	Hands-on training on building a ligand for a known macromolecular target
16.	Hands-on training on performing Quantitative Structure-Activity Relationships (QSAR) with in silico tools

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminar, laboratory work.	N/A

GENERAL INFORMATION ABOUT THE COURSE #9		
1.	The name of the course/module	Screening of Bioactivity
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	6
6.	The total number of hours	60
7.	General description and purpose of the educational component	Prospection of bio-sourced ingredient with characterized mode of action is the first step to EU allegation obtention. This course gives an overview of the strategy to obtain added – value molecules with a particular bioactivity from marine biomass through sequential or integrated processes: sample preparation, extractive procedures, conversion processes, bioassays.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to:
- Propose sample preparation methods for complex matrices.
- Evaluate a wide range of extraction and separation techniques for marine feedstocks.
- Formulate methodological approaches for conducting bioactivity assays.
- Judge the convenience of using animal models for bioactivity identification.
- Choose in vitro and in vivo bioassays for identification of bioactive fractions.
- Organize screenings from in vitro to in vivo and choose adequate extraction method
- Compare strategies using Structure-based (SB) and ligand-based (LB) chemoinformatics approaches.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Sample preparation methods from complex matrices
2.	Methods of extraction of natural products: solvent extraction; solvent selection; solvent extraction techniques: maceration, percolation, reflux extraction
3.	Green extraction methods: supercritical fluid extraction (SFC), pressurized liquid extraction (PLE), ultrasound-assisted extraction (UAE) and microwave-assisted extraction (MAE)
4.	Separation and quantification of natural products: thin-layer chromatography, high-performance liquid chromatography (HPLC/DAD, HPLC/FI), gas chromatography (GC / MS), supercritical fluid chromatography (SFC). Main extraction and purification techniques used in the context of biomass valorisation
5.	Introduction to bioassay principles
6.	Hit identification
7.	Structure-based and ligand-based approaches
8.	Bioassays targets and examples: - molecules (genotoxicity, toxins, antioxidants, immunomodulation, enzyme involved assays); - organelles (mitochondria membrane potential, membrane permeability); - cells (viability, anticancer assays, cell migration, wound healing assays); - tissues (hepatoxicity and hepatoprotective assays, permeability)
9.	Animal models
10.	Principles and equipment for high throughput assays
11.	Organ-on-chip approaches
12.	Hands-on training on in vitro screening, obtaining, and analyzing results
13.	Isolation of bioactive fractions: Integration of separation process together with bioactivity monitoring for identification of active fractions in marine feedstocks

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face teaching; lectures, seminars, laboratory work, case studies.	N/A

GENERAL INFORMATION ABOUT THE COURSE #10		
1.	The name of the course/module	Biological Profiling of Marine Natural Products
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Optional

4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	The most outstanding methods (high-content-, high-throughput-, guided by in silico tools) for biological characterization of active fractions from marine feedstocks will be provided. Procedures for prediction of bioactivities, functional properties and revealing of mechanisms of action in lead compounds will be covered.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to:
- Organize and perform a wide range of high-throughput and high content screenings.
- Support in silico efforts to drug discovery.
- Design methodological approaches for conducting bioactivity assays for biological profiling, including toxicity evaluation, pharmacology, and pharmacokinetic assays.
- Estimate drug-likeness and predict adsorption, distribution, metabolism, excretion, and toxicity (ADMET) properties.
- Conclude on bioactivities and reveal mechanisms of action.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Introduction to the process "from hit to lead"
2.	Screening diversity (Iterative screening, smart, targeted screening, mixed-mode screenings (a combination of full screening and focused or specialty screening), high throughput screening (HTS), High-content screening)
3.	Screening optimization. Methods to increase the efficiency of screening (lead selection, promotion of interaction with therapeutic and chemical groups)
4.	Screening guided by in silico tools (predictive tools for compounds and virtual screening, pathway analysis, and metabolic profiling)
5.	Pathway approaches to understand the effect of a compound on an entire cell
6.	Biological characterization of active fractions: specificity, selectivity, Absorption, Distribution, Metabolism, and Excretion (ADME), toxicity (hepatotoxicity, cardiotoxicity, neurotoxicity)
7.	Prediction of bioactivities/functional properties
8.	Mechanisms of action revealing

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, case studies.	N/A

ENERAL INFORMATION ABOUT THE COURSE #11

1.	The name of the course/module	Optimization of Marine Natural Products
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	After hit obtention, the step of their optimization is crucial. The most outstanding methods to increase the bioactivity of hits, through computer assisted design together with chemical or enzymatic modification will be covered to allow the production of new molecules with higher added value
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to:
- Justify the steps going from target validation to commercial introduction of new marine therapeutic drugs.
- Evaluate and validate biomolecular structure and binding to small ligands through computer software tools and relevant databases.

- Estimate the strengths and limitations of various experimental and computational approaches for studying macromolecular structure and function. - Design enzymatic or chemical processes for depolymerization or functionalization of biomolecules to obtain highly bioactive molecules. - Evaluate the metabolism of new molecules in a living organism to ensure product safety.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Design processes for the discovery of new and more efficient leads
2.	Repurpose known MNPs
3.	Leads optimization using Structure-based (SB) and ligand-based (LB) chemo-informatics approaches
4.	Targeting new metabolites based on genome analysis
5.	Performing similarity searching, and pharmacophore identification
6.	Improving pharmacokinetic (PK) parameters
7.	Undertaking Molecular Dynamics and docking-binding cavity analysis approaches
8.	Identification and modification of the metabolism of molecules in living organisms
9.	Post-market recommendations (purity, contaminants)
10.	Chemical functionalization: - depolymerization (by radical splitting, microwave heating, ultrasounds); - addition of chemical groups (phosphate, sulphate etc.)
11.	Biochemical functionalization: - enzymes use to depolymerize compounds; - enzymes use to add functional groups
12.	Non-conventional enzymology (low water content, gas)
13.	Enzymes in complex mixtures

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, computer sessions.	N/A

GENERAL INFORMATION ABOUT THE COURSE #12		
1.	The name of the course/module	Marine Natural Products for Health and Wellness and Food
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	50
7.	General description and purpose of the educational component	Marine bioproducts can replace synthetic molecules with new biological activities. Health, disease and wellness targets definition as objectives to be achieved for new marine natural products will be provided. Mechanisms and procedures to demonstrate the relevant pharmacological and nutraceutical bioactivity of marine natural products in different manufacturing process stages in the way to the market will be highlighted.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
In successful completion of this course, students should be able to: - Support the process to allow a compound into clinical development. - Propose novel assays to identify/optimize new activities (biologically/biotechnologically- and ecologically-relevant MNP bioactivities). - Interpret key terms, principles, and issues of pharmaceutical and biomaterials manufacturing, including physical processes, GMP related issues, pharmaceutical marketing, and clinical trials. - Estimate formulation requirements and determine proper manufacturing process stages to reach the market. - Propose the use of macromolecules from Marine origin in food: lipids, carbohydrates, proteins, peptides.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Health, disease and wellness definition
2.	Methods to demonstrate pharmacologically-relevant MNP bioactivities like: antibacterial, antifungal, antimalarial, anti-inflammatory, anti-ageing (skin regeneration), anti-obesity, anticancer, pain relief, antibiofilm/fouling

3.	Methods to propose novel assays to identify/optimize new biological activities: - MNPs for food; - Definition of food additives; - MNP (Marine Natural Products) to maintain or improve the safety of food; - MNP to maintain or improve the freshness, taste, texture, or appearance; - MNP for food processing; - Methods to demonstrate MNP functional properties

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, case studies.	N/A

GENERAL INFORMATION ABOUT THE COURSE #13		
1.	The name of the course/module	Advanced Characterization Methods for Marine Natural Products Identification
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	Since the advanced structural characterization of a compound is an essential step in obtaining a health allegation, the most recent methods of structure elucidation will be presented, including their use in complex matrices.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
In successful completion of this course, students should be able to: - Design a workflow with chromatographic methods for isolating new biochemical compounds from bioactive samples. - Manage the chemical purification process of a newly isolated compound. - Evaluate the chemical structure of high-added-value product from marine biomass. - Propose molecular models and compare in silico simulations. - Revise validation and quality control of chemical analysis.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Isolation and Purification of secondary metabolites from bioactive samples
2.	Identification and analysis techniques: UV-vis spectroscopy, infrared spectroscopy (NIR), mass spectrometry (MS), nuclear magnetic resonance (NMR)
3.	Dereplication techniques for searching novel natural products and metabolite identification
4.	X-ray crystallography technics
5.	Structural elucidation of Marine Natural Products
6.	High-resolution mass spectrometry and chromatography coupled systems (LC/MS) for identification of new metabolites in a complex matrix
7.	Nuclear magnetic resonance and chromatographic coupled systems for structural elucidation of complex matrix and biological processes
8.	Method development, validation, and quality control of chemical analyses

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, case studies.	N/A

GENERAL INFORMATION ABOUT THE COURSE #14		
1.	The name of the course/module	Bioreactor Design and Management
2.	Faculty/department	Natural Sciences

3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	The most recent approaches to design and manage marine microorganisms and microalgae biomass production operations will be tackled. Hygienic practices, growth analysis and parameters monitoring of microorganisms and microalgae biomass and metabolites in different kinds of bioreactors will be covered.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to:
- Compare the features and performance of marine biomass production systems.
- Estimate culture growth kinetics in marine biomass production systems.
- Design bioreactors and photobioreactors according to matter and energy balances.
- Measure culture parameters and interpret changes of biomass production by microorganisms.
- Propose hygienic practices in sampling design and harvesting procedures for microbial biomass production operations.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Biomass production systems for marine microorganisms and microalgae: bioreactors, fermenters and photobioreactors
2.	Cell growth kinetics in different production systems
3.	Flow charts, matter, and energy balances for the quantitative design of bioreactors and photobioreactors
4.	Essential auxiliary systems for gas supply and removal and nutrient renewal, culture mixing, thermal and pH control
5.	Sampling and harvesting systems for biomass and metabolites
6.	Culture monitoring parameters and data collection
7.	Hygiene procedures

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, problem-based learning (PBL).	N/A

GENERAL INFORMATION ABOUT THE COURSE #15

1.	The name of the course/module	Microorganism Biomass and Metabolite Production
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	The present-day knowledge to produce and manage heterotrophic marine microorganisms' biomass that contain different high value-added metabolites will be provided. Scaling processes for their industrial production will be addressed.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to:
- Interpret ecological and metabolic biodiversity of marine heterotrophic microorganisms.
- Assess industrial applications of marine heterotrophic microorganism biomass and metabolite productions.
- Propose and justify strategies for marine heterotrophic microorganism biomass and metabolite productions.
- Design microorganism biomass and metabolite production systems.
- Manage microorganism biomass and metabolite production processes, including scale-up processes.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Marine heterotrophic microorganisms' diversity in the context of biomass production
2.	Industrial applications of marine heterotrophic microorganism biomass
3.	Marine bacterial biomass production: Culture management and Harvesting methods
4.	Marine protist biomass production: Culture management and Harvesting methods
5.	Marine yeast/fungi biomass production: Culture management and Harvesting methods
6.	Genetic and metabolic engineering of microorganisms for Production of Value-added Ingredients
7.	Biosafety in heterotrophic microorganism's biomass production operations

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, research-based learning (RBL).	N/A

GENERAL INFORMATION ABOUT THE COURSE #16		
1.	The name of the course/module	Microalgae Biotechnology
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	Production and Management of microalgae biomass, containing different high value-added metabolites, as well as the upstream processes for their industrial production will be further explored.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to:
- Interpret the ecological and metabolic biodiversity of microalgae.
- Formulate industrial applications of microalgae.
- Choose between different trophic strategies for microalgal biomass production.
- Design microalgal biomass production systems.
- Manage scale-up processes and organize microalgal biomass production processes.
- Propose strategies to tailored microalgal biomass production.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Microalgae: Biology and Taxonomy
2.	Industrial Applications of Microalgae: Advances and Prospects
3.	Phototrophic, mixotrophic and heterotrophic microalgal cultures
4.	Microalgal biomass culture systems: open ponds, photobioreactors and fermenters
5.	Photobioreactors technologies
6.	Monitoring of Microalgal Processes and systems biology using -omic technologies
7.	Modelling of Microalgae Culture Systems with Applications to Control and Optimization
8.	Strategies for the Production of Application-based custom Microalgae Biomass using Metabolic-Induction Strategies
9.	Genetic Engineering of Microalgae for Production of Value-added Ingredients
10.	Biosafety in microalgal biomass production operations

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, research-based learning (RBL).	N/A

GENERAL INFORMATION ABOUT THE COURSE #17		
9.	The name of the course/module	Microalgae Biotechnology

10.	Faculty/department	Natural Sciences
11.	Status of the educational component	Optional
12.	Semester	3d
13.	Number of ECTS credits	4
14.	The total number of hours	40
15.	General description and purpose of the educational component	Production and Management of microalgae biomass, containing different high value-added metabolites, as well as the upstream processes for their industrial production will be further explored.
16.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to:
- Interpret the ecological and metabolic biodiversity of microalgae.
- Formulate industrial applications of microalgae.
- Choose between different trophic strategies for microalgal biomass production.
- Design microalgal biomass production systems.
- Manage scale-up processes and organize microalgal biomass production processes.
- Propose strategies to tailored microalgal biomass production.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

11.	Microalgae: Biology and Taxonomy
12.	Industrial Applications of Microalgae: Advances and Prospects
13.	Phototrophic, mixotrophic and heterotrophic microalgal cultures
14.	Microalgal biomass culture systems: open ponds, photobioreactors and fermenters
15.	Photobioreactors technologies
16.	Monitoring of Microalgal Processes and systems biology using -omic technologies
17.	Modelling of Microalgae Culture Systems with Applications to Control and Optimization
18.	Strategies for the Production of Application-based custom Microalgae Biomass using Metabolic-Induction Strategies
19.	Genetic Engineering of Microalgae for Production of Value-added Ingredients
20.	Biosafety in microalgal biomass production operations

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, research-based learning (RBL).	N/A

GENERAL INFORMATION ABOUT THE COURSE #18

1.	The name of the course/module	Design of Biorefinery Processes
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	The scale-up from research scale to industrial scale for marine biomass fractionation, purification and conversion to final products or energy will be covered. Innovative integrated processes will be presented.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to:
- Propose new ideas and approaches for the use of marine biogenic raw material, assessing risks and challenges.
- Setup new technologies in terms of added value throughout the whole value chain and propose strategies used to increase the yield of a particular target compound.

- Design downstream processes for marine biomass valorization, including thermal, chemical, mechanical, and catalytic transformation. - Design and implement the working principles of marine biomass fractionation and purification of a given chemical component from biological material. - Propose methods to convert marine biomasses in energy.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Overview of marine biorefinery success stories
2.	Biomass standards for MNP production and downstream processes
3.	Enzymatic or chemical biomasses pre-treatments
4.	Reactor design
5.	Research-scale extraction and fractionation methods (precipitation, solvent, filtration, centrifugation including novel separation technics (CO_2 etc.) applied to Marine Natural Products recovery
6.	Industrial-scale extraction and fractionation methods and constraints
7.	Conversion processes including thermal, chemical, mechanical and catalytic transformation
8.	Energy production from marine resources methanisation (Anaerobic digestion, various design of digesters)

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, problem-based learning (PBL).	N/A

GENERAL INFORMATION ABOUT THE COURSE #19		
1.	The name of the course/module	Marine Biomass Functional Ingredients Extraction
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	The current procedures for functional ingredients extraction from marine feedstocks will be provided. Applications for health, cosmetics, food and aquaculture of extracted functional ingredients will be underlined.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
In successful completion of this course, students should be able to: - Compare and evaluate marine feedstocks as sources of functional ingredients. - Combine fatty acids biorefinery processes. - Design pigments and antioxidants extraction processes. - Setup proteins, bioactive peptides, and amino acids recovery. - Formulate polysaccharides extraction processes. - Propose applications for health, cosmetics, food, and aquaculture of extracted functional ingredients.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Diversity of feedstocks for functional ingredients supply
2.	ω-3 fatty acids extraction, refining and purification processes
3.	Pigments and antioxidants extraction
4.	Proteins, bioactive peptides and free amino acids extraction
5.	Polysaccharides extraction
6.	Fluorescence and other biotechnological substances (GFP, Taq polymerase etc.)
7.	Food additives

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, research-based learning (RBL).	N/A

GENERAL INFORMATION ABOUT THE COURSE #20		
1.	The name of the course/module	Functionalization of Marine-derived Biomaterials
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	The most relevant methods and strategies for functionalization of marine-derived compounds will be provided. Design tools for scaffolds using marine-derived nanomaterials/nanocomposites will be covered. Biomedical applications for marine-derived biomaterials will be highlighted.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
In successful completion of this course, students should be able to: - Formulate strategies for chemical, biochemical, and enzymatic functionalisation of marine-derived compounds. - Convincingly argue applications of several marine-based biomaterials. - Evaluate nanomaterials and nanocomposites for biomedical applications. - Value marine-derived biomaterials for 3D bioprinting applications.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Chemical functionalization: depolymerization (by radical splitting microwave heating, ultrasounds); addition of chemical groups (phosphate, sulphate etc.)
2.	Biochemical functionalization: enzymes use to depolymerize compounds; enzymes use to add functional groups
3.	Non-conventional enzymology (low water content, gas)
4.	Enzymes in complex mixtures
5.	Enzymes immobilization over marine-derived matrixes
6.	Calcium phosphates marine-based biomaterials
7.	Chitosan-based biocomposite scaffolds
8.	Marine polysaccharides functionalization for biomedical applications
9.	Chitin nanomaterials and nanocomposites
10.	Marine-derived biomaterials for 3D bioprinting applications

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, research-based learning (RBL).	N/A

GENERAL INFORMATION ABOUT THE COURSE #21		
1.	The name of the course/module	Marine Whole-cell Factories
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	Bioengineering approach to design biosynthetic manufacturing processes by using marine single cells as production facilities will be covered. Metabolic engineering tools for setting marine microorganisms as whole-cell factories will be provided.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
In successful completion of this course, students should be able to:

- Evaluate the "One strain many compounds" strategy for setting a marine microorganism as cell factory. - Select candidates to cell factories using omics technics. - Design biosynthetic manufacturing processes using metabolic engineering in marine microorganisms. - Propose genetic engineering to modify the metabolism of molecules in living organisms - Design cascade valorization in whole-cell factories biorefining.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Systems metabolic engineering
2.	Algal cell factories applications
3.	Fungi cell factories applications
4.	Microbial cell factories applications
5.	Cascaded valorization in marine biorefining coupled to bioenergy production and fertilizers

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, research-based learning (RBL).	N/A

GENERAL INFORMATION ABOUT THE COURSE #22

1.	The name of the course/module	Aquaculture Systems and Seafood Processing
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	The latest advances in aquaculture technology and processing will be provided. Designing, constructing and maintain systems for farming aquatic organisms and their processing will be covered, in line with the food safety and environmental requirements.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to: - Compare the outcome, the impact of different aquaculture systems and/or management tools and to evaluate the physiological and commercial characteristics of aquatic organisms with their potential for introduction in commercial production. - Choose production processes for certain types of products and evaluate the factors that affect the quality of fish products and select appropriate analytical methods to determine the quality and safety of raw materials and seafood products. - Support modern research and analytical methods for collecting and interpreting data necessary for practical aquaculture biotechnology development and cultured seafood processing. - Plan, arrange, conduct, and evaluate experiments on aquaculture in recirculating aquaculture systems under the rules of animal health and bioethics. - Collect and study the newest academic literature and other information sources on different aquaculture types and technologies. - Assess and to introduce research results to aquaculture practitioners, managers and seafood customers following standard trends accepted in aquaculture and blue-biotechnology business. - Design the cultivation systems of aquatic organisms in line with safety and environmental requirements.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Definition, historical development, and importance of aquaculture worldwide
2.	Overview of the species and production systems
3.	Technology of marine and freshwater fish species production
4.	Biofilms in aquaculture
5.	Emerging species of fish in aquaculture. Crustacean and bivalve production. New species of crustaceans, bivalves, and other organisms in aquaculture
6.	Postmortal changes in fish fillets
7.	Methods and equipment for fish preservation using low temperature: low temperature by chilling using ice, seawater, ice slurry; super chilling and freezing using liquid refrigerant and cryogenic liquid; refrigerant equipment; the requirement of ice during chilling or freezing

8.	Methods and equipment for fish preservation using high temperature: dried in air, inert gas, salting, smoking, dehydration
9.	Product stability and factors that affect it during storage
10.	Analysis of Indicators for biochemical, physical, and microbial degradation
11.	Risk Analysis Assessment and HACCP in processing and packaging
12.	Microbiological and sensory analyses as an indicator of fish and fish products quality. Novel processing and packaging technology
13.	Biotechnological improvements applicable to production systems
14.	Bioremediation applied to aquaculture production systems

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, problem-based learning (PBL).	N/A

GENERAL INFORMATION ABOUT THE COURSE #23

1.	The name of the course/module	Fish Nutrigenomics
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	The course will provide all the appropriate methodology to assess the nutritional needs of the aquatic organisms. Students will gain the ability to understand the impact of the genotype on the nutritional status, as well as gene regulation as a response to specific feed ingredients.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to:
- Assess the nutritional needs of cultured organisms and interpret the common principles of feeding processes.
- Combine feeding process, effective feed conversion and assimilation.
- Set up fishmeal and fish oil supplementation with the view to improve the Fish In Fish Out ratio.
- Propose tools to analyze the impact of feeding and nutrition on gene regulation and proteome.
- Plan feeding regimes taking account nutritional parameters on various developmental stages during production.
- Estimate the impact of genotype on nutritional status and assess the genomic responses of reared organisms upon different diets.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Nutrients in aquaculture concerning dietary requirements of cultured organisms and presence in raw materials
2.	Feeding process, digestion, and assimilation of nutritive substances
3.	Principles of exchange of substances in cultured organisms
4.	Growth of cultured organisms and methods of estimation
5.	Feeding of warm and cold-water fish. Marine fish nutrition from larva to harvesting
6.	Feeding in aquaculture and environmental conditions
7.	Genotype and fish nutrition
8.	Feeding, feed supplementation and ingredient substitution on gene regulation and physiology
9.	The impact of nutrition on the transcriptome and proteome

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, case studies.	N/A

GENERAL INFORMATION ABOUT THE COURSE #24

1.	The name of the course/module	Health and Welfare in Aquaculture
2.	Faculty/department	Natural Sciences

3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40
7.	General description and purpose of the educational component	The advanced theoretical background related to animal health management and animal welfare in aquaculture will be provided. Essentially understanding the etiopathology, diagnosis, management, and treatment of the most important diseases, and importance of different tools and biosensors for health of farmed aquatic species will be covered.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to:
- Estimate the most significant diseases of aquatic organisms, assess the causes of the disease, plan preventive measures, and predict possible ways of spreading and transmitting disease.
- Argue the occurrence, transmission, and course of a disease.
- Assess the hosts, the pathogens, and the environmental factors for disease outbreak.
- Design tools and biosensors for control and prevention of contagious diseases.
- Compose risk assessment plans and develop biosecurity measures.
- Argue and determine the impact of husbandry practices on fish stress and welfare.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Definition of disease and development of the disease-related with host, causative agent, and environment
2.	Quantification of disease, determination of hosts, pathogens, and environmental factors
3.	Koch´s postulates, Evan's rules, and research variables
4.	The course of a disease
5.	Analysis of the occurrence and transmission of the disease
6.	Transmission of disease, risk assessment analysis for cultivated and wild populations. Defence of the organism and types of immunity
7.	Control and prevention of contagious diseases
8.	Risk analysis and the basics of biosecurity
9.	Disinfection and quarantine
10.	Methods of monitoring and sampling. Interaction between the cultivated and wild populations
11.	One Health approach
12.	Welfare aspects of cultured organisms
13.	Welfare indicators and the 3Rs concept
14.	Stress and welfare assessment
15.	Use of probiotics and nutraceuticals as a tool to improve health and well-being
16.	Biosensors for the detection of pathogens and biotoxins
17.	Preparation of vaccines (viruses, bacteria, parasites)
18.	Detection of virulence and traceability of pathogenesis

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, problem-based learning (PBL).	N/A

GENERAL INFORMATION ABOUT THE COURSE #25

1.	The name of the course/module	Advanced Breeding Programmes
2.	Faculty/department	Natural Sciences
3.	Status of the educational component	Optional
4.	Semester	3d
5.	Number of ECTS credits	4
6.	The total number of hours	40

7.	General description and purpose of the educational component	Define the factors that influence breeding objectives and consider the needs and priorities in aquaculture breeding programs. The students will be able to design breeding programs and monitor the outcomes, with special emphasis to the genomic toolkit that will facilitate the understanding of population structure and the enhancement of selective breeding efficiency.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

In successful completion of this course, students should be able to:
- Argue the environmental, nutritional, and endocrine control of reproduction, development, and growth.
- Propose husbandry practices to increases production yield and quality characteristics of the aquaculture populations.
- Design selection programs for production traits.
- Set-up genetic and genomic tools for monitoring the performance of breeding programs.
- Select gene manipulation techniques and applications in broodstock management.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Environmental, nutritional, and endocrine control of reproduction
2.	Principles of domestication and the application of genetic improvement in aquaculture
3.	The theoretical basis of genetic breeding and selection
4.	Breeding and selection strategies and how they are achieved by mating design
5.	Calculation of breeding values and the response of a population to selection
6.	Estimates of genotype and environmental fitness interactions
7.	Configuration and management of breeding stock
8.	Induction, control, and management of the reproductive cycle
9.	Techniques and applications of chromosomal manipulation
10.	Genetic markers and genetic mapping in aquaculture
11.	Quantitative Genetics, Quantitative Trait Loci, NGS-RAD and GWAS sequencing in aquaculture
12.	Genetic and genomic tools for broodstock management and improvement of aquaculture production
13.	The analysis of transcriptomic libraries applied to genetic improvement in aquaculture

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
On-line teaching; lectures, seminars, problem-based learning (PBL).	N/A

GHENT UNIVERSITY

1	Criterion A: University profile	
1.1	Name of the University	**GHENT UNIVERSITY**
1.2	Classical or applied	Applied
2	Criterion B: Profile of the educational program (Curriculum)	
2.1	Number of Aquaculture disciplines	28
2.2	The name of the educational program	Aquaculture
2.3	Type of diploma	Master, Double
2.4	Total number of credits (ECTS)	120
3	Criterion C: Setting the educational program (Curriculum)	
3.1	Duration of the program	4 semesters
3.2	The purpose of the educational program	The objectives of the programme are: • to deliver researchers able to perform and design research in various aquaculture fields; • to deliver experts who can draw and implement strategies for future development in the aquaculture industry; • to form key persons who can act as a nucleus in their local environment through dissemination and teaching their acquired knowledge; • to deliver academically trained staff for the aquaculture industry.
4	Criterion D: Characteristics of the educational program (Curriculum)	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Aquaculture
5	Criterion E: Teaching and assessment	
5.1	Teaching and learning methods	Active learning - interactive learning methods; problem-oriented learning; the principle of binary - active direct participation of the teacher and student; away classes; learning through practice; self-study; personalized training - individual consultations; seminar; lecture; online lecture; excursion; self-reliant study activities; seminar: practical PC room classes; online seminar: practical PC room classes; group work.
5.2	Assessment	Types of assessment: summative assessment - level determination achievements of a higher education student learning outcomes; Assessment methods: practical assessment, examination assessment.
6	Criterion F: Software competencies	
6.1	Integral competence	N/A
6.2	General competences	N/A
6.3	Professional competences	N/A
7	Criterion G: Program Learning Outcomes	
7.1	Program learning outcomes	1. possesses a broad knowledge at an advanced level in a number of basic disciplines (biology, ecology, pathology, genetics, zootechnology, nutrition, management, economics and statistics) relevant to aquaculture 2. understands the processes ongoing in different forms and systems of aquatic production 3. has acquired a broad knowledge on the production of aquatic organisms 4. has acquired practical experience in production of aquatic organisms and their live feeds 5. understands the ethical issues of animal production and experimentation 6. has acquired a scientific approach to formulate and test hypotheses to design research protocols, and to collect and analyze data

		7. can identify and analyze the interactions between aquatic biological production systems and their environmental context, and can implement potential mitigating interventions 8. can identify and analyze the interactions between aquatic biological production systems and their socio-economic context, and is familiar with the practicalities and organization of commercial ventures 9. can design and implement strategies for future development in aquaculture 10. is able to interact with peers, with various stakeholders in the aquaculture sector, and with a general public concerning personal research, thoughts, ideas, and research proposals, both written and orally	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	N/A	
8.2	Material and technical support	Aquaculture & Artemia Reference Center Blue Growth Research Lab Environmental Toxicology (GhEnToxLab)	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Applied Freshwater Ecology	3	Written examination
9.1.2	Applied Marine Ecology	3	Written examination with open questions, written examination with multiple choice questions
9.1.3	Biology of Fishes	4	written examination with open questions, oral examination, skills test
9.1.4	Freshwater Fish Culture Techniques	6	written examination, participation, report
9.1.5	Microbial Ecology and Environmental Sanitation	4	written examination, open book examination, participation, assignment, report
9.1.6	Technology of Fishery Products	3	written examination with open questions, participation, assignment
9.1.7	Applied Statistics	5	written examination with open questions, written examination, open book examination, skills test
9.1.8	Principles of Marine Fish Larviculture	3	written examination
9.1.9	Applied Marine Fish Larviculture	3	participation, assignment, report
9.1.10	Physiology of Aquatic Organisms	3	written examination, oral examination, participation
9.1.11	Algae Culture	3	written examination, participation
9.1.12	Aquatic Farm Management Training	3	oral examination, participation, assignment, report
9.1.13	Mollusc and Crustacean Culture	5	written examination, participation
9.1.14	Aquaculture Nutrition	5	written examination, participation, report
9.1.15	Aquaculture Environmental Impact	3	written examination, assignment, report
9.1.16	Water Quality Management	4	written examination with open questions, assignment, report
9.1.17	Management in the Aquaculture Industry	3	written examination, open book examination, participation
9.1.18	Aquaculture Genetics	6	written examination, participation, assignment, report
9.1.19	Diseases in Aquaculture	6	written examination, participation, report
9.1.20	Viral Disease Management	3	written examination

9.1.21	Fish and Shellfish Immunology	4	written examination
9.1.22	Aquatic Microbial Community Management	3	written examination
9.1.23	Master's Dissertation	30	oral examination, participation, assignment
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Internship	5	oral examination, participation, report
9.2.2	Project	5	assignment, report
9.2.3	Programming	5	open book examination, skills test
9.2.4	Animal Welfare, Law and Ethics	3	end-of-term assessment
9.2.5.	Coaching and Diversity	3	Portfolio, assignment
9.2.6	Migration and Society: an Interdisciplinary Introduction	5	Written examination
9.2.7	Co-Creation	6	Assignment, report
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Master's dissertation	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
9.	The name of the course/module	Applied Freshwater Ecology
10.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
11.	Status of the educational component	Mandatory
12.	Semester	1/1
13.	Number of ECTS credits	3
14.	The total number of hours	90
15.	General description and purpose of the educational component	This course offers general insights in the composition and functioning of freshwater systems, in both natural as (over)exploited systems. The students receive knowledge about rivers, lakes, ponds and wetlands, and are supposed to be able to analyze systems in the field concerning main components and processes, as well as the dynamic behavior of the system.
16.	Prerequisites for studying the course/module, connection with other educational components	Basic ecological knowledge concerning components and processes of ecosystems: the student can define, explain and identify key-processes and concepts of ecosystems.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Define and explain key terminology and concepts of freshwater ecosystems
2. Systematically analyze freshwater ecosystems concerning the composition and major processes
3. Optimize the exploitation of freshwater ecosystems (drinking water production, fisheries, aquaculture, wastewater treatment, …) in a context of sustainability
4. Develop and defend a vision in a discussion related to the exploitation and/or disturbance of a particular freshwater ecosystem (pool, wetland, lake or river)
5. Identify the major components and processes of natural and exploited freshwater ecosystems in the field (or in pictures and videos).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

THEORY (with insight questions for stimulating the interaction): 20 h
Key freshwater systems: an overview of rivers, lakes, ponds and wetlands
Hydrology, hydraulics and hydromorphology in relation to composition and behavior of freshwater systems The specific (bio)chemical key processes of rivers, lakes, ponds and wetlands The biology of freshwater ecosystems: an overview of the diverse communities and their traits
Energy flows and storage in freshwater ecosystems
Ecostoichiometry of freshwater ecosystems
Migration in and between freshwater ecosystems
Invasion-ecology: key processes and impacts
Ecological interactions and food webs, with an emphasis on competition and predation Behavior of freshwater ecosystems: dynamics and spatial heterogeneity Exploitation of freshwater ecosystems: combination, optimization, overexploitation and protection
GUIDED PRACTICAL EXERCICES: 5 h
During two sessions, the students get in contact with international river systems (Mekong, Amazon, Nile, …), large lakes (Victoria, Tonle Sap, …), as well as Flemish water systems such as The Scheldt and large stagnant waters. The objective of these guided questions is to make students familiar with the application of the theory, especially concerning the effects of wastewater discharges, nutrient enrichment, invasions and hydropower. After a short introduction of the systems and

explaining the questions, the student can individually prepare answers, that serve as a basis for a plenary discussion to solve the questions. EXCURSION: 5 h During the field excursion, several freshwater ecosystems are visited and discussed. The objective of these visits and discussions is to prepare students via insight questions for the exam. In particular, the identification of components and processes is trained during the excursion.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Excursion, lecture, lecture: plenary exercises, seminar: coached exercises	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #2		
1.	The name of the course/module	Applied Marine Ecology
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	This course aims at describing and illustrating the fundamental and applied concepts of marine processes and ecosystems. In the theory lectures, the interactions between biotic and abiotic processes and the structure and functions of marine ecosystems are reviewed in detail. The field excursions integrate these theoretical aspects and give the student in-depth experienceoriented knowledge. In contrast with classic marine ecology, the modern human relation with the marine environment is incorporated in this course. Both blue growth threats and opportunities from a bioscience engineering point of view are discussed.
8.	Prerequisites for studying the course/module, connection with other educational components	General Biology, General Ecology, General Physics, General Chemistry.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. Understand the specific charachteristics of the oceans and their importance for marine applications. 2. Understand the main physical-chemical and ocean life processes driving ecosystem dynamics in different marine ecosystems, and their importance for marine applications. 3. Discuss possible theoretical consequences and opportunities of/for human interactions in the different marine ecosystems. 4. Estimate in a quantitative way the consequences and opportunities of/for human interactions in the different marine ecosystems.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
Part I - Ocean characteristics, physical-chemical processes and man a) Planet Ocean: Introduction and terms b) Moving Oceans: seafloor, winds and currents c) Salty Oceans: salinity and importance d) Deep Oceans: temperature, pressure and density e) Dark Oceans: light and importance f) Chemical Oceans: CO2, interactions, climate change and consequences Part II - Ocean life processes a) Living Ocean: origin of life, biodiversity and production b) Primary production: species, light/depth/nutrients/growth, cycles and phenomena c) Microbial ecology: production, decomposition, ecological context and seasonal cycles d) Secondary production: P/B ratio, measurements and drivers Part III - Ocean Systems a) Rocky and sandy shores: waves, tides, environmental variables, zonation and research b) Estuarine ecology: zones, salinity and ecological features c) Pelagic and benthic ecosystems Part IV – Threats and opportunities in marine systems a) Introduction: pressures, risks and benefits, ecosystem services and blue growth b) "Toxic" Ocean: presence and effects of chemicals, other stressors c) "Unbalanced" Ocean: risks of eutrophications

d) "Tasty" Ocean: need for food from the oceans e) "Healthy" Ocean: provision of known and unknown health services	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, excursion, lecture, fieldwork, seminar: practical PC room classes, online lecture	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #3		
1.	The name of the course/module	Biology of Fishes
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	4
6.	The total number of hours	120
7.	General description and purpose of the educational component	FISH MORPHOLOGY The purpose of this course is to focus on topics where knowledge and theory on fish biology are relevant for being applied in aquaculture practice. It is the aim to understand the biology of teleosts, thus providing a crucial knowledge base for developping a scientific approach towards fish culture. A rapidly expanding, world-wide aquaculture industry and the consequent shortcomings of contemporary practices in fisheries management are demanding this type of information. Recent efforts in enhancing larval fish quality require a good knowledge on larval fish biology. To meet these requirements, this part of the course focuses on the anatomy of bony fishes, followed by aspects of larval fish growth as well as ontogeny (both embryonic and postembryonic). The growth and ontogeny is also considered from a functional point of view. SYSTEMATICS OF FISHES The aim is to obtain a good overview on the diversity of fishes, in particular of those groups used in fish culture (marine and freshwater). After a general introduction on systematics and cladistics, an overview is given of the major fish groups and their specific morphological and ecological characters, and evolutionary adaptations (not part of the exam). In addition, elements from other disciplines, especially aquaculture, but also fisheries and molecular biology, ... are discussed. The practical sessions are quite important. The students learn how to identify the major groups of fishes, to comment upon their morphological characters and how to interpret these in the framework of a modern classification of fishes.
8.	Prerequisites for studying the course/module, connection with other educational components	No particular knowledge is needed to start this course. Terms, definitions and exercises are adapted to students with basic notions of biology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. Students understand the basics of fish anatomy 2. They are able to perform a dissection and understand the topographical relationship between organs and organ systems 3. They understand the functioning of organ systems, and the relevance of it with respect to applied fish culture 4. They are able to determine and interpret aspects of fish growth 5. They understand the ontogeny of fishes with respect to larval fish quality and crucial phases during ontogeny (for rearing fish) 6. They are able to recognize the different ordos of fishes discussed in the course, by external examination 7. They have a detailed insight of the worldwide biodiversity of fishes in general and in particular of target species that are used in aquaculture 8. They have a broad knowledge of biotic and abiotic factors controlling gametogenesis and spawning of fish 9. Students can interpret basic concepts of fish anatomy to phenotypic problems with fish in an aquaculture context (e.g. deformities)
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course "Biology of Fishes" consists of two main parts: (i) fish morphology and (ii) systematics of fishes. I. FISH MORPHOLOGY 1. Anatomy of bony fishes (with a practical) 2. Concepts of fish growth and development (growth, allometry, ontogeny) 3. Aspects of fish growth (measuring size and age, growth models, growth rates) 4. Aspects of fish development (staging of development, embryonic period, larval period, juvenile period, adult period) 5. Functional implications of ontogenetic changes (differential growth rates of body portions, growth and hydrodynamic implications, ontogeny and feeding). 6. Aspects related to deformities in aquaculture fish, by discussing some papers from specialised literature. II. SYSTEMATICS OF FISHES 1. Introduction (not part of the exam; necessary to set the scene) 2. Principles of systematics and cladistics (not part of the exam; necessary to set the scene) 3. General introduction to the anatomy and morphology of fishes (not part of the exam; necessary to set the scene) 3. Evolutionary classification of fishes, concentrating on the major taxonomic groups and on economically important taxa. In addition, the highlights of the FAO factsheets for the most important aquaculture finfish species are discussed. 4. Practical exercises on systematic collections.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, practicum, lecture: response lecture, online lecture. Lectures are given to the whole group in lecture rooms, with projected powerpoint slides as teaching aids. One discussion lecture is organised where some studies published in literature that deal with deformities in aquaculture fish species are being discussed, and where knowledge on fish anatomy is applied in relation to these issues. Practicals being organised, involve: (1) performing a dissection on bony fishes with some assignments to be performed (students work in groups of two), and (2) studying external morphology of fishes and identifying fish taxa using preserved specimens.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #4		
1.	The name of the course/module	Freshwater Fish Culture Techniques
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	This course offers a general introduction to fish culture and focusses on culture of freshwater fish of temperate and tropical regions. Different culture systems are explained such as ponds, cages and recirculation systems. Attention is paid to aeration, grading and feeding systems. Integrated pisciculture explains the different types of possible mixed aquaculture and agriculture production methods, and its advantages, pathways and drawbacks. As a practical case-study of fish culture and artificial reproduction, the African catfish (Clarias gariepinus) is used. A practical pond construction field work is included and students write an exploitation plan for a freshwater fish farm.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry and biochemistry.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. The student has knowledge on the cultivation techniques of freshwater fish (reproduction, larviculture, grow-out). 2. The student has knowledge on specific machines used in a commercial fish production plant. 3. The student has a good knowledge on advantages and disadvantages of integrated agro aquaculture. 4. The student is able to manage and exploite a freshwater fishfarm (amount and sizes of different tanks and pond, harvest cycles, need of water and feed, productivity, food conversion rate). 5. The student is able to construct ponds. 6. The student is able to reproduce naturally or artificially farmed fish species (based on their experience with Clarias gariepinus).
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Freshwater fish culture 1. Tilapia farming and aquaculture principles 2. Carp farming and polyculture 3. Carp reproduction - reproduction of tropical species 4. Trout - eel - catfish farming, intensive farming in recirculation systems 5. Exercise : design of an exploitation plan for a tilapia farm 6. Pondconstruction: theory and fieldwork 7. Practical on artificial reproduction in African catfish (Clarias gariepinus) 8. Principles of a recirculation system Integrated agro-aquaculture 1. Different combinations of fish culture with agriculture production: performance, nutrient balans, economics 2. Agro-aqua exercise

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, lecture, practicum, fieldwork, lecture: plenary exercises. Theory lectures: lectures based on powerpoint presentations and videos. Practical classes: pond construction field work and artificial reproduction lab work with Clarias in small groups. Guided selfstudy: writing of an exploitation plan for a freshwater fish farm. Field work : pond construction Lecture with plenary exercise	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #5		
1.	The name of the course/module	Microbial Ecology and Environmental Sanitation
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Biotechnology
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	4
6.	The total number of hours	120
7.	General description and purpose of the educational component	The purpose of this course is to introduce the student to the world of microbiology and microbial ecology, and to learn the important role of microorganisms in wastewater treatment. Microorganisms are a major constituent of all aquatic systems (including aquaculture). In fact, they are the dominant life form in the marine environment in terms of number and biomass. Moreover, microorganisms also perform crucial tasks. One of the greatest challenges of our times is undoubtedly to provide clean, healthy water to people and the environment. Therefore, responsible wastewater treatment is crucial. This applies also to aquaculture, as environmental impacts are one of the major bottlenecks for the further expansion of the sector. Microorganisms are the core engine of the biotechnological processes used to treat wastewaters. Microorganisms clean up water and outcompete pathogenic microorganisms, thereby greatly facilitating the production of clean water. On the other hand, some microorganisms are also detrimental to other organisms, including humans and aquaculture organisms. Diseases are another serious limitation to aquaculture production, and as a result of growing concerns with respect to the use of antibiotics, we need to adopt novel strategies in order to control diseases. In this respect, a thorough understanding of the physiology and ecology of microorganisms is of paramount importance. The goal of this course is to understand basic microbiological, ecological and biotechnological processes to the level that they can be assessed and quantified. The acquired course knowledge will allow to understand basic principles for sustainable and responsible aquaculture. This course is for most of the students a first contact with microbiology and with environmental technology, and is hence relatively basic.
8.	Prerequisites for studying the course/module, connection with other educational components	Mathematics, physics and chemistry: at the level of bachelor in beta-sciences.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		

1. Understanding and quantifying (aquatic) microbial processes 2. Interpreting and evaluating information related to microbial processes, including state-of-the1 art biotechnology for wastewater treatment 3. Performing basic practical manipulations in relation to microbiological analyses, determination of water quality and microbial processes and critically evaluating the obtained results
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
1. Principles of microbiology (Self-study package) 1.1. Microbial diversity 1.2. Cell structure 1.3. Microbial metabolism 1.4. Microbial detection techniques 2. Microbial ecology 2.1. Basic concepts 2.2. Diversity 2.3. r/K selection 2.4. Microbial interactions 2.5. Bacterial signalling and detection mechanisms 2.6. Microbial ecology of aquaculture systems 3. Microbial pathogens 3.1. General principles of infectious disease 3.2. Aquaculture pathogens 3.3. Pathogenicity mechanisms of bacterial aqauculture pathogens 3.4. Management of bacterial aquaculture pathogens 4. Wastewater treatment: sewage and aquaculture effluent 4.1. The urban water cycle 4.2. Aquaculture 4.3. Wastewater constituents 4.4. Sewage composition 4.5. Aquaculture waste composition 4.6. Discharge limits 4.7. Sewage treatment processes 4.8. Treatment of aquaculture effluent

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, practicum, seminar: coached exercises.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #6		
1.	The name of the course/module	Technology of Fishery Products
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Food Technology, Safety and Health
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	The aim of this course is to create an insight in the relation between post-mortem changes in fish and the consequences on its quality and further processing. Furthermore, the students should get familiar with the different processes used in the fish industry as well as aspects of safety and quality and basis aspects of prerequisite programmes (PRP) in fish processing.
8.	Prerequisites for studying the course/module, connection with other educational components	General knowledge on biochemistry and microbiology.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
1. To have insights in the properties and post-mortem changes of fish as a raw material and how these properties influence the quality of the derived fish and fishery products. 2. To have insights in how processing used for the production of fishery products influences the properties and the quality of the produced product. 3. To be able to identify and explain the consecutive steps in the production of a fishery product.		

4. To be able to argument on quality and safety aspects of fishery products in a certain situation. 5. To be able to critically reflect and make substantiated decisions based on scientific literature related to fish processing/technology.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
Theory: 1. Chemical composition 2. Post-mortem changes in fish 2.1. Rigor mortis 2.2. Autolytic changes 2.3. Bacteriological changes 2.4. Rancidity 2.5. Physical changes 3. Technological processes 3.1. Chilling 3.2. Freezing 3.3. Modified atmosphere packaging (MAP) 3.4. Canning 3.5. Curing 3.6. Marinades 4. Basic principles of Prerequisite Programmes related to fish processing. 5. Quality monitoring of fish and fishery products 6. Safety aspects of fish and fishery products Practice: Case studies on fish processing Tasting session Company visit

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, excursion, lecture, seminar: coached exercises	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #7		
1.	The name of the course/module	Applied Statistics
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	5
6.	The total number of hours	150
7.	General description and purpose of the educational component	In general, the course aims to reach the following end terms: Knowledge: knowledge on basis statistical data analysis techniques Skills: the student will be able to translate a research question into a statistical problem, which he/she can solve using basic statistical methods. In particular, these methods are related to the analysis of means (e.g. t-tests, ANOVA) and regression analysis. The student will be capable of performing the data analysis, and of interpreting the results, and he/she will be able to translate these conclusions back to the context of the original research question. Emphasis is put on the exercises, most of which are on PC with statistical software. The examples and exercises are based on case studies relevant to the students' work environment. In particular, examples are selected from food science, food technology, aquaculture and environmental sciences. The practicals are organised in groups.
8.	Prerequisites for studying the course/module, connection with other educational components	A basic knowledge of calculus and probability theory (random variables, probability and distributions) is required.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
1. The student understands the basics of statistical data exploration and statistical inference. 2. The student can perform basic statistical data analyses using the software R. 3. The student recognises important problems in the study design/analyses and knows how these may affect the conclusions from the statistical data analysis. 4. The student can correctly report the results of a statistical data analysis in a scientific report.		

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
1. Descriptive statistics (means, medians, percentiles, ...) 2. Some common distributions: normal, binomial, multinomial 3. Basics of statistical inference: confidence intervals and statistical hypothesis tests 4. Statistical tests for association in contingency tables 5. Comparison of 2 means (t-test and Mann-Whitney test) 6. Comparison of k means (F-test and Kruskal-Wallis test) 7. Multiple comparison of means (Tukey, Bonferroni,..) 8. 2-way ANOVA and interaction 9. Multiple way ANOVA.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory: lectures Exercises: seminars, including practical PC room classes.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #8		
1.	The name of the course/module	Principles of Marine Fish Larviculture
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	The aim of this course is to give a general overview and principles of marine fish larviculture, focusing on nutritional and zootechnical aspects. Firstly, larval nutritional requirements in general are addressed. The different aquatic invertebrates that can be used as live food are highlighted, including their natural availability, general characteristics,culture techniques and fields of application in larviculture of mainly marine fish. Also developments in the field of microdiets are explained.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. The student has general knowledge on general principles of marine fish larviculture, such as techniques used, current developments and future perspectives. 2. The student has in-depth knowledge on the nutritional aspects of marine fish larviculture: nutritional requirements; feeding behaviour; live food versus artificial diets. 3. The student has detailed knowledge on various aspects of different live food organisms (rotifers, Artemia, other zooplankton organisms) used in larviculture, such as their advantages and restrictions, availability, production techniques and fields of application. 4. The student has general knowledge on Artemia biology, ecology and taxonomy.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
1. Introduction to marine fish species larviculture: principles, techniques, past and present successes and bottlenecks, perspectives and current developments with focus on nutrition; crucial role of live food. 2. Artemia biology, ecology and taxonomy and strain study; production of cysts and biomass; commercial aspects and quality control; Artemia applications in aquaculture. 3. Production techniques and applications of rotifers and other zooplankton organisms. 4. Larviculture of marine fish species: general feeding strategies and zootechnical aspects.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Theoretical lectures based on power point presentations and with plenary exercises, followed by discussion rounds.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #9		
1.	The name of the course/module	Applied Marine Fish Larviculture
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/2
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	The aim of this course is to provide knowledge on practical applications of live food in marine fish larviculture. This is mainly achieved by a number of practical classes and hands-on exercises, related to the laboratory culture of fish larvae and the use of live food
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1 The student is able to apply practical techniques related to the use of Artemia in larviculture (such as cyst decapsulation, nauplius enrichment, cyst quality control) and can report about them. 2 The student is able to run a rotifer batch culture and has insight into rotifer recirculation production systems, and can report about this. 3 The student is able to run a larval fish culture at laboratory scale, including aspects such as supply of artificial and live food (calculation of needed amounts of artificial and live food), zootechnical aspects including maintenance of recirculation system, analysis of parameters related to fish larval growth, and is able to report about this in a written report in the format of a scientific paper.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
1. Design and practical application of a larval fish feeding regime; assessment of fish larval performance 2. Quality control in live food commercial products, especially Artemia cysts 3. Methodologies for practical application of Artemia in hatcheries 4. Design and practical application of rotifer laboratory cultures

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Demonstration, group work, lecture, practicum. Theoretical lecture introduces to a number of practicals, labworks and demonstrations, for which students are organized in groups (with individual report). Depending on the labwork (nature of work and duration of the test, e.g. prolonged fish larviculture test vs. short guided labwork), more or less independent working is required.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #10		
1.	The name of the course/module	Physiology of Aquatic Organisms
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/2
5.	Number of ECTS credits	3
6.	The total number of hours	75

7.	General description and purpose of the educational component	Animal physiology can be defined as the study of the function of animals and their constituent parts. The ultimate goal of this subject is to understand the mechanisms that operate in living organisms at all levels, ranging from cell to the whole organism. This goal is a very ambitious one, for each living organism, a single cell, is incredibly complex.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry and biochemistry.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. The student understands the structure and function of biomembranes.
2. The student ynderstands the ionic and osmotic balances and gas exchanges.
3. The student understands the acquisition and use of energy.
4. The student is able to apply good laboratory practices.
5. The student is able to perform measurements on energy use (respiration rates, energy stores).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Introduction: Central themes in animal physiology
2. Energetics of living cells
3. Membranes, channels, transport
4. Ionic and osmotic balance
5. Gas exchange and acid base balance
6. Hormonal control
7. Energy metabolism, size and temperature

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, practicum.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #11

1.	The name of the course/module	Algae Culture
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/2
5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	This course aims at providing an overview of the procedures which are used for the cultivation of microalgae, needed as live food in aquaculture of shellfish, crustaceans and zooplankton or which are widely considered as candidate biofuels, as well as the cultivation of macroalgae (seaweeds) of which numerous useful products are extracted and which are considered as important components of integrated multitrophic aquaculture. The practical training involves the maintenance of microalgae cultures and quality analysis.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. The student knows the different procedures, which are used for the cultivation of microalgae and macroalgae.
2. The student is able to describe how environmental parameters limit algal growth (including application in intensive cultures).
3. The student understands and can apply algal growth dynamics.
4. The student understands the advantages and disadvantages of autotrophic versus heterotrophic growth.
5. The student has experienced basic techniques of microalgal culturing, has taken samples and has done quality checks.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Microalgae 1.1. Importance and uses of microalgae 1.2. Characteristics of microalgae, species cultured 1.3. Culture requirements: physical, chemical 1.4. Types of cultures and growth dynamics (autotrophic versus heterotrophic) 1.5. Culture systems and procedures (including highly intensive microalgal cultures for biofuel) 1.6. Problems and constraints: nutritional, technical, economical 1.7. Practical classes on the maintenance and quality analysis of microalgal cultures 2. Macroalgae 2.1. Importance and uses of macroalgae 2.2. Characteristics of macroalgae, species cultured 2.3. Culture requirements: physical, chemical 2.4. Culture systems and procedures for green, brown and red algae

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, practicum. Theory lectures: lectures based on powerpoint presentations. Practical classes: microalgae culturing experiments in small groups.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #12		
1.	The name of the course/module	Aquatic Farm Management Training
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/2
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	Various visits are paid to algae, fish, shrimp, mussel and/or oyster farms and aquaculture related research institutes during a one-week excursion to a European region having significant aquaculture relevance. Economical, managerial, environmental and zootechnical aspects of the farms are analysed. It is furthermore important to get a critical view on the farm by the student. Zootechnical aspects will be water treatment systems, tank design, hygiene, prevention, life food department, transport, culture aspects, etc. Economical aspects are market prices of larvae and finished product, production schedule vs expenses.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. The student understands and is able to describe the zootechnical aspects of running an aquaculture farm. 2. The student understands the economics of running an aquaculture farm. 3. The student is able to report on the zootechnical, environmental and economic aspects of running an aquaculture farm.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
1. Overview of the extensive and intensive aquaculture farms that will be visited 2. Group visit to various aquaculture farms

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, excursion, group work, lecture, microteaching.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics. Theory lectures: interactive lectures based on powerpoint presentations. Microteaching: student presentations during interactive lectures. Excursion: farm and research institute visits.

GENERAL INFORMATION ABOUT THE COURSE #13

1.	The name of the course/module	Mollusc and Crustacean Culture
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/2
5.	Number of ECTS credits	5
6.	The total number of hours	150
7.	General description and purpose of the educational component	The aim of this course is to teach culture techniques that are commonly applied for the commercial production of crustaceans and molluscs. The course offers detailed knowlegde on various mollusc and crustacean species. Practical classes on mollusc anatomy and freshwater shrimp development are included.Zootechnical aspects will be water treatment systems, tank design, hygiene, prevention, life food department, transport, culture aspects, etc. Economical aspects are market prices of larvae and finished product, production schedule vs expenses.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. The student has knowledge on the biological requirements of crustaceans and molluscs in commercial production systems.
2. The student has technical knowledge on the rearing systems used for crustaceans and molluscs.
3. The student has insight into how to start a hatchery or grow-out farm for crustaceans.
4. The student is able to identify mollusc organs.
5. The student is able to identify different larval stages of freshwater prawn.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Crustacean culture
1. General aspects on the production of crustaceans : maturation, reproduction, larval culture, grow-out, feeds
2. Production techniques for penaeid shrimp
3. Production techniques for freshwater prawn Macrobrachium
4. Production techniques for lobster
5. Exercise on a penaeid hatchery
6. Practicum identification different larval stages of Macrobrachium

Mollusc culture
1. World production of molluscs
2. Abalone culture
3. Anatomy of bivalves with practicum dissection
4. General aspects on the production of bivalves : life cycle, nutritional requirements in different life stages and environmental adaptations of bivalves
5. Exceptional species
6. Common hatchery and nursery systems for bivalves
7. Common grow-out systems for bivalves
8. Impact of bivalve culture on the environment
9. Diseases in cultured molluscs

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, lecture, practicum, seminar: coached exercises.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics. Theory lectures: lectures based on powerpoint presentations and videos. Practical classes: dissection of bivalves and identification of different larval stadia of Macrobrachium. Exercises: exercise on the starting-up and exploitation of a shrimp hatchery.

GENERAL INFORMATION ABOUT THE COURSE #14

1.	The name of the course/module	Aquaculture Nutrition
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology

3.	Status of the educational component	Mandatory
4.	Semester	1/2
5.	Number of ECTS credits	5
6.	The total number of hours	150
7.	General description and purpose of the educational component	The course covers a number of general and specific issues related to (non-live) feed requirements, feed characteristics, feed production, feeding practices in an aquaculture context.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1 The student is able to enumerate the main ingredients being used for aquaculture feeds, their advantages and disadvantages, and is able to critically evaluate tendencies within aquaculture nutrition with a focus on enhanced sustainability of rearing practices
2 The student is able to explain why an ingredient is suitable for the production of feeds in the aquatic environment.
3 The student understands which feed ingredients are necessary, and in which proportions, to compose a balanced artificial aquaculture diet depending on the species and the rearing context
4 The student is able to describe how the organism takes advantage of the feed ingredients and how feed formulation is related to intake and digestion by the organism.
5 The student is able to describe the various methods for feed analysis and can argue why 1 they may be suitable in a scientific and/or an industrial production environment.
6 The student has insight into compound feed formulation based on linear programming.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Aquaculture feed ingredients, feed analysis, chemical and nutritive characteristics of feedd ingredients
2. Aquaculture feed production technology
3. Nutritional requirements of aquaculture organisms
4. Efficiency of use of feed by aquaculture organisms: feed conversion ratio; fish-in/fish-outratio
5. Sustainability in feed production; alternative feed ingredients: potentials and challenges
6. Aquaculture feed formulation based on linear programmingquaculture feed analysis
7. Excursion

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, demonstration, excursion, lecture, seminar: coached exercises	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics. Theory lectures: lectures based on powerpoint presentations and videos. Exercises: virtual lab excercise on feed analysis; guided exercises on linear programming in feed formulation. Excursion: visit to feed production plant and to aquaculture facilities.

GENERAL INFORMATION ABOUT THE COURSE #15

1.	The name of the course/module	Aquaculture Environmental Impact
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/2
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	In the past, oceans and seas were often perceived as a limitless source of seafood with an ever increasing supply of fish. However, with an increasing global population, the limits of both our terrestrial and marine food provisioning systems are becoming poignantly clear. Fish and other marine products are an important source of proteins, but as more than 30% of our fish stocks are already overfished, it is unlikely that increasing fishing activities will result in an adequate supply of proteins. Aquaculture, on the other hand, has been exponentially growing since the 1990's. is As of today, aquaculture provides already half of the fish products being consumed, providing

		food security in various areas around the world. However, the impacts of aquaculture on the local ecosystem cannot be neglected. For example, extensive feeding causes eutrophication, which may lead to harmful algal blooms, which on their turn endanger harvests, local ecosystems and human health. Coastal ecosystems, like mangrove forests, often with a high carbon sequestrating potential, are being removed in favor of aquaculture with consequences such as coastal erosion, biodiversity loss and a lower carbon sequestration. Antibiotics, applied to avoid losing profit due to diseases in the system, are an important cause of increasing antibiotic resistance. The impact of aquaculture on the environment should thus be taken into careful consideration in order to ensure a sustainable food supply.
8.	Prerequisites for studying the course/module, connection with other educational components	Notions on general aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. The student has insight into the factors determining the sustainability of aquaculture.
2. The student can describe different aquaculture configurations including their advantages and disadvantages with regards to environmental impact.
3. The student can describe the relationship between different environmental impacts (.e.g (harmful) algal blooms) and aquaculture.
4. The student can quantitatively compare different aquaculture configurations in terms of sustainability and feasibility.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course aims at giving an extensive overview of aquaculture systems and their effects and interactions with the environment. To gain insight in said interactions, knowledge on different configurations and forms, e.g. traditional versus industrial aquaculture, is required and will be illustrated using case studies from all over the world. Additionally, the sustainability of different configurations will be discussed. Problems associated with aquaculture will be debated, such as, for example, (harmful) algal blooms with special attention to toxin production, species and monitoring. The theoretical insights in system configurations and interactions with the environment will be put into practice during the exercise sessions, in which the sustainability of different aquaculture systems will be quantitatively assessed and compared.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, integration seminar, seminar. Theory lectures: lectures based on powerpoint presentations.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #16

1.	The name of the course/module	Water Quality Management
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/2
5.	Number of ECTS credits	4
6.	The total number of hours	120
7.	General description and purpose of the educational component	This course provides basic and applied information and know how on the components and processes in aquatic ecosystems. Sources and impacts on these systems are presented, as well as monitoring, assessment and management methods.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge of general ecology and chemistry are sufficient to follow this course.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. know which activities have an impact on the quality of the surface waters
2. know what the effects of human activities are on aquatic systems and have to know how to avoid or how to lower these activities
3. be able to present the different methods of monitoring for the different types of surface waters and their impacts and they also have to be able to present the different instruments and methods for monitoring
4. be able to know the proper measures of management so that the different types of impacts are lowered and they have to place it in the context of the Water Frame Work Directive and Integrated Water Resource Management
5. be able to define sustainable development of water and the different examples and applications
6. be able to carry out a sampling of surface waters and with the results they have to make an interpretation of the water quality

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
1. Introduction: what is water quality management? Relation with sustainable development goals and sustainable water management 2. Water quality monitoring (habitat, chemical and biological, standards and basic and advanced technologies (e-DNA and biotechnology, drones, probes, tags, camera's, citizen science)) 3. Water quality modelling (data driven approaches + mechanistic models for system analysis (diagnosis) and forecasting (scenario analysis, cost-benefit analyses)) 4. Water quality assessment (chemical and biological indices, standards, ecosystem services, sustainability assessment) 5. Water quality protection and restoration management (approaches, directives and legislation, actors, stakeholders, project management), including a case-study on aquaculture sector 6. Recent developments: big data, video mining, internet of things, smart water systems, citizen science, co-creation, blue and green growth, natural capital, glocal networks (recent articles and guest speakers from government, companies and presentations by international experts) 7. Case study: field monitoring and modelling exercise 8. The students have to work in groups about a certain case study. They have to find out a strategy of monitoring, take physical and chemical measurements and they also have to take some samples in lentic and/or lotic waters. Further they also have to analyse the chemical and biological samples, calculate the indices, apply some basic modelling techniques, assess the results and develop the proper management measures.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Group work, lecture, practicum, fieldwork, self-reliant study activities. The course consists of two main parts: theory and practice. The theory entails several lectures, combined with guided exercises and guest lecturers. The practical part entails both field and lab work, during which there will be a focus on the evaluation of water quality based on the chemical and biological conditions. Students have to write a group report about the obtained results. This practical exercise is an obligatory part of this course.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #17		
1.	The name of the course/module	Management in the Aquaculture Industry
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	This course aims at the understanding of the economics and financial aspects of a typical aquaculture venture.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. The student has insight into the principle of business accounts and is able to make a balance sheet, a profit /loss account and a cash flow. 2. The student can perform breakeven analysis. 3. The student has insight into strategic management frameworks. 4. The student can evaluate working capital management of an aquaculture of seafood trading company. 5. The student can make decisions based on relevant costing techniques and on net present value and internal rate of return. 6. The student has knowledge on certification in the fisheries supply chain.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
1. Concept of profit 2. Profit and loss account 3. Balance sheet 4. Cash flow 5. Sales and Purchases versus receipts and payments 6. Importance of valuations 7. Depreciations, assets, liabilities, net worth and output 8. Account formats

9. Optimizing the financial resources of a company: working capital management, cash conversion cycle. Exercise: comparison of working capital management of different companies active in the aquaculture industry 10. Breakeven analysis & relevant costing, exercises on investment decisions (subcontracting, machine replacement, ...) and assessment of product profitability 11. Understanding net present value (NPV) and internal rate of return (IRR), making decisions using NPV and IRR, case based teaching using a case from Harvard Business School on IRR and NPV 12. Introduction to strategic management, Porter's five forces and Blue Ocean Strategy, casebased teaching using an INSEAD case on Blue Ocean Strategy 13. Certification on the fisheries supply chain, food market, globalGAP aquaculture

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, seminar: coached exercises. Theory lectures: lectures based on powerpoint presentations. Guided exercises: case study based exercises.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #18

1.	The name of the course/module	Aquaculture Genetics
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	This course starts with the study of the essential knowledge on genetic principles and molecular genetic techniques. In the second part attention is paid to specific methods and implications of genetic research in aquaculture.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture..

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. The student has insight into Mendelian genetics.
2. The student has basic knowledge on heritability and quantiative genetics.
3. The student has knowledge on molecular markers and their application.
4. The student has insight into breeding strategies in aquaculture (including sex reversal).
5. The student understands the importance of inbreeding and genetic drift in aquaculture.
6. The student has insight into the construction and the use of genetic maps.
7. The student is able to amplify and analyse (RFLP) a DNA fragment.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Theory
2. Fundamental knowledge on DNA structure
3. Molecular techniques for detecting genetic variation
4. Qualitative genetics
5. Quantitative genetics
6. F-statistics
7. Inbreeding
8. Use of androgenesis, gynogenesis and triploidisation
9. Manipulation of sexual phenotype
10. Breeding programmes
11. Genetic maps
12. Practical exercises
13. Handling and analysing genetic data
14. Application of molecular tools in analysis of broodstock population (paper group exercise)
15. Exercise on heritability
16. Lab exercise RFLP analyis of a mitochondrial DNA fragment

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, lecture, practicum, seminar: coached exercises. Theory lectures: lectures based on powerpoint presentations. Practical classes: RFLP experiment in small groups. Exercises: guided exercises and calculations and group work on cloning strategies.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #19		
1.	The name of the course/module	Diseases in Aquaculture
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	The aim of the course is to understand the importance of microbial, viral and parasitic diseases in aquaculture, how to enumerate micro-organisms, to convey methodologies to prevent, to cure microbial diseases and and how to handle, manipulate and sample fish.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. The student has insight into microbial morphology.
2. The student has insight into techniques to enumerate bacteria.
3. The student has knowledge on aquatic animal diseases and their causative/eliciting agents.
4. The student has insight into the pathogenesis of microbial diseases.
5. The student has insight into the importance of hygienic techniques in an aquaculture environment.
6. The student understands techniques for disease prevention, including the use of probiotics, immunostimulants and vaccines.
7. The student understands techniques for disease mitigation such as the use of antibiotics and bacteriophages.
8. The student has knowledge on handling and sampling techniques.
9. The student is able to enumerate aquaculture pathogens.
10. The student is able to determine antibiotic resistance transmission among bacterial species.
11. The student has knowledge on basic principles in epidemiology and ethical issues.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Bacterial morphology
2. Enumeration methods for bacteria (including PCR, ELISA)
3. Antibiotics and antibiotic resistance, vaccination and immunostimulants in aquaculture
4. Overview of a selection of relevant aquatic animal diseases
5. Hygiene and sanitation
6. Probiotics
7. Case studies of marine fish hatcheries, including vaccination protocols
8. Handling/sampling techniques
9. Basic principles in epidemiology and ethical issues
10. Practical lab work on bacterial antibiotics susceptibility, bacterial plasmid conjugation, quorum sensing, bacterial virulence factors. Practical work on the setup of experimental scientific research on fish diseases

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory lectures: lectures based on powerpoint presentations. Practical classes: microbiological experiments on antibiotic susceptibility, bacterial conjugation, virulence factors and quorum sensing in small groups. reflection on the setup of scientific experimental research regarding fish diseases including regulatory, practical and ethical aspects.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #20		
1.	The name of the course/module	Viral Disease Management
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	This course aims at providing a detailed overview of virology, viral diseases and their control in cultured fish and shellfish.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. The student has knowledge on general principles of virology.
2. The students has knowledge on viral immunity in fish and shellfish.
3. The student has knowledge on different viral diseases in fish and shellfish.
4. The student has knowledge on the different ways to control viral diseases in fish and shellfish.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Taxonomy
2. Virus structure
3. Replication cycle
4. Different types of viral infections (local versus general)
5. Antiviral immunity
6. Viral immunity in fish
7. Viral immunity in shellfish
8. Control of viral diseases by vaccination
9. Control of viral diseases by immunomodulators
10. Control of viral diseases by water treatment
11. Control of viral diseases by the use of SPF animals

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory lectures: lectures based on powerpoint presentations.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #21		
1.	The name of the course/module	Fish and Shellfish Immunology
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	4
6.	The total number of hours	120
7.	General description and purpose of the educational component	This course aims at providing a detailed overview on immunology of fish and shellfish.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, microbiology, basic knowledge on aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. The student possesses a broad knowledge at an advanced level in a number of basic disciplines (biology, immunology) relevant to aquaculture. 2. The student understands the processes ongoing in different forms and systems of aquatic production in relation to disease prevention. 3. The student understands the ethical issues of animal production and experimentation. 4. The student can design and implement strategies for future development in aquaculture 1wiht emphasis on prevention of infectious diseases. 5. The student is able to interact with peers, with various stakeholders in the aquaculture sector, and with a general public concerning personal research, thoughts, ideas, and research proposals, both written and orally.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
1. History of immunology 2. Antigens 3. Immune organs of fish 4. Inflammation 5. Innate immunity 6. Key cells 7. Cell based innate immune sensing fish 8. Cellular effectors in fish 9. Humoral-based immune sensing in fish 10. Cytokines and chemokines 11. MHC in fish 12. Ag presentation 13. T cell response in fish 14. Immunoglobulines of fish 15. B cell response in fish 16. Hemocytes in shellfish and tissues of their immune system 17. PRR of shellfish 18. ProPO in shellfish

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory lectures: lectures based on powerpoint presentations	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #22		
1.	The name of the course/module	Aquatic Microbial Community Management
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	The purpose of this course is to familiarize the students with the importance of the microorganisms that are present in (the different compartments of) aquaculture systems, and how these can be managed. The students will learn that by the targeted manipulation of the microbiota in aquaculture systems, the disease risk for the cultured animals can considerably be decreased and production output can be increased. At the end of this course, it is the goal that the student can assess if an aquaculture system is managed in a microbially proper way, and how this can be remedied if this should not be the case.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		

1. The student is aware of the significance of the natural microbiota in aquaculture systems. 2. The student is able to describe and discuss the microbial compartments in aquaculture systems. 3. The student knows the methods that are available to evaluate the microbial community composition. 4. The student is able to assess if the microbial status in the aquaculture system poses a potential danger for the cultured animals or not. 5. The student is able to make funded suggestions and recommendations to improve the 1microbial community composition and functionality with the aim of maximizing animal health and culture performance.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Intro: the presence of micro-organisms in aquaculture systems
1.1	Concepts, origin and prevalence
1.2	Microbial biomass vs. target biomass
1.3	Bacteria as food
1.4	Commensal bacteria vs. pathogenic bacteria
2.	Traditional management of the microbiota in aquaculture systems: antibiotics, hygienic barriers, SPF animals
3.	Sustainable management of the microbiota in aquaculture systems:
3.	Probiotics and prebiotics
3.2	Quorum sensing inhibition and quenching
3.3	r/K selection
3.3.1	flow-through
3.3.2	matured biofilters
3.3.3	recirculating aquaculture systems
3.4	Bio-floc technology
3.4.1	Concept
3.4.2	Basics of biofloc management
3.4.3	Beneficial effects on cultured animals
4.	Managing the microbiota towards functionality
4.1	Management of the microbiota based on ecological theory
4.2	Management of the microbiota towards biodiversity increase
5.	Tracking of micro-organisms in aquaculture systems
5.1	Tools: Plating, flow cytometry, DGGE, t-RFPL, next generation sequencing
5.2	Interpretation of microbial community composition data
5.3	Basics of biofloc management

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory lectures: lectures based on powerpoint presentations	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #23		
1.	The name of the course/module	Internship
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Applied Mathematics, Computer Science and Statistics
3.	Status of the educational component	Optional
4.	Semester	2/2
5.	Number of ECTS credits	5
6.	The total number of hours	125
7.	General description and purpose of the educational component	This course covers a training period of minimum 4 weeks in a workplace, other than the educational institute where the student is, or has been registered or employed in the past, and domain-related to the educational program of the student.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. The student is able to reflect critically on the experience gained. 2. The student is able to integrate and participate in the day-to-day-activities of the workplace.

3. The student is able to analyse the workplace and the activities it undertakes within its economical, managerial and strategic context. 4. The student is able to give a scientific account of the experience gained in the form of a presentation and a scientific report
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
The student will be engaged in every-day working activities at a level corresponding to their final degree. Upon completion of the internship, the student will write a report and the report will be defended for a jury. In the report, students will pay attention not only to the practical work they performed but also to managerial, economical and strategic aspects.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Work placement	Professional work, participation.

GENERAL INFORMATION ABOUT THE COURSE #24		
1.	The name of the course/module	Project
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Applied Mathematics, Computer Science and Statistics
3.	Status of the educational component	Optional
4.	Semester	2/2
5.	Number of ECTS credits	5
6.	The total number of hours	125
7.	General description and purpose of the educational component	The purpose of this course is to let the students, in small groups, independently work on an aquaculture-related theme. This theme needs to be of a multidisciplinary nature, and needs to be developed in such a way, covering apart from biological and zootechnical issues, also socioeconomical, managerial, ethical issues. The results are collected in a report and presented.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. The student is able to search relevant literature on a specific topic. 2. The student is able to understand, process and sythesize relevant literature on a specific topic. 3. The student is able to write, present and defend a scientific literature study on a specific topic. 4. The student can work in a group and organize and divide tasks. 5. The student can participate in regular feedback sessions with a supervisor to improve the preliminary work.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
Elaboration of the theme in groups of a few students. Preparation of a written report and presentation with the help of a powerpoint presentation followed by a discussion.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, group work, project.	Work with references. Period aligned evaluation: project: assessment of report, presentation and discussion.

GENERAL INFORMATION ABOUT THE COURSE #24		
1.	The name of the course/module	Programming
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Applied Mathematics, Computer Science and Statistics
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	5
6.	The total number of hours	150

7.	General description and purpose of the educational component	Researchers are often confronted with time-consuming and repetitive tasks when processing and analyzing information using computers, namely, collecting data from websites, converting files from one format into another, and analyzing, summarizing and visualizing the obtained data. The exponential flow of newly incoming information requires modern researchers to be able to automate these tasks, in order to speed up their daily routine jobs. This course teaches you how to translate these time-consuming and repetitive tasks in such a way that these can be performed automatically by the computer. The necessary programming skills for that purpose will be acquired by learning to work and think in the programming language Python.
8.	Prerequisites for studying the course/module, connection with other educational components	Some basic computer knowledge is advantageous. Prior programming skills are not required at all.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Translate a task described in natural language into a program in the Python programming language and have this program being executed by a computer in order to generate a correct result.
2. Test and debug a program.
3. Make the right choices between different alternatives when implementing a program, taking into account performance, coding style and correctness.
4. Have a working knowledge about the basis principles of object oriented programming

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Programming is the process of designing, writing, testing, debugging and maintaining the source code of computer programs. This requires knowledge of the syntax and semantics of a
programming language and the skills to write programs in that language. Additionally, and maybe most importantly, in writing computer programs one must learn how to think as a programmer. This computational thinking process, or in other words, learning the skill of problem solving by programming, is underlined throughout the whole course. The programming language Python is used in particular to solve problems in terms of

- basic components: instructions, variables, data types and operators
- control structures: conditional tasks, control loops and functions
- data structures: strings, lists, tuples, dictionaries, sets, files and modules
- object oriented programming: objects, classes, attributes, methods, inheritance,
- polymorphism and exceptions

Example programs will show that the acquired programming skills can also be applied in other
programming languages and programming contexts.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture, self-reliant study activities, seminar: practical PC room classes, online lecture, online seminar: practical PC room classes. Interactive lectures and guided hands-on sessions in a PC-room. Use of the electronic learning environment Pythia (pythia.ugent.be) for automatic evaluation of programming exercises. Interactive coaching (between students themselves or between student and lecturer) is stimulated by making use of the electronic learning environment Ufora (Ufora.ugent.be). The study handbook is highly recommended for self-study.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #25

1.	The name of the course/module	Animal Welfare, Law and Ethics
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Internal Medicine, Reproduction and Population Medicine
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	The inter-university, inter-faculty course offers all, who are interested in how we deal with animals in society, the opportunity to reflect on this and to acquire insights centred around the animal and, as such, benefit animal welfare. Attention is also given to the implications of the jurisprudence for animals. Twelve lectures are offered from various scientific disciplines that address different aspects of animal welfare, ethics and law, with opportunity for reflection and discussion. • Students acquire knowledge about the basic principles of animal welfare.

		• Students are aware of different socio-cultural approaches to dealing with animals and the reasons for this. • Students can reflect critically on how one should deal with animals. • Students know the basic principles about the legal status of the animal. • Students acquire insight into ethical reflections on our interaction with animals and are aware of different approaches to animal welfare. • Students can articulate their vision appropriately. • Students develop a critical-reflexive attitude towards how we deal with animals in society
8.	Prerequisites for studying the course/module, connection with other educational components	There is no specific prior knowledge required.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. To have insight in the scientific and ethical approach to owning and using animals (Ma 3.1,Ma 5.4).
2. To have insight in animal welfare (Ma 3.1; Ma 1.16)
3. To have insight in the legislation about animals (MA 3.1)
4. To have insight in the concepts of One Welfare (and One Health) and how these are embedded at the crossroads of welfare science, law and ethics (MA 5.4, MA 5.7).
5. To be conscious of the ethical and societal issues surrounding the keeping, using and dealing with animals, both in national and international context (Ma 3.5, Ma 5.6)
6. To have insight into the societal debate about animals and animal welfare (Ma 3.5, Ma 5.4, Ma 5.6)
7. To be able to analyse examples of dealing with animals, identifying good and bad aspects (MA 3.5).
8. To research scientific information independently, to critically synthesize and analyze it (Ma 3.2).
9. To independently and critically analyse a problem, to assess and solve it (MA 3.3).
10. To elaborate on and/or defend a line of reasoning scientifically (Ma 3.3, Ma 4.2)

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course consists of a series of 12 lezingen, each one combined with a discussion session.
How we deal with animals in our society is approached from different disciplines (welfare, law and ethics). The following themes are discussed:

1. animals as sentient beings
2. the different human-animal relations and the consequences for animal welfare
3. recent insights in the research of animal welfare for different animal groups
4. animal welfare and sustainability
5. the role of the veterinarian in monitoring animal welfare
6. attention for the welfare of pest species
7. the debate about the moral status of animals and the implication for different forms of animal
8. use
9. different approaches to animal welfare from the ethical debate
10. the legal status of the animal

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture. Each class consists of a lecture followed by an integration seminar about the same theme.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #26

1.	The name of the course/module	Coaching and Diversity
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Orthopedagogics
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	This course is optional and accessible for all University students. Students get opportunities - within a community service learning framework - to practice and expand their coaching competencies in peer-to-peer support. While looking for local/small/particular solutions for needs in fellow students at our University we try to motivate students to built bridges between research, theory building and practical solutions for diversity challenges in Higher Education.
8.	Prerequisites for studying the course/module, connection	There is no specific prior knowledge required.

	with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Students define (in dialogue with the mentee) the specific question(s) of the mentee.
2. Students are able to formulate (in dialogue and with support) a coaching trajectory.
3. Students are able to situate the variety in diversity.
4. Students can realize (with support) specific coaching activities.
5. Students are able to built a portfolio.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Situate diversity in a broad sense in our society
2. Coaching-, mentoring- and support processes and competencies

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, fieldwork, seminar. - Coaching of one or two mentees - Working around diversity, coaching and mentoring in lessons and online platform - Involvement in supervision with other mentors - Reflection on coaching and your own position as coach in assignments in an online portfolio	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #27

1.	The name of the course/module	Migration and Society: an Interdisciplinary Introduction
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Social Work and Social Pedagogy
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	5
6.	The total number of hours	150
7.	General description and purpose of the educational component	This educational component is a university-wide elective course. Migration is a highly diverse and fast changing phenomenon, with implications for all the institutions of our societies. As such, it is studied by an increasing number of disciplines, each with its own focus, questions and preferred methods. This course will give students enrolled in 3rd Bachelor and Master programs across Ghent University, a multi- and interdisciplinary introduction to migration studies. Key concepts will be explained, and important theories and authors from different disciplinary traditions will be presented. All of this is done in a critical manner, which is also accessible to students with very diverse disciplinary backgrounds.
8.	Prerequisites for studying the course/module, connection with other educational components	There is no specific prior knowledge required.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. To be able to critically follow the public and political debates related to migration, asylum, integration and discrimination
2. To be able to critically interpret the results of multidisciplinary research on international migration
3. To Integrate cultural sensitivity and respect for diversity, pluralism and tolerance in your own field of scientific study and work
4. To have insight into interactions between disciplines and into multidisciplinary issues, as applied in the case of migration
5. To be able to write a group paper on topics concerning migration, using the most recent studies and insights from the social sciences

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course is divided into two parts. In the first part, we offer a general introduction of key concepts and debates in migration studies. The lectures present the global patterns and trends of international migration; the governance and politics of migration; its legal pathways; its determinants and imaginaries; and superdiversity and integration. They draw on a broad set of disciplines - social-demography, geography, political science, law, economics, social work, educational sciences, anthropology, sociology and history, among others, but each lecture takes a specific discipline as a starting point. The main goal is that students gain a broad grasp of the field of migration studies, which enables them to explore more specific approaches and issues.
In the second part, we offer a more focused discussion of specific issues (in 2021-2022, this included discrimination and racism, language and access to public services; legal identities and age assessment; communication and representation).. These are set up as dialogues between two disciplines approaching the same issue through a different lens. The double goal

of this part is to provide a more in-depth view on current debates on migration, and to foster interdisciplinary dialogue. The specific topics will (partly) change across the years to reflect contemporary debates in the field.	
TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Introductory lectures. The first 6 lectures will each be given by one expert speaking from a specific disciplinary lens covering a broad span of concepts, theories and findings relevant to different dimensions of migration. Each lecture will try to answer a (broad) key question: Has the world become more migratory? How is migration governed? Why do people move? How are they integrated in their host societies, and how do these societies change in the process? These lectures will also showcase the contributions that different disciplines have made to achieving a holistic understanding of the multifaceted nature of migration. Topic-focused lectures The last 6 lectures will focus on specific topics and life domains impacted by migration. They will each be taught by two experts from different disciplines, engaged in an interdisciplinary dialogue. This is followed by a discussion, moderated by a group of students, on how the two perspectives may complement each other. The studentsmoderators will be able to prepare beforehand based on prior readings given by the lecturers. Group work. From week 1 students are divided into groups of 3 to 6 persons, ideally composed of students with different disciplinary backgrounds. Every group analyzes a case study, combining insights from at least two disciplines. Every group is coached by a member of the CESSMIR consortium, who can be professor, post-doc, PhD student or teaching assistant. The lecturers and coaches provide a list with possible case studies, based on input from the wider CESSMIR network. These cases consist of migration issues that can be linked to the topics discussed in the first and second part of the course, and that are realistic to be explored by empirical visits to 'he field' The coach helps to formulate an initial research question, suggests initial literature references and provides feedback. The groups are expected to work independently and contact the coach for feedback or support. The end product is a group essay. At the end of the term, the groups are expected to present their draft versions of the group essay.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #28		
1.	The name of the course/module	Co-Creation
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Industrial Systems and Product Design
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	An important goal of the university is to stimulate multi-perspectivism. Transdisciplinary research is an appropriate method to bring motivated stakeholders from different education programs and disciplines together. Transdisciplinary collaboration is such interrelated that the individual disciplines can not be distinguised. Problems are no longer solved by using elements of all disciplines but through collaboration and integration. Interaction and mix are essential parameters of transdisciplinarity
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge about methods, tools and techniques from student's own research discipline. Be open to diverse aspects of multi-perspectivism (transdisciplinarity, entrepreneurship, deontology, communication, design thinking).
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
1. Observe and control behavior in multiple context and achieve a level of repeatability by iteratively applying all steps of design thinking.		

2. Empathize and conceive real requirements of multiple stakholders: individual clients, communicties, society, natur and envrironment 3. Use complementary skills and resources of the team in an effective and creative manner. 4. Design a dialogue/interaction between all involved stakeholders. 5. Identify and use all relevant social, economic and technical aspects.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
Semester 1: 1. Overview: Focus on diverging and converging, design thinking and co-creation 2. Discover: Empathy, design for dialogue, conversation(s) 3. Define: System oriented design-thinking, design variables, causal feedback 4. Develop: User testing by (re)search, inquiries and observations 5. Deliver: reporting and interactive presentations Semester 2: 1. Overview: Focus on iterating by feedback and multi-perspectivism 2. Discover: Act ethically and sustainable (SDG) 3. Define: Value (co-)creation, value (co-)destruction at the level of user,s organisation, communities, society, nature and environments 4. Develop: stakholder testing through particiaptory design and co-creative "prototyping & capturing" methods 5. Deliver: Inspiring en engaging stakeholders through communication and conversations Lectures are given by a team of experts afrom one domain. For each subject, an introductory lecture will be given followed by a debate from all involved disciplines.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Group work, seminar.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GHENT UNIVERSITY

1	**Criterion A: University profile**	
1.1	Name of the University	**GHENT UNIVERSITY**
1.2	Classical or applied	Applied
2	**Criterion B: Profile of the educational program (Curriculum)**	
2.1	Number of Aquaculture disciplines	20
2.2	The name of the educational program	Health Management in Aquaculture
2.3	Type of diploma	Master, Double
2.4	Total number of credits (ECTS)	120
3	**Criterion C: Setting the educational program (Curriculum)**	
3.1	Duration of the program	3 years/4 semesters
3.2	The purpose of the educational program	Programme responds to the need for an expert training that prepares students to develop and implement innovative solutions to aquaculture health issues thus contributing to the sustainable development of the aquaculture industry. The programme focuses on understanding and controlling the interaction between aquaculture species and their environment, in order to produce robust and healthy animals with attention for epidemiologic, environmental and welfare regulations.
4	**Criterion D: Characteristics of the educational program (Curriculum)**	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Aquaculture. The programme offers 3 distinct learning lines, each addressing aquaculture health issues on a different level: • The relationship between the ecosystem and health • Preventing disease and maintaining adequate health, whilst minimising the impact on the environment • The relationship between animal physiology and health
5	**Criterion E: Teaching and assessment**	
5.1	Teaching and learning methods	Active learning - interactive learning methods; problem-oriented learning; the principle of binary - active direct participation of the teacher and student; away classes; learning through practice; self-study; personalized training - individual consultations; seminar; lecture; online lecture; excursion; self-reliant study activities; seminar: practical PC room classes; online seminar: practical PC room classes; group work.
5.2	Assessment	Types of assessment: summative assessment - level determination achievements of a higher education student learning outcomes; Assessment methods: practical assessment, examination assessment.
6	**Criterion F: Software competencies**	
6.1	Integral competence	1. Possess a broad knowledge at an advanced level in essential disciplines underpinning health management in aquaculture (immunology, applied microbiology, virology...) 2. Integrate knowledge of fish and shellfish (micro)-biology, immunology, genetics and (viral) diseases in the use of aquatic organisms in aquatic production systems.
6.2	General competences	1. Read, use and reference published work of others, in an appropriate manner 2. Find and critically use online information as a means of communication, and as a source of information 3. Collaborate in an interdisciplinary and international team with respect for gender and cultural diversity. 4. Continue to develop the skills necessary for self-managed and life-long learning 5. Identify and work towards targets for personal, academic and career development 6. Develop an adaptable and flexible approach to study and work 7. Use English as lingua franca in science but recognise worldwide diversity in the use of English, which will enhance her/his communication skills

		8. Be aware that other languages are used in Europe and recognise the value of cultural diversity in Europe and worldwide 9. Endorse gender equality by experiencing study and working activities 10. Identify themselves as open- minded citizens of the world.	
6.3	Professional competences	1. Design and implement strategies for innovative health management in aquaculture 2. Design a research plan in which the problem definition, hypothesis, research objectives and research questions are described in relation to relevant literature. 3. Acquire a scientific approach to formulate and test hypotheses to design research protocols, and to collect and analyse data 4. Discuss and defend their viewpoints and conclusions in a professional and academically correct way 5. Acknowledge and endorse ethical issues in science research 6. Understand the ethical issues of animal production and experimentation 7. Interact with peers, with various stakeholders in the aquaculture sector, and with the other societal stakkeholders concerning personal research, thoughts, ideas, and research proposals, both written and orally.	
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	1. Understand how infectious diseases develop and spread in populations, as well as general principles and measures to prevent the introduction and further spread of infectious agents 2. Evaluate the consequences of technological, ecological, economic and social aspects of how the environment and the ecosystem affect fish health, welfare and environmental issues from larval to adult stages of fish on marine fish farming and aquaculture. 3. Design ecologically, economically, and socially sustainable production systems of fish and other marine organisms in a global perspective in circular aquaculture systems 4. To evaluate critically with knowledge of the influences of nutrition on health and feed improvement disease resistance, which strategy needs developing to activate the immune system and use innovative tools such as generation vaccines. 5. Understand underlying processes of stress response, the innate and adaptive mechanisms of immune defences, the regulatory systems involved, infections patho-physiological responses in aquatic organisms 6. Understand how to influence physiological mechanisms and use that knowledge to develop tools improving health of fish and shellfish.	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	N/A	
8.2	Material and technical support	Aquaculture & Artemia Reference Center Blue Growth Research Lab Environmental Toxicology (GhEnToxLab)	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Principles of Marine Fish Larviculture	3	written examination
9.1.2	Diseases in Aquaculture	6	written examination, participation, report
9.1.3	Viral Disease Management	3	written examination
9.1.4	Fish and Shellfish Immunology	4	written examination
9.1.5	Aquatic Microbial Community Management	3	written examination
9.1.6	Aquaculture Genetics	6	written examination, participation, assignment, report
9.1.7	Applied Statistics	5	written examination with open questions, written examination, open book examination, skills test
9.1.8	Aquaculture in the Ecosystem	7.5	oral examination, portfolio, assignment
9.1.9	AquaHealth Club	7.5	participation, assignment, peer assessment, report
9.1.10	Internship Project	7.5	oral examination, portfolio, report
9.2	**Selective components**	**Number of credits**	**Final control form**

9.2.1	Fish Welfare and Health	7.5	oral examination, portfolio, assignment
9.2.2	Recirculating Aquaculture Systems RAS	7.5	written examination, assignment, report
9.2.3	Expert in Teams	7.5	oral examination, participation, assignment, report
9.2.4	Marine Juvenile Production	7.5	written examination, oral examination, assignment, report
	Laboratory Animal Science for Researchers	7.5	written examination, assignment
	Environmental Assessment Methods and Quality of Coastal Water	7.5	oral examination, assignment, repor
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Master's dissertation	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Principles of Marine Fish Larviculture
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	The aim of this course is to give a general overview and principles of marine fish larviculture, focusing on nutritional and zootechnical aspects. Firstly, larval nutritional requirements in general are addressed. The different aquatic invertebrates that can be used as live food are highlighted, including their natural availability, general characteristics,culture techniques and fields of application in larviculture of mainly marine fish. Also developments in the field of microdiets are explained.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. The student has general knowledge on general principles of marine fish larviculture, such as techniques used, current developments and future perspectives.
2. The student has in-depth knowledge on the nutritional aspects of marine fish larviculture: nutritional requirements; feeding behaviour; live food versus artificial diets.
3. The student has detailed knowledge on various aspects of different live food organisms (rotifers, Artemia, other zooplankton organisms) used in larviculture, such as their advantages and restrictions, availability, production techniques and fields of application.
4. The student has general knowledge on Artemia biology, ecology and taxonomy.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Introduction to marine fish species larviculture: principles, techniques, past and present successes and bottlenecks, perspectives and current developments with focus on nutrition; crucial role of live food.
2. Artemia biology, ecology and taxonomy and strain study; production of cysts and biomass; commercial aspects and quality control; Artemia applications in aquaculture.
3. Production techniques and applications of rotifers and other zooplankton organisms.
4. Larviculture of marine fish species: general feeding strategies and zootechnical aspects.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical lectures based on power point presentations and with plenary exercises, followed by discussion rounds.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #2

1.	The name of the course/module	Diseases in Aquaculture
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	The aim of the course is to understand the importance of microbial, viral and parasitic diseases in aquaculture, how to enumerate micro-organisms, to convey methodologies to prevent, to cure microbial diseases and and how to handle, manipulate and sample fish.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. The student has insight into microbial morphology.
2. The student has insight into techniques to enumerate bacteria.
3. The student has knowledge on aquatic animal diseases and their causative/eliciting agents.
4. The student has insight into the pathogenesis of microbial diseases.
5. The student has insight into the importance of hygienic techniques in an aquaculture environment.
6. The student understands techniques for disease prevention, including the use of probiotics, immunostimulants and vaccines.
7. The student understands techniques for disease mitigation such as the use of antibiotics and bacteriophages.
8. The student has knowledge on handling and sampling techniques.
9. The student is able to enumerate aquaculture pathogens.
10. The student is able to determine antibiotic resistance transmission among bacterial species.
11. The student has knowledge on basic principles in epidemiology and ethical issues.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Bacterial morphology
2. Enumeration methods for bacteria (including PCR, ELISA)
3. Antibiotics and antibiotic resistance, vaccination and immunostimulants in aquaculture
4. Overview of a selection of relevant aquatic animal diseases
5. Hygiene and sanitation
6. Probiotics
7. Case studies of marine fish hatcheries, including vaccination protocols
8. Handling/sampling techniques
9. Basic principles in epidemiology and ethical issues
10. Practical lab work on bacterial antibiotics susceptibility, bacterial plasmid conjugation, quorum sensing, bacterial virulence factors. Practical work on the setup of experimental scientific research on fish diseases

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory lectures: lectures based on powerpoint presentations. Practical classes: microbiological experiments on antibiotic susceptibility, bacterial conjugation, virulence factors and quorum sensing in small groups. reflection on the setup of scientific experimental research regarding fish diseases including regulatory, practical and ethical aspects.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #3

1.	The name of the course/module	Viral Disease Management
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	3

6.	The total number of hours	90
7.	General description and purpose of the educational component	This course aims at providing a detailed overview of virology, viral diseases and their control in cultured fish and shellfish.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. The student has knowledge on general principles of virology.
2. The students has knowledge on viral immunity in fish and shellfish.
3. The student has knowledge on different viral diseases in fish and shellfish.
4. The student has knowledge on the different ways to control viral diseases in fish and shellfish.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Taxonomy
2. Virus structure
3. Replication cycle
4. Different types of viral infections (local versus general)
5. Antiviral immunity
6. Viral immunity in fish
7. Viral immunity in shellfish
8. Control of viral diseases by vaccination
9. Control of viral diseases by immunomodulators
10. Control of viral diseases by water treatment
11. Control of viral diseases by the use of SPF animals

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory lectures: lectures based on powerpoint presentations.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #4

1.	The name of the course/module	Fish and Shellfish Immunology
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	4
6.	The total number of hours	120
7.	General description and purpose of the educational component	This course aims at providing a detailed overview on immunology of fish and shellfish.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, microbiology, basic knowledge on aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. The student possesses a broad knowledge at an advanced level in a number of basic disciplines (biology, immunology) relevant to aquaculture.
2. The student understands the processes ongoing in different forms and systems of aquatic production in relation to disease prevention.
3. The student understands the ethical issues of animal production and experimentation.
4. The student can design and implement strategies for future development in aquaculture 1wiht emphasis on prevention of infectious diseases.
5. The student is able to interact with peers, with various stakeholders in the aquaculture sector, and with a general public concerning personal research, thoughts, ideas, and research proposals, both written and orally.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. History of immunology 2. Antigens 3. Immune organs of fish 4. Inflammation 5. Innate immunity 6. Key cells 7. Cell based innate immune sensing fish 8. Cellular effectors in fish 9. Humoral-based immune sensing in fish 10. Cytokines and chemokines 11. MHC in fish 12. Ag presentation 13. T cell response in fish 14. Immunoglobulines of fish 15. B cell response in fish 16. Hemocytes in shellfish and tissues of their immune system 17. PRR of shellfish 18. ProPO in shellfish

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory lectures: lectures based on powerpoint presentations	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #5		
1.	The name of the course/module	Aquatic Microbial Community Management
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	The purpose of this course is to familiarize the students with the importance of the microorganisms that are present in (the different compartments of) aquaculture systems, and how these can be managed. The students will learn that by the targeted manipulation of the microbiota in aquaculture systems, the disease risk for the cultured animals can considerably be decreased and production output can be increased. At the end of this course, it is the goal that the student can assess if an aquaculture system is managed in a microbially proper way, and how this can be remedied if this should not be the case.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
1. The student is aware of the significance of the natural microbiota in aquaculture systems. 2. The student is able to describe and discuss the microbial compartments in aquaculture systems. 3. The student knows the methods that are available to evaluate the microbial community composition. 4. The student is able to assess if the microbial status in the aquaculture system poses a potential danger for the cultured animals or not. 5. The student is able to make funded suggestions and recommendations to improve the 1microbial community composition and functionality with the aim of maximizing animal health and culture performance.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	Intro: the presence of micro-organisms in aquaculture systems	
1.1	Concepts, origin and prevalence	
1.2	Microbial biomass vs. target biomass	
1.3	Bacteria as food	
1.4	Commensal bacteria vs. pathogenic bacteria	
2.	Traditional management of the microbiota in aquaculture systems: antibiotics, hygienic barriers, SPF animals	
3.	Sustainable management of the microbiota in aquaculture systems:	

3.	Probiotics and prebiotics
3.2	Quorum sensing inhibition and quenching
3.3	r/K selection
3.3.1	flow-through
3.3.2	matured biofilters
3.3.3	recirculating aquaculture systems
3.4	Bio-floc technology
3.4.1	Concept
3.4.2	Basics of biofloc management
3.4.3	Beneficial effects on cultured animals
4.	Managing the microbiota towards functionality
4.1	Management of the microbiota based on ecological theory
4.2	Management of the microbiota towards biodiversity increase
5.	Tracking of micro-organisms in aquaculture systems
5.1	Tools: Plating, flow cytometry, DGGE, t-RFPL, next generation sequencing
5.2	Interpretation of microbial community composition data
5.3	Basics of biofloc management

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory lectures: lectures based on powerpoint presentations	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #6		
1.	The name of the course/module	Aquaculture Genetics
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	This course starts with the study of the essential knowledge on genetic principles and molecular genetic techniques. In the second part attention is paid to specific methods and implications of genetic research in aquaculture.
8.	Prerequisites for studying the course/module, connection with other educational components	General biology, chemistry, biochemistry and basic knowledge on aquaculture..

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. The student has insight into Mendelian genetics. 2. The student has basic knowledge on heritability and quantiative genetics. 3. The student has knowledge on molecular markers and their application. 4. The student has insight into breeding strategies in aquaculture (including sex reversal). 5. The student understands the importance of inbreeding and genetic drift in aquaculture. 6. The student has insight into the construction and the use of genetic maps. 7. The student is able to amplify and analyse (RFLP) a DNA fragment.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Theory 2. Fundamental knowledge on DNA structure 3. Molecular techniques for detecting genetic variation 4. Qualitative genetics 5. Quantitative genetics 6. F-statistics 7. Inbreeding 8. Use of androgenesis, gynogenesis and triploidisation 9. Manipulation of sexual phenotype 10. Breeding programmes 11. Genetic maps 12. Practical exercises 13. Handling and analysing genetic data 14. Application of molecular tools in analysis of broodstock population (paper group exercise) 15. Exercise on heritability 16. Lab exercise RFLP analyis of a mitochondrial DNA fragment

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, lecture, practicum, seminar: coached exercises. Theory lectures: lectures based on powerpoint presentations. Practical classes: RFLP experiment in small groups. Exercises: guided exercises and calculations and group work on cloning strategies.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #7		
1.	The name of the course/module	Applied Statistics
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	5
6.	The total number of hours	150
7.	General description and purpose of the educational component	In general, the course aims to reach the following end terms: Knowledge: knowledge on basis statistical data analysis techniques Skills: the student will be able to translate a research question into a statistical problem, which he/she can solve using basic statistical methods. In particular, these methods are related to the analysis of means (e.g. t-tests, ANOVA) and regression analysis. The student will be capable of performing the data analysis, and of interpreting the results, and he/she will be able to translate these conclusions back to the context of the original research question. Emphasis is put on the exercises, most of which are on PC with statistical software. The examples and exercises are based on case studies relevant to the students' work environment. In particular, examples are selected from food science, food technology, aquaculture and environmental sciences. The practicals are organised in groups.
8.	Prerequisites for studying the course/module, connection with other educational components	A basic knowledge of calculus and probability theory (random variables, probability and distributions) is required.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. The student understands the basics of statistical data exploration and statistical inference. 2. The student can perform basic statistical data analyses using the software R. 3. The student recognises important problems in the study design/analyses and knows how these may affect the conclusions from the statistical data analysis. 4. The student can correctly report the results of a statistical data analysis in a scientific report.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Descriptive statistics (means, medians, percentiles, …) 2. Some common distributions: normal, binomial, multinomial 3. Basics of statistical inference: confidence intervals and statistical hypothesis tests 4. Statistical tests for association in contingency tables 5. Comparison of 2 means (t-test and Mann-Whitney test) 6. Comparison of k means (F-test and Kruskal-Wallis test) 7. Multiple comparison of means (Tukey, Bonferroni,..) 8. 2-way ANOVA and interaction 9. Multiple way ANOVA.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory: lectures Exercises: seminars, including practical PC room classes.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #8		
1.	The name of the course/module	Aquaculture in the Ecosystem
2.	Faculty/department	Faculty of Bioscience Engineering/Department of Animal Sciences and Aquatic Ecology
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	200
7.	General description and purpose of the educational component	This course will provide a research-based understanding of developments in sea-based aquaculture, with a focus on environmental, technological and biological challenges that need to be resolved to ensure a sustainable development of the aquaculture sector. The main focus of the course will be on the sea-based aquaculture and environmental aspects related to it. However, mussel farming, cultivation of macroalgae and integrated multitrophic aquaculture (IMTA), and the importance of these within an ecological understanding of the aquaculture will be covered.
8.	Prerequisites for studying the course/module, connection with other educational components	Competence for admission to EM AquaH study program and first semester courses at UGent. Batchelor of marine science and aquaculture for national program MSOCEAN.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. Candidates will understand ecological interactions between marine aquaculture and the marine environment, including aquaculture installations, operation of seabased farms, possible genetic interactions of fish farming, spread of parasites and the use of feed resources. 2. Candidates will gain an understanding of the principles for future sustainable aquaculture production and which bottlenecks that is critical for such development. 3. He / she should also be able to put Norwegian aquaculture into a global situation. 4. Candidates should be able to describe principles for evaluating interactions between environment and aquaculture, and understanding future trends in aquaculture. 5. Candidates should have good knowledge of comprehensive solutions for planning and operating sea-based aquaculture facilities. 6. He / she must understand the dynamics of the marine ecosystem and learning forms and activities

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
1. General marine ecology 2. Water transport models 3. Waste from fish farming 4. Genetic interactions 5. Parasite dynamics linked to fish farming 6. Spread of diseases 7. Introduction of alien species 8. Artificial reef issues 9. Coastal zone planning and new sustainable feed raw materials

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures: 30 hours, optional 1-2 days excursion, study report/semester assignment:10 days. Compulsory assignments: Approved report	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #9		
1.	The name of the course/module	AquaHealth Club
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	200
7.	General description and purpose of the educational component	The course is obligatory for all AquaH students at all partner universities. Students are awarded 7.5 ECTS after the 3rd semester upon documentation that they have attended actively >80% of the seminars and taken part as organizers of their share. AquaHealth Club is inspired by BI3062 Science Seminars, Marine which is obligatory for all MSOCEAN students at NTNU, but AquaHealth Club is a digital meeting place for EM AquaH students staying at different partners. Students will interact through Zoom .
8.	Prerequisites for studying the course/module, connection with other educational components	Competence for admission to EM AquaH study program and first semester courses at UGent.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1) After finishing AquaHealthClub, candidates will have knowledge on:
1. Recent most important published knowledge in the aquaculture health sector in their learning line
2. Main issues and challenges in aquaculture health outside their learning line.
3. Interdisciplinary challenges of aquaculture health across learning lines
4. The aquaculture private sector, activities and challenges

2). After finishing AquaHealthClub, candidates will based on their knowledge be able to:
1. Extract important results from literature, knowledge from their own but also from the other 1learning lines.
2. Take part in scientific and public discussions in the aquaculture health field
3. React convincingly to critical and other questions from the public
4. Organize and lead a scientific seminar or meeting among colleagues and aquaculture actors

3) After finishing AquaHealthClub, candidates will based on their knowledge and skills be able to:
1. Understand and reflect on aquaculture health issues in a wider marine science perspective
2. Understand and react soundly to new questions and challenges in the aquaculture health field
3. Evaluate and act to solve problems as part of multidisciplinary team
4. Analyze critically and communicate aquaculture issues beyond the health sector in a societal and public perspective

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Student presentations from important publications in their learning line. Students belonging to other study lines prepare in advance for active questioning and discussion across the student groups
2. Presentation of results from Internship projects, critical evaluations of projects and results
3. Presentations and reflections given by guest lectures or representatives from associated and external industry partners, covering broad issues of learning lines.
4. Students in the 4th semester may also voluntarily take part, and master thesis results may then be part of the seminar for the second student cohort and beyond.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, group work, lecture, integration seminar, online discussion group, seminar, self-reliant study activities, seminar: coached exercises. Learning activities will include #33 2h-seminars, one introductory in 1st semester and the remaining #32 in weekly seminars in the 2nd and 3rd semester, corresponding to 130 h workload. Besides,	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

20 lectures given by partner staff, associated partners or external partners, corresponding to 40h workload (2-3 lectures given by staff from each partner university). The students are finally supposed to review and treat around 100 scientific papers, corresponding to 30h workload. The main responsibility for reviewing papers will circulate among the students, main responsibility for ~5 papers each.	

GENERAL INFORMATION ABOUT THE COURSE #10		
1.	The name of the course/module	Internship Project
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	200
7.	General description and purpose of the educational component	All learning lines of EM AquaH include a mandatory internship within relevant sociocultural/economic and professional environments in non-academic partners/associations. This professional practice module will involve a working load of 7.5 ECTS in the learning line Health and Ecosystem at NTNU, which corresponds roughly to 200 h (alternatively is another course Internship Project Comprehensive, giving 22.5 ECTS and workload of 600h). The internship aims at acquainting the student with the real working environment through practical training, teamwork, and individual learning.
8.	Prerequisites for studying the course/module, connection with other educational components	Competence for admission to EM AquaH study program and first semester courses at Ugent.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1) After finishing the Internship project, candidates will have knowledge on:
1. How to approach and discuss project cooperation with external partners in aquaculture
2. How the health management actors in the industry might use research to obtain knowledge
3. Methods used in research in aquaculture health
4. Analyzing, synthesizing and presenting project results to partners and advisers

2)_ After finishing the Internship Project, candidates will based on their knowledge be able to
1. Propose scientific projects to help solving health problems in aquaculture.
2. Communicate with health actors and in clear words describe disorders to support expert diagnosis
3. Select methods for use in research and assessment of health state
4. Together with advisers, plan a small research project related to specific aquaculture health issue.

3) After finishing AquaHealthClub, candidates will based on their knowledge and skills be able to:
1. Better see the industry perspectives and challenge of aquaculture health managements
2. See earlier gained theoretical knowledge and skills in broader scientific and societal perspectives
3. Inspire and occasionally lead a multidisciplinary team in scientific project on aquaculture health.
4. Communicate practical challenges of aquaculture management issues beyond the health sector in a societal and public perspective

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The AquaH Program Secretariat will be responsible for collecting a list of potential internship hosts from all partners, including associate and industry partners, and students are encouraged to contact specific companies of interest to them for internships subjects. The AquaH Steering Committee will examine whether the proposed internships meet the required scientific content. An agreement will be drafted and signed by the student, the host and the AquaH Program Coordinator. The agreement will in detail explain the rights and duties of the student and the professional partner, it will describe the content of the project and the criteria for scoring the internship. Projects will be carefully planned and discussed with the student and his supervisor well before the start. Once starting, the host will foresee practical support and advice on how the internship can be practically undertaken. A high number of companies, institutes as well av associations will generate research projects and host students during their internship. These also include the associate partner universities which may can mobilize a vast network of potential hosts among research and industry partners in the Southeast Asian region.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, practicum, work placement, research project. Teaching will be through learning by doing science in interaction with external project owner and adviser from partner university	Students carry through a scientific research project with external or associated partner. At the end, the students must communicate their results and conclusions in short written report and in an oral presentation followed by questions with project owner and advisers in the university.

GENERAL INFORMATION ABOUT THE COURSE #11		
1.	The name of the course/module	Fish Welfare and Health
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Optional
4.	Semester	2/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	200
7.	General description and purpose of the educational component	Products from fish farming and other aquaculture constitute an increasing proportion of the production of food for human consumption globally. Fish farming has developed to be one of the most important export industries in Norway, and it is clearly stated from the authorities that it is a main goal to increase this production significantly. However, it is a prerequisite that the production is sustainable. This implies that the production shall not affect the marine environment, including wild fish populations, to a degree that makes significant changes to fish stocks, and farming should also be sustainable in terms of welfare, disease, mortality and losses of farmed fish.
8.	Prerequisites for studying the course/module, connection with other educational components	Competence for admission to EM AquaH study program and first semester courses at UGent. Batchelor of marine science and aquaculture for national program MSOCEAN.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. The candidate shall obtain an overview of different categories of causes of disease in farmed Fish.
2. He/she should especially be able to understand how infectious diseases develop and spread in populations, as well as general principles and measures to prevent the introduction and further spread of infectious agents.
3. The candidate should also have knowledge of important, specific infectious diseases.
4. Furthermore, the candidate should have knowledge of the importance of good welfare and methods for measuring/documenting welfare.
5. The candidate should be able to describe general principles for spread of infection and disease control of infectious diseases in farmed fish, as well as the importance of specific infectious diseases with emphasis on conditions important for preventing introduction of infectious agents.
6. The candidate should also be able to explain different methods for documenting fish welfare.
7. The candidate shall have general knowledge and understanding of fish health and fish welfare as important elements in sustainable fish farming, as well as the importance of disease control and monitoring of welfare.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Sustainability in terms of welfare, disease, mortality and losses of farmed fish
2. Specific infectious diseases of high importance
3. Infectious agents and mechanisms for spread of infection
4. Health and marine environment
5. Methods of disease control
6. Principles for biosecurity in farmed fish.
7. Manipulation and stressors of handling experienced in aquaculture
8. Methods for measuring or evaluating cultured fish stress and welfare
9. Water quality aspects.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Demonstration, group work, lecture, practicum. The course involves 24 lectures, with a high number of teachers involved, and a mandatory 30h laboratory course. The course has been intensively taught in January to March. 20 students have so far been admitted.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #12		
1.	The name of the course/module	Recirculating Aquaculture Systems RAS
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Optional
4.	Semester	2/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	200
7.	General description and purpose of the educational component	Recirculation aquaculture systems (RAS) significantly reduces water demand, increases water quality control, allows for rapid growth at year-round stable temperatures, facilitates utilization of waste, facilitates a good bacterial environment, and provides a basis for more controlled and predictable production both in freshwater and seawater. The course will provide a broad introduction to RAS and how water treatment can help to create a stable and optimal water environment in the system. Design, dimensioning, start-up, operation, waste management, resource utilization, risk assessment and action plans will be addressed. The subject will hold an interdisciplinary profile, where the technological function and the importance of biological, chemical and physical factors are seen in connection to each other. The course will cover both RAS in freshwater and seawater, for the production of smolt, postmolt, marine fry and marine ongrowing, as well as other relevant species for production in RAS in Norway. The course will also provide insight into how the needs of selected technology and treatment methods change according to the species and life stage.
8.	Prerequisites for studying the course/module, connection with other educational components	Competence for admission to EM AquaH study program and first semester courses at UGent. Batchelor of marine science and aquaculture for national program MSOCEAN.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. The student should be able to explain the most important biological needs and mechanisms that affect the growth, survival and welfare of the fish in aquaculture, especially in RAS. 2. The student should be able to list the most important water quality variables in RAS, interpret limiting values for the most important water quality variables and assess whether the water quality is acceptable for the production organism. 3. The student should be able to list the different types of water treatment required in a recycling plant. 4. The student should be able to design a simple RAS, dimension biofilter and CO_2-degasser according to a given feed load and be able to justify the selection of the order of water treatment components. 5. The student should be able to provide an overview of the available technological solutions and the principle of how the water treatment components work, critical factors for functionality and how the water treatment components affect each other. 6. More specifically, the student should be able to explain the function and effect of a drum filter, a protein skimmer, a hydrocyclone, a membrane filter, a fixed bed biofilter, a moving bed biofilter, UV disinfection, disinfection with oxidants and a CO_2-degasser. 7. The student should be able to explain how a change in pH affects CO_2 toxicity, alkalinity, ammonia toxicity, toxicity of aluminum and H_2S, as well as the effectiveness of the biofilter and CO_2-degasser. 8. The student should be able to propose a good tank design and plan for logistics through the facility in relation to the given culture organism. 9. The student should be able to give an overview of the most important factors for starting and operating a RAS. 10. The student should be able to assess where to begin looking for errors if there are any problems with the operation of a RAS. 11. The student should be able to discuss, and propose measures and action plans when water treatment components fail, when the fish shows signs of disease, and when one or more of the most important water quality variables are beyond the limiting values for the cultured organism. 12. The student should be able to list different types of sensors and measurement methods to measure the most important water quality variables in RAS. 13. The student should be able to use correct measurement methods and information to assess the need for and effect of various forms of water treatment and actions in the RAS. 14. The student should be able to decide where to measure in the RAS and be able to make a plan for measuring water quality and maintenance of sensors in a RAS. 15. The student should be able to provide an overview of how physiochemical and biological factors can threaten the health of the cultured organism in RAS. 16. The student should be able to give examples of how water treatment and design of RAS affects the microbiology of the system. 17. The student should be able to analyze and plan biosecurity into a RAS.

18. The student should be able to explain how the ammonium oxidizing and nitrite oxidizing bacteria contribute in the biofilter and how they compete with the heterotrophic bacteria. 19. The student should also be able to explain how the most important water quality variables affect these bacteria groups and the effectiveness of the biofilter. 20. The student should be able to estimate the amount and form (dissolved in water, in gasous or particulate form) of the most important waste streams resulting from a given feed amount in a RAS, and be able to suggest ways for handling or utilizing the waste streams. 21. The student should be able to discuss different alternative options for disposal and utilization of the waste streams from RAS in an economic, practical and environmental perspective. 22. The student should be able to present an example of an aquaponic system and to explain the flows of resources in the aquaponic system. 23. The student should be able to use professional terminology and communicate well with the industry that designs, builds and operates.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
The course has an interdisciplinary profile; technological function and the importance of biological, chemical and physical factors 1. RAS in freshwater and seawater 2. RAS ecosystem characteristics 3. Design, dimensioning, start-up, operation 4. Water treatment 5. Microbial management 6. Creation of stable and optimal microbial water environment 7. Technology and treatment for different species and life stages 8. Production of smolt, postmolt, marine fry and marine on-growing 9. Waste management and resource utilization

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, demonstration, excursion, lecture, lecture: plenary exercises. The course consists of lectures (44 hours), project assignment, exercises, excursion, participation in conference, a short lab demonstration and self-study. Parts of the activity will take place in two seminar weeks together with participants in a course for the industry.	Students carry through a scientific research project with external or associated partner. At the end, the students must communicate their results and conclusions in short written report and in an oral presentation followed by questions with project owner and advisers in the university.

GENERAL INFORMATION ABOUT THE COURSE #13		
1.	The name of the course/module	Expert in Teams
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Optional
4.	Semester	2/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	200
7.	General description and purpose of the educational component	In Experts in Teamwork, students develop teamwork skills by reflecting on and learning from specific situations of cooperation in carrying out a project. Students work in interdisciplinary teams with participants from diverse programmes of study. Interdisciplinary teamwork is used as an opportunity to develop collaborative skills that make teamwork more productive. Relevant problem areas from civic and working life form the basis for teamwork, and the results achieved by the teams are used to benefit internal and external partners (https://www.ntnu. edu/eit/course-description).
8.	Prerequisites for studying the course/module, connection with other educational components	Competence for admission to EM AquaH study program and first semester courses at Ugent are well acceptable. EiT is normally compulsory in all programmes of study at second-degree (master's) level at NTNU. Other students may apply for admission to EiT but must be qualified for admission to a master's programme in order to participate. Students must be able to speak the language of instruction (Norwegian or English).

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. Students have gained knowledge about group processes and are familiar with key concepts and prerequisites for good teamwork. 2. Based on experience from the team, students can describe the prerequisites for good interdisciplinary teamwork.

3. Students have insight into how their teamwork is influenced by their own behaviour patterns and attitudes, as well as those of others. 4. Students can apply their academic learning in cooperation with people from other subject areas, and jointly define problems and find solutions to them. 5. Students can apply fundamental group theory and concepts to describe their own specific collaborative situations. 6. Students can reflect on their teamwork and analyse the way that the group communicates, plans, decides, accomplishes tasks, handles disagreements and relates to professional, social and personal challenges. 7. Students can provide feedback to the individual team member and to the team as a whole and can reflect on feedback from the team. 8. Students can take initiatives (actions) that encourage cooperation, and they can contribute to changing patterns of interaction to create more productive, constructive and social collaboration in a group. 9. Students have extended their perspective on their own specialized knowledge in their encounter with skills from other disciplines. 10. They can communicate and apply skills they have developed in their own field in collaboration with students from other disciplines. 11. Students can collaborate with people from other disciplines, and they can contribute to realizing the potential of their combined interdisciplinary expertise.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
Students in EiT are divided into villages of up to 30 students, and each village is divided into interdisciplinary teams of five to six students. The language of instruction is either English or Norwegian. Each village is headed by a lecturer, called the village supervisor. In addition, two learning assistants in each village facilitate the student teams. Each village has a broad overall theme related to societal issues or working life. This theme forms the basis for the student team's project work. The village may have external partners who may serve as advisers and recipients of the students' work. The village themes are presented on the EIT website, and the desired combination of subjects in the villages is specified as a guide to help students choose a village. Students submit their preferences for five villages in order of priority by 1 November each year. To ensure interdisciplinary teams in the villages, each student is encouraged to choose at least two villages from a faculty other than the one the student comes from. Students are allocated to the villages on the basis of their preferences, the village's need for competence in various disciplines, and the number of places in the village.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, group work, lecture, project, lecture: plenary exercises. The learning method in EiT is experience-based. An important part of the learning process is the situations that arise as the team works together. Students develop skills in collaboration by reflecting on these situations throughout the project life cycle. Team members perform reflection activities together, stimulated by facilitation, writing down reflections, exercises in teamwork, and feedback. The EiT staff create the professional foundation for facilitation, which is carried out by the village supervisor and learning assistants. Teaching consists of both teacher- and student-led activities. At the beginning, activities are arranged to introduce the students to each other. The village theme is presented to the students, who draw up a cooperation agreement in the team. The student team prepares a proposal for their project based on the village theme and the individual student's academic competence and interests. After approval by the village supervisor, the student team works with the project throughout the semester (or the intensive period, not relevant for AquaH students). The student team is responsible for following up the cooperation agreement and for revising it if necessary. The members of the student team are facilitated while they work. Facilitation involves being observed and receiving feedback on the interaction in the team. Students write both personal reflections and team reflections. Reflections initiated by facilitation and writing of reflections provide the basis for understanding how the individual member's actions influence the teamwork. The team must initiate actions that increase its awareness of its teamwork, and take action to improve its teamwork if necessary. What is meant by actions is defined in the assessment criteria. The effect of the actions must be evaluated. Semester-based villages: Attendance each Wednesday throughout the semester (time: 08:00- 16:00).	Students carry through a scientific research project with external or associated partner. At the end, the students must communicate their results and conclusions in short written report and in an oral presentation followed by questions with project owner and advisers in the university.

GENERAL INFORMATION ABOUT THE COURSE #14

1.	The name of the course/module	Marine Juvenile Production
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Optional
4.	Semester	2/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	200
7.	General description and purpose of the educational component	The course is focusing upon growth and functional development of different types of fish larvae, and fish will be compared with other animal groups. The importance of nutritional and environmental conditions are viewed in relation to larval adaptation and sensitivity to environmental factors in nature and in cultivation. The course has a special focus upon marine pelagic fish larval development, and how biological and rearing conditions may determine the further growth and functional development. The course will also focus upon cultivation of microalgae and zoo-plankton used as food for the early stages of marine fish larva. Emphasis is given to the physiology and growth kinetics of different species, and also to cultivating techniques (production). The course includes practical exercises in cultivation of microalgae, zooplankton and marine fish larvae.
8.	Prerequisites for studying the course/module, connection with other educational components	Competence for admission to EM AquaH study program and first semester courses at UGent.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. The candidate should know:
how fish reproduction startegies and spawning biology affect the offsprings developmental pattern, viability and environmental adaptation
Comparative functional development in fish, from fertilisation to adult stage
Environmental and nutritional requirements in fish larvae, using marine peleagic fish larvae as model organisms
Cultivation methods and basic biology for microalgae and zooplankton species.
2. Assess basic environmental requirements and ecological niche of fish embryos/larvae based on the fish spawning biology and morphological traits of the offspring
3. Identify critical stages and factors for cultivation of early life stages of fish, and estimate possible effects from environmental variations
4. Design cultivation regimes for fish larvae and live feed organisms based on water quality control and the larval nutritional and environmental requirements
5. Evaluate feed quality, growth and functional development of larvae during experimental or commercial rearing conditions
6 . General competence (attitudes): - a solid understanding of how cultivation conditions may affect the characteristics of live feed organisms - a good understanding of the plasticity of marine fish larval development - a good understanding of how environmental conditions (water quality, nutritional quality, feeding strategies, etc) may affect development, growth, and juvenile production both in captive, controlled systems and in nature.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Culture of marine fish larvae, different species
2. Growth and functional development of fish larvae
3. Nutritional and environmental conditions
4. Effects of reproductive strategies and spawning biology on embryonic development and early
5. life stages
6. Larval sensitivity to environmental factors
7. Effects of rearing conditions on functional development.
8. Cultivation of microalga
9. Cultivating techniques of live food zooplankton for fish larvae
10. Physiology and growth kinetics of live food species
11. Practical exercises in cultivation of microalgae, zooplankton and marine fish larvae in
12. cultivation of microalgae, zooplankton and marine fish larvae

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Demonstration, lecture, practicum, project. The course involves 20 lectures, a comprehensive obligatory laboratory exercise lasts for 7-10 days (not full time). Students prepare a laboratory report field work, an aim of course teaching is learning by doing.	Students carry through a scientific research project with external or associated partner. At the end, the students must communicate their results and conclusions in short written report and in an oral presentation followed by questions with project owner and advisers in the university.

GENERAL INFORMATION ABOUT THE COURSE #15

1.	The name of the course/module	Aquaculture in the Ecosystem
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	200
7.	General description and purpose of the educational component	This course will provide a research-based understanding of developments in sea-based aquaculture, with a focus on environmental, technological and biological challenges that need to be resolved to ensure a sustainable development of the aquaculture sector. The main focus of the course will be on the sea-based aquaculture and environmental aspects related to it. However, mussel farming, cultivation of macroalgae and integrated multitrophic aquaculture (IMTA), and the importance of these within an ecological understanding of the aquaculture will be covered.
8.	Prerequisites for studying the course/module, connection with other educational components	Competence for admission to EM AquaH study program and first semester courses at UGent. Batchelor of marine science and aquaculture for national program MSOCEAN.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Candidates will understand ecological interactions between marine aquaculture and the marine environment, including aquaculture installations, operation of seabased farms, possible genetic interactions of fish farming, spread of parasites and the use of feed resources.
2. Candidates will gain an understanding of the principles for future sustainable aquaculture production and which bottlenecks that is critical for such development.
3. He / she should also be able to put Norwegian aquaculture into a global situation.
4. Candidates should be able to describe principles for evaluating interactions between environment and aquaculture, and understanding future trends in aquaculture.
5. Candidates should have good knowledge of comprehensive solutions for planning and operating sea-based aquaculture facilities.
6. He / she must understand the dynamics of the marine ecosystem and learning forms and activities

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course will treat the challenges of the growth of the aquaculture sector, general marine ecology, water transport models, waste from fish farming, genetic interactions, parasite dynamics linked to fish farming, spread of diseases, introduction of alien species, artificial reef
issues, coastal zone planning and new sustainable feed raw materials.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures: 30 hours, optional 1-2 days excursion, study report/semester assignment:10 days. Compulsory assignments: Approved report. Learning materials include optional costs for excursion. PowerPoint lectures and other materials are made available for free on the web.	Students carry through a scientific research project with external or associated partner. At the end, the students must communicate their results and conclusions in short written report and in an oral presentation followed by questions with project owner and advisers in the university.

GENERAL INFORMATION ABOUT THE COURSE #16

1.	The name of the course/module	AquaHealth Club
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	200
7.	General description and purpose of the educational component	The course is obligatory for all AquaH students at all partner universities. Students are awarded 7.5 ECTS after the 3rd semester upon documentation that they have attended actively >80% of the seminars and taken part as organizers of their share. AquaHealth Club is inspired by BI3062 Science Seminars, Marine which is obligatory for all MSOCEAN students at NTNU, but AquaHealth Club is a digital meeting place for EM AquaH students staying at different partners. Students will interact through Zoom.

8.	Prerequisites for studying the course/module, connection with other educational components	Competence for admission to EM AquaH study program and first semester courses at Ugent.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1) After finishing AquaHealthClub, candidates will have knowledge on:
1 Recent most important published knowledge in the aquaculture health sector in their learning line
2 Main issues and challenges in aquaculture health outside their learning line.
3 Interdisciplinary challenges of aquaculture health across learning lines
4 The aquaculture private sector, activities and challenges
2) After finishing AquaHealthClub, candidates will based on their knowledge be able to:
1 Extract important results from literature, knowledge from their own but also from the other learning lines
2 Take part in scientific and public discussions in the aquaculture health field
3 React convincingly to critical and other questions from the public
4 Organize and lead a scientific seminar or meeting among colleagues and aquaculture actors
3 After finishing AquaHealthClub, candidates will based on their knowledge and skills be able to:
1 Understand and reflect on aquaculture health issues in a wider marine science perspective
2 Understand and react soundly to new questions and challenges in the aquaculture health field
3 Evaluate and act to solve problems as part of multidisciplinary team
4 Analyze critically and communicate aquaculture issues beyond the health sector in a societal and public perspective

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The seminars may for example include:
1. Student presentations from important publications in their learning line. Students belonging to other study lines prepare in advance for active questioning and discussion across the student groups
2. Presentation of results from Internship projects, critical evaluations of projects and results
3. Presentations and reflections given by guest lectures or representatives from associated and external industry partners, covering broad issues of learning lines.
4. Students in the 4th semester may also voluntarily take part, and master thesis results may
5. then be part of the seminar for the second student cohort and beyond.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, group work, lecture, integration seminar, online discussion group, seminar, self-reliant study activities, seminar: coached exercises. Learning activities will include #33 2h-seminars, one introductory in 1st semester and the remaining #32 in weekly seminars in the 2nd and 3rd semester, corresponding to 130 h workload. Besides, 20 lectures given by partner staff, associated partners or external partners, corresponding to 40h workload (2-3 lectures given by staff from each partner university). The students are finally supposed to review and treat around 100 scientific papers, corresponding to 30h workload. The main responsibility for reviewing papers will circulate among the students, main responsibility for ~5 papers each.	There is a requirement of active participation in at least 80% of the seminars to be admitted 7.5 ECTS in the end of the 3rd semester. Participation will be monitored by respective university partners. The course will accordingly have a Portfolio assessment with grades: Passed/Failed depending on active participation. Assignment include preparations and reporting from seminars, shared among the students, ca 5 per student.

GENERAL INFORMATION ABOUT THE COURSE #17

1.	The name of the course/module	Internship Project
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	200
7.	General description and purpose of the educational component	All learning lines of EM AquaH include a mandatory internship within relevant sociocultural/economic and professional environments in non-academic partners/associations. This professional practice module will involve a working load of 7.5 ECTS in the learning line Health and Ecosystem at NTNU, which corresponds roughly to 200 h (alternatively is another course Internship Project Comprehensive, giving 22.5 ECTS and workload of 600h). The internship aims at acquainting the

		student with the real working environment through practical training, teamwork, and individual learning.
8.	Prerequisites for studying the course/module, connection with other educational components	Competence for admission to EM AquaH study program and first semester courses at Ugent.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1) After finishing the Internship project, candidates will have knowledge on:
1 How to approach and discuss project cooperation with external partners in aquaculture
2 How the health management actors in the industry might use research to obtain knowledge
3 Methods used in research in aquaculture health
4 Analyzing, synthesizing and presenting project results to partners and advisers
2) After finishing the Internship Project, candidates will based on their knowledge be able to
1 Propose scientific projects to help solving health problems in aquaculture.
2 Communicate with health actors and in clear words describe disorders to support expert diagnosis
3 Select methods for use in research and assessment of health state
4 Together with advisers, plan a small research project related to specific aquaculture healthissue.
3) After finishing AquaHealthClub, candidates will based on their knowledge and skills be able to:
1 Better see the industry perspectives and challenge of aquaculture health managements
2 See earlier gained theoretical knowledge and skills in broader scientific and societal perspectives
3 Inspire and occasionally lead a multidisciplinary team in scientific project on aquaculture health.
4 Communicate practical challenges of aquaculture management issues beyond the health sector in a societal and public perspective

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. The AquaH Program Secretariat will be responsible for collecting a list of potential internship hosts from all partners, including associate and industry partners, and students are encouraged to contact specific companies of interest to them for internships subjects. The AquaH Steering Committee will examine whether the proposed internships meet the required scientific content.
2. An agreement will be drafted and signed by the student, the host and the AquaH Program Coordinator. The agreement will in detail explain the rights and duties of the student and the professional partner, it will describe the content of the project and the criteria for scoring the internship. Projects will be carefully planned and discussed with the student and his supervisor well before the start. Once starting, the host will foresee practical support and advice on how the internship can be practically undertaken.
3. A high number of companies, institutes as well av associations will generate research projects and host students during their internship. These also include the associate partner universities which may can mobilize a vast network of potential hosts among research and industry partners in the Southeast Asian region.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, practicum, work placement, research project. Teaching will be through learning by doing science in interaction with external project owner and adviser from partner university,	Students carry through a scientific research project with external or associated partner. At the end, the students must communicate their results and conclusions in short written report and in an oral presentation followed by questions with project owner and advisers in the university.

GENERAL INFORMATION ABOUT THE COURSE #18

1.	The name of the course/module	Laboratory Animal Science for Researchers
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	200
7.	General description and purpose of the educational component	Laboratory animal science (LAS) is a multidiciplinary branch of science. The main aim of this course is to ensure ethical and humane handling of experimental animals and the collection of informative, objective and reproducible research data from animal experiments. The course is divided into one general section and two special sections. All students must complete the general section. In the special sections, the students can choose between traditional laboratory animals (rodents, pigs) or fish/aquatic organisms. Course participants should select their specialization on the basis of the animals they will work with after the course.
8.	Prerequisites for studying the course/module, connection	Competence for admission to EM AquaH study program and first semester courses at UGent. Batchelor of marine science and aquaculture for national program MSOCEAN.

	with other educational components	Faculty of Medicine and Health Science require basic knowledge in anatomy and physiology, competence in statistics, knowledge about literature searches on the internet and in libraries, fulfilled by AquaH students.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1) The student should specifically be able to:
1. Identify and describe the national and European legislation which regulate the scientific use of animals
2. Describe the authorisation that is needed before acting as a user, breeder or supplier of laboratory animals and especially the authorisation required for projects
3. Indicate who bears primary responsibility for the animals undergoing procedures
4. Describe the differing views within society concerning the scientific use of animals
5. Identify ethical and animal welfare issues in their own work
6. Demonstrate a comprehensive understanding of the principle of the 3Rs, list examples of how the 3Rs can be implemented in research projects and list sources of information related to the 3Rs
7. Describe the severity classification system and give examples of each category
8. Describe the basic biology of the relevant animal species, including basic anatomy, physiology, reproduction and behaviour; and recognise the importance of attending to biological and behavioural needs
9. Describe the importance of providing an enriched environment to laboratory animals and give examples of environmental enrichment that is appropriate to the species
10. Describe the environmental factors of importance for maintaining an appropriate health status for the animals, and how a laboratory animal facility is organized to maintain an appropriate health status and welfare of animals
11. Describe the biological consequences of acclimatization, habituation and training
12. Describe how genetically altered animals can be used for scientific research and the importance of monitoring such animals very carefully
13. List potential human health hazards associated with contact with laboratory animals and describe how these can be prevented or reduced
14. Describe abnormal behaviour and signs of discomfort, pain, suffering or distress
15. Discuss methods available for assessing animal welfare
16. Describe the principle of implementing early humane endpoints and how this implementation can influence animal health and welfare during the course of an experiment
17. Define the term "humane killing" and list appropriate euthanasia methods for the relevant animal species
18. Recognise that the choice of a euthanasia method may influence the scientific outcome
19. Describe appropriate methods and principles for handling animals, and describe common techniques / procedures, including administration and sampling techniques
20. Describe where to find relevant and up-to-date information about refinement of animal experiments
21. List the different types of formal experimental designs
22. Identify the experimental unit
23. Describe the variables affecting significance, including the meaning of statistical power and the "p-value"
24. Describe how to monitor the microbiological health of laboratory animals
25. Describe the terms sedation, local anesthesia and general anesthesia
26. Describe the components of pain physiology and list the types of analgesic drugs that are effective at the different components
27. Define the term "Balanced anesthesia" and indicate methods to achieve this
28. Describe how to do pre-operative, intraoperative and post-operative evaluation of research animals
29. Describe different methods to optimize post anesthetic recovery
30. Indicate some of the problems associated with pain recognition and pain management inanimals

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

General part:
Topics in this section will include national and international legislation, design and statistics, public administration and the course of events, ethics, 3Rs and attitudes in society, humane endpoints, severity classification, humane killing, health hazards.
Part for Fish and aquatic animals specialization:
Topics in this section will include legislation concerning fish, experimental conditions, stress, biorythms and acclimatization, pain and suffering, anesthesia, handling, surgical procedures and euthanasia, aggression and hierarchy formation, health monitoring and microbiological qualities, genetically modified fish.
The part covering traditional laboratory animals is not relevant for AquaH.
The course will cover the following topics:
1. Legislation;
2. Ethics, animal welfare, and 3R;
3. Different views in the society;
4. Species specific biology of laboratory animals;
5. Management of laboratory animals;
6. Microbiological qualities;
7. Genetically modified animal models;
8. Environmental factors that may influence animal experiments;
9. Health hazards;
10. Assessment of pain and humane endpoints;
11. Severity classification;
12. Humane killing of animals,

13. Public administration and the course of events in animal experiments; 14. Design and statistics; 15. Principles of minimally invasive procedures on animals; 16. Anesthesia and analgesia for minor and long-lasting procedures; 17. Basic surgery

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture. The theoretical teaching will happen partly as self-studies using e-based learning tools with tests and assignments, and partly as auditorium lectures. The general part will consist of e-based learning tools using course material that will be made available in Blackboard. There will be tests and other assignments to each course module. Completion of tests and assignments is mandatory. The deadline will be given around the start of the course. Persons who will work with fish or aquatic animals will need to have their practical training supervised by persons with appropriate and up-to-date competence within the species and the techniques that the students will use in their future research. Practical training must be documented. Mandatory lectures are required for fish specialization.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics. The exam includes a written exam (home or normal) and an assignment. If the written exam is evaluated as "failed", the written exam must be repeated. If the home exam is evaluated as "failed" a new home exam must be submitted

GENERAL INFORMATION ABOUT THE COURSE #19		
1.	The name of the course/module	Environmental Assessment Methods and Quality of Coastal Water
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	200
7.	General description and purpose of the educational component	The course introduces a selection of key scientific methods for environmental and resourceoriented scientific studies of marine ecosystems, with an emphasis on surface seawater (open waters) studies. Such studies often aim to establish knowledge on the ecological and chemical state of the ecosystem based on measurements of physical, chemical and biological environmental variables. These are requirements set by EU environmental legislation; the Water Framework Directive. The course introduces how such investigations can be conducted and reported. Emphasis is placed on both theoretical knowledge, hands-on experience with methods, compiling results into a report where assessment of environmental sustainability has a focus.
8.	Prerequisites for studying the course/module, connection with other educational components	Competence for admission to EM AquaH study program and first semester courses at UGent. Batchelor of marine science and aquaculture for national program MSOCEAN.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1) After completing the course, the candidate should have: 1. Detailed scientific knowledge of, and "hands-on" experience with, methods for investigating ecological and chemical state of marine ecosystems, including environmental sustainability related to human activity in coastal waters 2. Comprehensive knowledge of the scientific and legal basis for environmental and resource1 oriented studies of marine ecosystems in marine surface waters and be familiar with how such studies are conducted and reported in a scientific format 3. Have a scientific methodological foundation as a basis, and be able to expand this to answer new questions in the field, including questions about the impact and sustainability of the coastal zone benthic ecosystem 4. Be familiar with past and recent development of relevant methodology in the subject area, and based on this, be able to analyze new issues related to the marine environment and resources area 5. Based on methodological knowledge, be able to critically evaluate different sources of information on new relevant methods that can be used in the assessments/studies of surface water ecosystem, but also of other ecosystems such as the benthic

6. Analyze and evaluate the scientific relevance and suitability of various methods for specific investigations of environmental and resource issues in coastal waters, among these newer digital methods that generate large datasets 7. Use new and established methods to independently determine ecological and chemical states as well as potential influences on environmental sustainability in coastal waters affected by human activity 8. Participate in research project and under supervision be able to carry out an independent part of the work and report the results in a scientific format 9. Have an active relationship to relevant issues within the scientific basis of the field and with ethical issues of research, especially aimed to marine environmental issues related to sustainability 10. Apply their knowledge and skills to carry out advanced projects and other tasks in their field, including tasks relevant to other marine ecosystems 11. Master written and oral scientific rhetorics as a basis for dissemination and other communication 12. Communicate academic issues and important conclusions within their methodical subject area with professional experts, colleagues and with the public 13. Contribute to new concepts and methodology for mapping the environment and resources in marine sites, with a special focus on future digitized environmental surveying and monitoring
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
1. International environmental legislation 2. Importance of scientific basis in management versus the precautionary principle 3. Water Framework Directive (WFD) 4. Ecological and chemical states, as questioned in the WFD, ecosystem health 5. Ecosystem's ability to assimilate biogenic (non-toxic) emissions, their carrying capacity 6. Environmental footprint of salmon production 7. Mechanisms for understanding algae blooms 8. Spreading of microorganisms 9. Field and laboratory work in assessment study 10. Analytical methods for water quality assessment. 11. Report worked out in scientific format

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Guided self-study, demonstration, group work, lecture, practicum, project, fieldwork. The course involves 24 lectures, off which 10 is given by external lecturers, one day of method demonstration, 3 days of field work followed up by analytical work and paper writing, with a learning by doing profile.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #19		
1.	The name of the course/module	Environmental Assessment Methods and Quality of Coastal Water
2.	Faculty/department	Faculty of Economics and Business Administration/Department of Data Analysis and Mathematical Modelling
3.	Status of the educational component	Mandatory
4.	Semester	2/2
5.	Number of ECTS credits	30
6.	The total number of hours	900
7.	General description and purpose of the educational component	The master dissertation is an integration course that forms the final part of the master's program in which the scientific final competences are applied to the programme-specific knowledge competences. Students can choose the topic for their master's dissertation (thesis) in a broad range of disciplines in which the scientific staff of the master programs is active. In general, the students become involved in ongoing research within the research laboratories of their promoter(s). They can however also propose their own research topic. Students have to conduct research with the appropriate expertise in order to contribute to the development of a particular research domain. The ultimate goal is to initiate students into research at an academic level so that, upon completion of their master program, they are able to carry out scientific research in a proper way. For some programs, specific requirements will be mentioned in the practical procedure.
8.	Prerequisites for studying the course/module, connection with other educational components	A thorough scientific basic knowledge and knowledge of research techniques in the field of the master program.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		

1. Establish a well-defined research problem 2. Formulate clear research questions and/or hypotheses 3. Establish a suitable methodology in accordance with the prevailing scientific standards of the research field 4. Systematically collect, search, critically interpret and integrate scientific literature 5. Collect data in an accurate way (existing and/or obtained through personal laboratory and/or fieldwork and/or surveys) 6. Process data in a correct way 7. Analyze data critically in a scientific context 8. Adjust independently the research process based on feedback from experts and critical self1 assessment 9. Summarize and present data in a concise manner 10. Write a report on scientific and technical information, materials and methods, results and findings 11. Handle a problem critically, creatively, quantitatively with attention for ethical, social, international and sustainability aspects 12. Act according to the principles and good practices of scientific integrity 13. Show independence, motivation, commitment, a drive for innovativeness and creativity, initiative and perseverance to achieve learning outcomes 1 to 12 14. Present, defend and frame the research results vis-à-vis peers and experts
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
The master's dissertation is a written report of the scientific research the student has conducted. This manuscript contains the following items, similar to the structure of a scientific publication: 1. preface 2. table of contents 3. list of abbreviations 4. abstract 5. introduction 6. relevant literature: should contain only what is necessary to understand the work, with a 7. focus on a critical synthesis 8. materials and methods: trivial and well known methods should not be explained in detail 9. results: raw data can be delivered in an electronic format 10. discussion 11. general conclusions 12. recommendations for further research 13. list of references 14. appendices (only in an electronic format) More information about the practical procedure for the master's dissertation and about the properties, rights and duties of those involved in the master's dissertation can be found on the website of the faculty.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Master's dissertation.	The master's dissertation is actively coached by the promoter(s) and tutor(s) during counseling meetings, during which the work as well as the ongoing learning process involved are reviewed.

WAGENINGEN UNIVERSITY AND RESEARCH

1	Criterion A: University profile	
1.1	Name of the University	**WAGENINGEN UNIVERSITY AND RESEARCH**
1.2	Classical or applied	Applied
2	Criterion B: Profile of the educational program (Curriculum)	
2.1	Number of Aquaculture disciplines	18
2.2	The name of the educational program	Aquaculture and Marine Resource Management: Aquaculture
2.3	Type of diploma	Master
2.4	Total number of credits (ECTS)	120
3	Criterion C: Setting the educational program (Curriculum)	
3.1	Duration of the program	4 semesters
3.2	The purpose of the educational program	The task of the master's program is to train specialists in Aquaculture and Marine Resource Management to specialize in aquaculture for further production and processing of aquatic bioresource products. This field deals with the culture of numerous aquatic organisms (such as finfish, shrimp, shellfish, ornamental fish, corrals, sponges and algae) in a wide range of culture environment (from sea enclosures to semi-extensive ponds and high-tech recirculation systems). It requires a thorough knowledge and skills to maintain the biological, physical and chemical integrity of water bodies and insight in economic and social driving factors. In this specialisation you will learn to design optimal and sustainable production systems of for example finfish, shrimp, shellfish, corals and algae. These organisms can be cultured in many environments: from sea enclosures to semi-extensive ponds and high-tech recirculation systems. You will learn to maintain the biological, physical and chemical integrity of water bodies. Moreover, you will learn about animal physiology and economic and social driving factors of aquaculture.
4	Criterion D: Characteristics of the educational program (Curriculum)	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Marine Biology
5	Criterion E: Teaching and assessment	
5.1	Teaching and learning methods	Active learning - interactive learning methods; problem-oriented learning; the principle of binary - active direct participation of the teacher and student; away classes; learning through practice; self-study; personalized training - individual consultations; seminar; lecture; online lecture; excursion; self-reliant study activities; seminar: practical PC room classes; online seminar: practical PC room classes; group work.
5.2	Assessment	Assessment methods: practical assessment, examination assessment.
6	Criterion F: Software competencies	
6.1	Integral competence	1. - reflect upon personal knowledge, skills, attitudes and functioning, both individually and in discussions with others and design and plan their own study path.
6.2	General competences	1. analyse critically the social dynamics of the utilisation of marine resources, and the conservation and restoration of marine ecosystems; 2. - evaluate different stakeholder positions, including the role of the expert and reflect upon cross-disciplinary views on marine ecosystem and aquatic production issues;
6.3	Professional competences	1. analyse the physiology, ecology and management of aquatic organisms and marine ecosystems; 2. - analyse critically the ethical and societal consequences of production of aquatic organisms and use of marine ecosystems, define dilemmas and design possible solutions;
7	Criterion G: Program Learning Outcomes	

7.1	Program learning outcomes	1. design a research plan in which the problem definition, hypothesis, research objectives and research questions are described in relation to relevant literature; 2. apply appropriate research methods and techniques, including gathering new information and integrating this in existing theories in order to test the scientific hypotheses by gathering new information and by integrating this in existing theories; 3. co-operate in an interdisciplinary and international team to perform project-based work; 4. communicate clearly (verbally and in writing) about the results of project and research work with specialists and non-specialists considering the nature of the target group; 5. - to design optimal and sustainable production of fish and other marine organisms in a global perspective.	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	N/A	
8.2	Material and technical support	N/A	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Marine Systems	6	Examination
9.1.2	Life History of Aquatic Organisms	6	Examination
9.1.3	Environmental Quality and Governance	6	Examination
9.1.4	Modular Skills Training	3	Examination
9.1.5	Academic Consultancy Training	9	Examination
9.1.6	European Workshop Environmental Sciences and Management	12	Examination
9.1.7	Research Master Cluster for Animal Sciences	12	Examination
9.1.8	Laboratory Animal Science: Design and Ethics in Animal Experimentation	3	Examination
9.1.9	MSc Thesis Aquaculture and Fisheries	24	Thesis
9.1.10	MSc Internship Aquaculture and Fisheries	24	Raport
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Aquaculture Production Systems	6	Examination
9.2.2	Separation Process Design	6	Examination
9.2.3	Advanced Statistics	6	Examination
9.2.4	Nutrition, Welfare and Reproduction in Aquaculture	6	Examination
9.2.5.	Microalgae Biotechnology	3	Examination
9.2.6	Building with Nature: Ecosystem Engineering for Coastal Protection and Aquatic Production	3	Examination
9.2.7	Academic Argumentation Skills in Writing and Debate	1.5	Credit
9.2.8	Management Skills	1.5	Credit
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Master’s thesis	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
9.	The name of the course/module	Marine Systems
10.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
11.	Status of the educational component	Mandatory
12.	Semester	1/1
13.	Number of ECTS credits	6
14.	The total number of hours	180

15.	General description and purpose of the educational component	The lectures deal with the principles of (marine) ecology and the governance of marine systems. The core element of the course is a case study, done by groups of four students and dealing with prominent issues in the management of marine systems all over the world.
16.	Prerequisites for studying the course/module, connection with other educational components	Ocean and Coastal Governance; Aquaculture and Fisheries; Introduction Marine and Estuarine Ecology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to be able to:
- demonstrate insight in the principles of marine and coastal ecosystems, including:
a.- the principal physical, chemical, biological processes
b.- the functioning of marine systems and their response to changes
c.- the economic, social and political forces affecting marine systems;
- integrate and apply obtained knowledge by analysing a particular marine issue;
- apply sampling techniques commonly used in sea research;
- present the results to a critical audience;
- discuss a scientific concept in their role as a critical scientist;
- apply academic and communicative skills and experience what skills should be improved.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. Nature;
2. Fisheries;
3. Shellfish aquaculture;
4. Recreation;
5. Urbanisation;
6. Transport and energy.

The course includes training of academic and communication skills. An essential part of the course is a weekend on the island of Texel (10-14 September 2013) including a boat trip on the North Sea and the Wadden Sea with limited capacity. As this course serves as an entrance course for the MSc Aquaculture and Marine Resource Management, students of this programme are given priority; the same is true for students for the specialization Marine Biology in the MSc Biology.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- attending lectures: - active participation in a group assignment and field work; - report writing and presentation of a poster.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #2

1	The name of the course/module	Life History of Aquatic Organisms
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	The course Life History of Aquatic Organisms deals with the biology and ecology of aquatic organisms, with an emphasis on life history theory. The focus in the course lies with animal species, especially those which are important for fisheries, aquaculture and nature conservation.
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge on the principles of organismal biology and ecology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to be able to:
1. analyse and integrate the different aspects of the life histories of aquatic organisms in relation to physical, chemical and biological characteristics of their aquatic biota;
2. identify and measure the main freshwater zooplankton groups and extract relevant data for life-history comparisons;
3. analyse and evaluate food-web related scientific viewpoints;
4. explain and apply the concepts of adaptation, constraint and trade-off;
5. analyse the evolutionary background and concepts of adaptation, niche differentiation and adaptive radiation using eco-morphological principles;

6. perform morphological measurements and dissection on fishes and mollusks supporting eco-morphological analysis; 7. analyse the different patterns and scales of swimming and migration, using a cost - benefit model; 8. design, perform and analyse simple laboratory experiments, including the application of basic statistics; 9. - explain the main reproductive strategies in aquatic organisms, including the mechanisms of sex change and how these can be used in aquaculture.	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
A wide array of subjects is treated, from the organism (reproduction, feeding, homeostasis, migration, habitat use), the population (population ecology) and the community level (fish communities), as well as a large variety of aquatic systems and diverse organism groups. To understand the life history of organisms, i.e. to comprehend why they are like they are and why they behave like they do, evolution is the leading principle. Evolutionary mechanisms can explain how organisms have adapted to certain environmental circumstances, but also that not all structures and behaviours are necessarily adaptive, or the best possible solution. From the perspective of the life history of organisms there are three concepts that are leading in this course: 1) adaptation, which is a phenotypic change in a species, caused by environmental pressures, leading towards better fitness; 2) constraint, which means that adaptations and patterns of traits in a species are restricted by the phylogeny (evolutionary history) of the species; and 3) trade-off, which is an (evolutionary) compromise in the structure, physiology, or behaviour of a species. Trade-offs occur when the development of several traits is coupled, prohibiting the independent optimization of all these traits.	
TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- follow lectures; - perform exercises in tutorials and practicals; - study course book.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #3		
1	The name of the course/module	Environmental Quality and Governance
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	Environmental quality is fundamental to the healthy functioning of ecosystems which in turn support human cultural, social and economic activities. To estimate and reduce the risk of poor environmental quality, policy makers require a sound technical understanding of biological and physico-chemical processes, as well as the social, administrative and economic forces determining the use of the environment. This course enables students to explore the possible role of science in the public policy process by bringing together key concepts in environmental toxicology, water quality, public administration, and environmental governance.
8.	Prerequisites for studying the course/module, connection with other educational components	As students participating in this course can have a background in ecology, policy making and environmental sociology or environmental toxicology and water quality, no specific knowledge is assumed. We do assume, however, that you are very eager to learn more about the 'other' fields of science in the knowledge that this is vital for everyone aspiring to a future in environmental management.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
On completion of the course you should be able to: 1. explain the basic principles and indicators of environmental quality and appraise their application in environmental risk assessment; 2. evaluate a range of toxicological and water quality research methods and analyse the uncertainty scientists and policy makers face when using the results of environmental risk assessments; 3. use social science concepts such as risk society and uncertainty to explain and assess the role of public and private actors in negotiations over environmental policy; 4. - critically analyse the formulation of policy goals, as well as technical and political strategies for engaging public and private sector actors to improve environmental quality.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		

In the first half of the course you will become acquainted with technical skills required to gathering, processing and interpreting data on environmental toxicology and water quality, as well as relevant social science theories on the relationship between science and politics in the public policy process. In the second half of the course you will participate in a policy simulation in which you must generate, interpret and present scientific data needed to estimate and reduce the risk associated with poor environmental quality. The course caters for students with a background in either natural or social sciences by providing a unique opportunity to integrate both perspectives into practical environmental research and policy.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
1. the course will consist of 12 lectures in which key concepts in each discipline will be introduced; 2. students will then have an opportunity to develop practical skills in toxicology and water quality assessment; 3. a policy game or simulation will provide students with a chance to put skills and theories into practice; 4. students will be asked to hand in an individual major paper in which they will reflect on the linkages between the theory introduced in the lectures and their experiences in the simulation; 5. - finally there will be an exam to test the basic knowledge and understanding gathered during the course.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics. Students will be assessed on tasks set through the simulation and practicals, and a final exam designed test the basic knowledge and understanding gathered during the course. The breakdown of marks is as follows: practicals and related assignments (30%), simulation participation and related assignments (30%), and a final exam (40%). All assessments will be marked out of 10 and to pass the course you must get at least 5.5 on each of the tasks.

GENERAL INFORMATION ABOUT THE COURSE #4		
1	The name of the course/module	Academic Argumentation Skills in Writing and Debate
2.	Faculty/department	Faculty of Plant Sciences and Social Sciences/ Department of Plant Sciences and Social Sciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	1.5
6.	The total number of hours	45
7.	General description and purpose of the educational component	Are you thinking of a career in science? Maybe doing a Research Master or a PhD? And do you wonder how you can best get your scientific messages across to a scientific audience? Or even a public audience? In Academic Argumentation Skills, you learn how to improve your scientific writing using knowledge about the nature of argumentation.
8.	Prerequisites for studying the course/module, connection with other educational components	Does not require additional or special knowledge.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
After following this course, students will be able to effectively structure their argumentation when writing a scientific paper, abstract and/or a research proposal. Students are expected to learn and understand the philosophical basis of argumentation in science, and adjust a scientific message to both scientific and public audiences.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
The course also addresses the philosophical basics about what is science, what constitutes a good argument, and how argumentation is used in scientific writing.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Learning activities include writing, analysing and structuring scientific abstracts, improving argumentation of current writing projects, literature study, lectures and scientific discussion and debate.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #5		
1	The name of the course/module	Management Skills
2.	Faculty/department	Faculty of Plant Sciences and Social Sciences/ Department of Plant Sciences and Social Sciences

3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	1.5
6.	The total number of hours	45
7.	General description and purpose of the educational component	The course focuses on enhancing students understanding and application of management skills.
8.	Prerequisites for studying the course/module, connection with other educational components	Does not require additional or special knowledge.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to:
1. be able to understand and analyse a range of management roles and competencies needed in different management contexts;
2. have trained various management skills such as bringing bad news, self-presentation, meeting skills, time management, leading a job interview, conflict management;
3. have gained insights and are able to reflect on own management competencies, strengths and challenges;
4. - have designed an action plan for becoming a manager.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course starts with presenting and interactively discussing various roles, and competencies relevant nowadays when being a manager, taking into account different management contexts. Then, students are trained in a number of management skills. Those include: self-presentation skills, meeting skills, bringing bad news, time management, leading a job interview and conflict management. Through theatre acts and role-plays the practice of management roles and skills is further deepened, taking into account personal strengths and challenges. Students are finally engaged with the development of an action plan to develop their management skills.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- lectures; - awareness building exercises; - training of skills; - theatre role plays; - writing an action plan.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #6

1	The name of the course/module	Academic Consultancy Training
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	9
6.	The total number of hours	270
7.	General description and purpose of the educational component	The course is, only on request of the study adviser. Teams students are assigned a project. These consultancy teams are composed on the basis of required disciplinary mix for the execution of the project and the interests students have expressed in an application letter to the course coordinator. In their application letter students indicate what their disciplinary knowledge will add to the execution of the project. Each team has an assigned process coach and is required to find at least one content coach/expert relevant to the project.
8.	Prerequisites for studying the course/module, connection with other educational components	Before starting an ACT the student should have successfully completed at least 24 credits of MSc-level courses or a first MSc-thesis. Furthermore the student should master Information literacy, computer literacy and presentation skills on minimally the level of the MOS-modules; English verbal and writing skills should minimally be on a level which allows self-reflection and feedback and full independent functioning in a student team.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After this course students are expected to be able to:
1. determine, with a team and in interaction with a client, the goals of a project and formulate tasks and a project plan on the basis of their disciplinary knowledge and general academic skills and attitude;
2. adjust, with their team and in interaction with the client, the formulated project goals and plan when and if necessary;

3. defend and sell their viewpoints and conclusions in a professional and representative way and academically correct; 4. contribute at an academic level to the execution of an interdisciplinary project both in terms of process and content related to their own disciplinary training by gathering, selecting and analysing information and integrating this into project deliverables; 5. implement reflective learning by an assessment of their personal functioning in and contribution to a professional team and reflection on this in writing and during an assessment interview; 6. - assess the contribution of other team members and other stakeholders on team functioning and execution of project tasks and appropriately reflect on these and give feedback in writing and verbally.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
The multidisciplinary and preferably multicultural team will carry out a design type project for a client. This may be design of new technologies, but also policy papers, business plans, communication plans or draft research plans for integrated research programmes. Crucial is that teams reach an interdisciplinary synthesis of the compiled information and translate this into an advice on future actions for their client.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- Team meetings: During the course, teams have formal meetings, which the process coach attends regularly. With the assistance of the coach students regularly reflect on the functioning of the team and of individual members. - Assigned team functions: Prior to starting, the students will be assigned functions with a clear task description: team manager, secretary, financial controller, member. - Meetings with commissioner: Students organize and prepare meetings with the commissioner. During at least one the coach will be present as observer. - Work plan: Teams prepare a project plan, a first concept is discussed with a project planning expert. Work plans should at least address the mission/vision of the group, the planning chart, the stakeholder analysis, go/no-go decisions and involved risks. The plan is further assessed by the client and a content coach/expert before a final plan is made. When needed, the group will negotiate with the client in order to meet client wishes, on condition academic standards and project limitations are respected. During project execution the group checks the work-plan and negotiates adjustments when and if needed. - Project execution: During project execution a certain division of tasks is needed, yet the group should not start to work as a task group, with only one or two persons working on the integration of elements. Interdisciplinarity requires that all members actively work on synthesis and participate in the formulation of the final product and recommendations to the client. - Project deliverables: All groups deliver an oral presentation, in English, to their commissioner, peers and coaches involved in the ACT. Further deliverables for each project are defined in the work-plan in interaction with the commissioner and the content and process coach. - Individual assignments: Students compile a (self) assessment dossier. This includes the: application letter, expectation paper, reflection forms, mid-term reflection paper and final reflection paper. During the starting, mid-term and final interviews the coaches give feedback on the dossier. Elements of this dossier are discussed during group meetings. - Additional skills training: Lectures are given on theory of project planning and the preparation of a work plan. Training sessions are organized for a revision of the theory on communication, group dynamics and self-reflection and for team building exercises and training on multicultural communication.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics. All parts: written self-assessment, project proposal, product, team process and individual process.

GENERAL INFORMATION ABOUT THE COURSE #7		
1.	The name of the course/module	European Workshop Environmental Sciences and Management
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences

3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	12
6.	The total number of hours	360
7.	General description and purpose of the educational component	In this course a group of 30 students of different nationalities and disciplinary background work together on an environmental problem commissioned by a client.
8.	Prerequisites for studying the course/module, connection with other educational components	Before starting an ACT the student should have successfully completed at least 24 credits of MSc-level courses or a first MSc-thesis. Furthermore the student should master Information literacy, computer literacy and presentation skills on minimally the level of the MOS-modules; English verbal and writing skills should minimally be on a level which allows self-reflection and feedback and full independent functioning in a student team..

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to be able to:
1. apply their academic knowledge and general academic skills and attitude to a project dealing with a complex problem commissioned by a client outside the university;
2. design solutions for an environmental issue by analysing it, using theory and methods in the field of environmental sciences and environmental management;
3. work as part of a multi-disciplinary and -cultural team and value the contribution of different perspectives in designing solutions for complex (environmental) problems;
4. develop a project management plan (including a data generation plan), execute it and adjust it if circumstances make it necessary;
5. reflect on aspects that are of importance for successfully executing a project, like project management, decision making in a complex situation, team roles and team building;
6. reflect on their own functioning and contribution to the execution of a project in terms of disciplinary knowledge, academic skills, group dynamics, intercultural setting;
7. - communicate their findings orally or in writing to the client, in a manner that is consistent with the client's needs and level of knowledge.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course consists of three phases. In the preparation period students apply their knowledge of environmental sciences and management to make a project plan based on the Terms of Reference received from the client. In this period an applied training in project management, data collection & interview techniques, and team work is offered. A few lectures are given that provide students with additional background information to tackle the issue. The second phase consists of two weeks of field work mainly dedicated to data collection on site. At the end of this phase the preliminary results will be presented to the client. Finally students are expected to analyse the data, incorporate the feedback from the client and write a concise report for the client. In this final phase supporting lectures on data analysis and consultancy report writing are given as well as feedback on the draft reports. Every student is expected to contribute his / her own knowledge and expertise to the group assignment and to reflect on this.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The main task is to prepare and execute a project for a real client in an interdisciplinary and intercultural team and contribute to a report for this client. Lecturers, seminars and training sessions are included to support the group project. A two-week field work period dedicated to data collection on site is part of the workshop. Students are expected to participate in the above mentioned activities and perform several group- and individual assignments.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #8

1.	The name of the course/module	Research Master Cluster for Animal Sciences
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	12
6.	The total number of hours	360

7.	General description and purpose of the educational component	Acquire professional skills in writing a scientific research proposal in the domain of Animal Sciences.
8.	Prerequisites for studying the course/module, connection with other educational components	A BSc giving admittance to one of the Wageningen MSc programs, as well as approval of your study advisor that you follow the research variant within your MSc.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. have gained knowledge and professional skills in designing a project in the Animal Sciences domain;
2. are able to collect relevant information in your field, identify existing gaps in knowledge and translate them into research objectives;
3. - are able to write and defend a PhD-research proposal.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Not available

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- acquire professional skills related to scientific writing, project planning, management and presentation. - write your own PhD-proposal under supervision of a staff member. - interact with your fellow students in discussion groups. - the final project proposal is assessed by two PhD's (in their final year) and one of the lecturers; - the rebuttal to this assessment and the final presentation for a scientific jury are assessed by the jury and the lecturers; - the final product in combination with the process contribution are marked by the lecturers; - the final grading is worked out individually based on these assessments.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #9

1	The name of the course/module	Laboratory Animal Science: Design and Ethics in Animal Experimentation
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	The LAS course entails scientific, ethical and practical aspects of animal experimentation. The main purpose of the course is to enhance a positive attitude towards animal needs and well-being.
8.	Prerequisites for studying the course/module, connection with other educational components	Human and Animal Biology, Human and Animal Biology, Vertebrate Structure and Function.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The participant has a critical and analytical attitude towards the scientific knowledge underlying Laboratory Animal Science related activities. The participant demonstrates the ability to assess her/his scientifically based knowledge and skills. From a participant, who successfully passed the course, one can expect that he/she:
1. is familiar with legislation concerning the use of laboratory animals;
2. knows about basic principles, which guide towards the ethical judgment of animal experiments;
3. knows about the possibilities and limitations of alternative techniques;
4. has knowledge of the requirements of laboratory animals with respect to housing, nutrition and care;
5. possesses the necessary knowledge for responsible animal handling and also obtained some practical experience in this respect;
6. has taken note of the different methods for the collection of body fluids;
7. has taken note of a number of other frequently used experimental techniques (amongst others cannulation, insertion of catheters);
8. possesses the knowledge to recognize pain as well as discomfort in laboratory animals and to define humane end points;
9. has knowledge of the most important methods of anesthesia, analgesia and euthanasia, which can be used in various laboratory animal species;
10. has knowledge of the possible impact of environmental and procedural factors on experimental results;
11. has knowledge of the importance of hygienic measures and barrier systems;

12. has knowledge of the impact of diseases in laboratory animals on the experimental approach and knows about possible health monitoring; 13. knows about the specific demands that are necessary for a correct preparation and performance of animal experimental techniques and research; 14. - knows the possibilities that statistics can offer to optimize the use of laboratory animals.	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
Not available	
TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- compulsory participation to lectures and practical class; - active participation to project learning and literature study.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #10		
1	The name of the course/module	Aquaculture Production Systems
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	This course deals with the relation between aquatic organisms (algae, fish, crustaceans, molluscs) and their environment, the latter comprising the direct production space and the wider environment in which farms operate.
8.	Prerequisites for studying the course/module, connection with other educational components	Aquaculture and Fisheries, Life History of Aquatic Organisms.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
After successful completion of this course students are expected to be able to: 1. integrate insights in biological, physical and chemical processes occurring in water into the design of sustainable aquaculture production units, while considering input needs and environmental impacts; 2. apply and control the main biological processes affecting water quality in aquatic ecosystems; 3. calculate the carrying capacity for any type of aquaculture production unit, considering productivity, animal health and wellbeing, and optimize the management of the unit accordingly; 4. -design and operate outdoor and indoor recirculating aquaculture systems; 5. -make nutrient mass balances of aquaculture production systems, and integrate them with other aquatic or terrestrial farming activities as part of integrated farming systems; 6. - apply the principles governing management of aquaculture production systems to the maintenance, design or restoration of natural or man-made aquatic ecosystems.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
The main aspects of aquaculture systems (extensive and intensive) are addressed considering effluents, water quality management, husbandry (e.g. stocking density, feeding strategies) and overall farm design. A lot of attention is given to biological water quality control though photo- and heterotrophic processes in natural waters or in purpose-build reactors. The focus is on how farm system components and management options determine farming success and sustainability. During the course, the students build and operate recirculating aquaculture production systems, relying on different types of bioreactors. The contribution of each bioreactor to the nutrient balance in systems is analyzed, and compared with other bioreactors. This knowledge is applied in the design of a fish farm, including effluent control and management, and dealing with both intensive and extensive types of farming.		
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)		Study methods (what types of educational activities should be performed by the student independently)
- follow lectures; - perform practical exercises with recirculation systems containing fish; - calculate designs of production systems.		Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #11		
1	The name of the course/module	Separation Process Design

2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	This course teaches you how to design such separation units based on transport kinetics; it extends the theory which uses only equilibria.
8.	Prerequisites for studying the course/module, connection with other educational components	Bioprocess Engineering Basics; General Chemistry; Mathematics.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to be able to:
1. identify the rate-affecting phenomena in separators discussed in the course;
2. identify the degrees of freedom in the design of a separator and explain their effect;
3. set up the balance equations required for the design of a separator and solve them;
4. evaluate the consequences of design choices, also in combinations of separators;
5. - optimize the operation of a separator, given some criterion.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

You will learn how to derive the algebraic equations or ordinary differential equations needed for the design from force, mass and energy balances, and how to use them to calculate the required size, the allowed feeding rate or the possible product recovery efficiency of a separator. Some attention is also paid to design of coupled process units. This course is part of a series of process engineering courses, so skills and knowledge from 1st-year mathematics and physical chemistry courses.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- attend lectures; - study the syllabus and work on assignments (tutorials); - do experiments; - analyse and discuss the outcome.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #12

1	The name of the course/module	Advanced Statistics
2.	Faculty/department	Faculty of Plant Sciences and Social Sciences/ Department of Plant Sciences and Social Sciences
3.	Status of the educational component	Optional
4.	Semester	1/2
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	The purpose of the course is to reveal the basics of statistical analysis and mathematical modeling.
8.	Prerequisites for studying the course/module, connection with other educational components	The student should be familiar with 1) The principles of probability calculus and the subjects: estimation, construction of confidence intervals and hypothesis testing from statistical inference 2) Application of these principles to inference about central values (mean or success probability) for the 1-sample and 2-sample situations, in case of Normal observations and binary (0,1) observations 3) Methods of analysis for simple (one explanatory variable) linear regression.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After the course the student should (within the limits of the subjects treated) be able to:
1. translate a research question into a statistical hypothesis: make a plan (type of design or sampling procedure) for the data collection.
2. choose an appropriate model with an understanding of the ingredients of the model in relation to the data;
3. analyse the data (with SPSS);
4. - interpret the results and form conclusions relevant for the actual problem.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Brief overview of (a) the principles of inference and (b) inference about means in the 1- and 2-sample situation, including non-parametric procedures. Choosing the sample size required to obtain a given precision in the 1- and 2-sample situations. Multiple linear regression: 1) model formulation and meaning of model parameters and 2) inference on (a) a single parameter (b) a linear combination of model parameters (c) several model parameters simultaneously (d) checking model assumptions (e) prediction. Factorial designs: completely randomized design for 1 and 2 factors, block designs. One-way and two-way analysis of variance: additive and interaction models, (overparametrization) , F-tests for interaction and/or main effects, t-tests for one mean or a difference of two means, multiple comparisons. Analysis of covariance and use of a model with a quantitative and a qualitative factor. Inference (notably Chi-Square tests) for (count) data summarized in a contingency table.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- lectures: follow classes; - study the book and make exercises; - computer practical's (compulsory): (learn how to) use SPSS and PQRS, work on case studies.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #13		
1	The name of the course/module	Nutrition, Welfare and Reproduction in Aquaculture
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	This course deals with the aspects and mechanisms at the organism level and organ level, with the focus on the first. In the course the various disciplines (e.g., breeding, nutrition, husbandry etc.) will be dealt with in an integrative approach. The focus of this course is on the juvenile and adult (brood stock) life stage of fish (only minor attention is given on the larval stage).
8.	Prerequisites for studying the course/module, connection with other educational components	Aquaculture and Fisheries; Life History of Aquatic Organisms.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
After successful completion of this course students are expected to be able to: 1. describe, explain and generalise how major factors, like nutrition, water quality, husbandry and animal related aspect, influence the performance (growth, feed intake, efficiency, mortally and disease occurrence); 2. explain, illustrate how, and integrate the role and mechanisms by which nutrition (composition [e.g., energy, protein and carbohydrate content], physical properties, etc.) interact with energy metabolism, protein metabolism, feed intake regulation and waste production; 3. demonstrate the principle of formulating fish diets, have knowledge and skills in measuring physical pellet quality, chyme characteristics and gut histology and morphology; 4. explain, illustrate and describe the concept of vitality and welfare in aquatic organisms by integrating knowledge on fish behaviour, stress physiology, osmoregulation and endocrine control; 5. assess fish welfare aspects by performing behavioural observation and measuring blood stress parameters; 6. describe, explain and generalize the endocrinology of reproduction and factors influencing sex determination, sex differentiation and semen preservation in fish; 7. - summarise and present orally a scientific research article and to formulate a generalized concept of factors involved on specific topics being dealt with in case-studies on the basis of 3 to 4 articles.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
Students need to understand how fish grow, reproduce, and stay healthy (incl. welfare aspects) using basic nutritional, physiological, immunological, endocrinological and genetic knowledge and to integrate the various disciplines. Key aspects are bio-energetics, phenotypic plasticity and adaptive capacity. Issues that will be addressed in the course are: metabolic aspects of fish nutrition; impact of anti-nutritional factors on gut health/physiology (limitations/consequences of fishmeal replacement); feed intake regulation mechanisms; endocrinological aspects of reproduction and brood stock management; sex differentiation; stress physiology and fish behaviour in relation to fish welfare.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

- follow lectures; - perform practical exercises; - perform computer exercises.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #14		
1	The name of the course/module	Microalgae Biotechnology
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	This combined with the use sunlight as their sole energy source, makes that they are often seen as the most promising candidates for sustainable production of biofuels.
8.	Prerequisites for studying the course/module, connection with other educational components	Separation Process Design.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to be able to:

1. present an overview of the possible applications of microalgae and cyanobacteria;
2. analyze photoautotrophic microalgae growth and product accumulation based on simplified mathematical models;
3. calculate light penetration in microalgae cultures based on a simplified mathematical model;
4. calculate productivity of microalgae cultures in photobioreactors based on the models derived;
5. present an overview of state-of-the-art microalgae photobioreactors, and explain their design, based on the concepts of light dilution and light integration;
6. culture microalgae in fully controlled lab-scale photobioreactors;
7. - design, execute and evaluate experiments to induce and maximize product formation in microalgae.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The use of sunlight, however, imposes specific demands on the bioreactors (i.e. photobioreactors) and cultivation protocols. This course aims at a simple mathematical description of microalgae growth in photobioreactors and the accumulation of specific products. Combined with a simplified model for light penetration, the productivity of photobioreactors is analyzed and can be calculated. In addition, the design and operation of photobioreactors is discussed. Finally, you will cultivate microalgae under fully controlled conditions in lab-scale photobioreactors and induce the production of a specific product.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Following lectures and studying lecture notes and course theory. Practicing example calculations and performing a computer case study based on Excel (spreadsheet). Practical experimentation, including planning, data analysis, reporting and presentation.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics. Theory lectures: lectures based on powerpoint presentations and videos.

GENERAL INFORMATION ABOUT THE COURSE #15		
1	The name of the course/module	Building with Nature: Ecosystem Engineering for Coastal Protection and Aquatic Production
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	The course includes an in depth part focusing on the implementation and use of bivalve reefs for coastal protection and aquatic production in the Netherlands. This part of the course includes a case study and monitoring activities at an oyster reef in the field.

8.	Prerequisites for studying the course/module, connection with other educational components	Marine Systems.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to be able to:

1. describe the principles of the Building with Nature concept for sustainable coastal intervention based on ecosystem engineering in combination with aquaculture (i.e. restoration, protection, production);
2. describe the ecological role and societal importance of ecosystem engineers in a global perspective;
3. apply the concept of ecosystem services as a tool to describe the value of ecosystems for nature and society;
4. develop conceptual Building with Nature designs by acquiring and integrating information on physical processes, biogeomorphological processes, ecological processes and biological production processes;
5. analyse and describe the economic and governance aspects (cost-benefit analysis, risk assessment, legislation, stakeholder involvement) of a Building with Nature design;
6. carry out first-order detailing of conceptual designs (e.g. application of simple design rules, order of magnitude analysis, feasibility check, assessment of ecological and societal effects);
7. - compare Building with Nature designs with traditional coastal protection and aquaculture schemes.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course covers the following topics:

1. introduction to the concepts of building with nature;
2. ecological engineering - formation of biogenic reefs: conditions for settlement and development of mussel beds, oyster reefs and coral reefs;
3. goods and services of eco-engineers to the ecosystem and to society; synergies of eco-engineering and aquatic production;
4. the design of coastal protection using biogenic reefs in combination with other measures for coastal defence and maintaining tidal flats (e.g. nourishments);
5. coastal processes: hydro-, morpho- and ecodynamics; and their interaction;
6. effect of biogenic reefs on the environment (hydromorphological effects: impact on currents/waves, sedimentological effects: impact on erosion/stabilization, and ecological effects: impact on (surrounding) benthic invertebrates;
7. coastal management - economic and governance aspects;
8. - building with nature: a global perspective.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
A series of lectures and tutorials will prepare for three individual assignments and one group assignment. The students will execute desktop studies, which include working with basic physical models that describe coastal processes. Project work plays a dominant role in the examination. Small groups of students (4 students) cooperate on one case study during the course. A field practical including a stakeholder meeting are integrated in this group project.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

WAGENINGEN UNIVERSITY AND RESEARCH

1	Criterion A: University profile	
1.1	Name of the University	**WAGENINGEN UNIVERSITY AND RESEARCH**
1.2	Classical or applied	Applied
2	Criterion B: Profile of the educational program (Curriculum)	
2.1	Number of Aquaculture disciplines	18
2.2	The name of the educational program	Aquaculture and Marine Resource Management: Marine Resources and Ecology
2.3	Type of diploma	Master
2.4	Total number of credits (ECTS)	120
3	Criterion C: Setting the educational program (Curriculum)	
3.1	Duration of the program	4 semesters
3.2	The purpose of the educational program	The task of the master's program is to train specialists in Aquaculture and Marine Resource Management to specialize in aquaculture for further production and processing of aquatic bioresource products. This field deals with the culture of numerous aquatic organisms (such as finfish, shrimp, shellfish, ornamental fish, corrals, sponges and algae) in a wide range of culture environment (from sea enclosures to semi-extensive ponds and high-tech recirculation systems). It requires a thorough knowledge and skills to maintain the biological, physical and chemical integrity of water bodies and insight in economic and social driving factors. This specialisation focuses on the sensitivity of marine ecosystems in relation to human interventions like fisheries, climate change and habitat destruction. You will learn about ecology, models of population dynamics and fishing yield, international regulations, management tools and economic driving forces in order to sustainably manage the living resources in the sea.
4	Criterion D: Characteristics of the educational program (Curriculum)	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Marine Biology
5	Criterion E: Teaching and assessment	
5.1	Teaching and learning methods	Active learning - interactive learning methods; problem-oriented learning; the principle of binary - active direct participation of the teacher and student; away classes; learning through practice; self-study; personalized training - individual consultations; seminar; lecture; online lecture; excursion; self-reliant study activities; seminar: practical PC room classes; online seminar: practical PC room classes; group work.
5.2	Assessment	Assessment methods: practical assessment, examination assessment.
6	Criterion F: Software competencies	
6.1	Integral competence	2. - reflect upon personal knowledge, skills, attitudes and functioning, both individually and in discussions with others and design and plan their own study path.
6.2	General competences	3. analyse critically the social dynamics of the utilisation of marine resources, and the conservation and restoration of marine ecosystems; 4. - evaluate different stakeholder positions, including the role of the expert and reflect upon cross-disciplinary views on marine ecosystem and aquatic production issues;
6.3	Professional competences	3. analyse the physiology, ecology and management of aquatic organisms and marine ecosystems; 4. - analyse critically the ethical and societal consequences of production of aquatic organisms and use of marine ecosystems, define dilemmas and design possible solutions;

7	Criterion G: Program Learning Outcomes	
7.1	Program learning outcomes	6. design a research plan in which the problem definition, hypothesis, research objectives and research questions are described in relation to relevant literature; 7. apply appropriate research methods and techniques, including gathering new information and integrating this in existing theories in order to test the scientific hypotheses by gathering new information and by integrating this in existing theories; 8. co-operate in an interdisciplinary and international team to perform project-based work; 9. communicate clearly (verbally and in writing) about the results of project and research work with specialists and non-specialists considering the nature of the target group; 10. - to evaluate limiting factors in order to be able to contribute to an improved biodiversity, environmental quality and sustainability of marine ecosystems.
8	Criterion H: Resource support for the implementation of the educational program (Curriculum)	
8.1	Staff support	N/A
8.2	Material and technical support	N/A

9	Criterion I: List of components of the educational program and their logic sequence		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Marine Systems	6	Examination
9.1.2	Life History of Aquatic Organisms	6	Examination
9.1.3	Environmental Quality and Governance	6	Examination
9.1.4	Modular Skills Training	3	Examination
9.1.5	Academic Consultancy Training	9	Examination
9.1.6	European Workshop Environmental Sciences and Management	12	Examination
9.1.7	Research Master Cluster for Animal Sciences	12	Examination
9.1.8	Laboratory Animal Science: Design and Ethics in Animal Experimentation	3	Examination
9.1.9	MSc Aquatic Ecology and Water Quality Management	24	Thesis
9.1.10	MSc Internship Aquatic Ecology and Water Quality Management	24	Raport
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Marine Resources Management	6	Examination
9.2.2	Fisheries Ecology	6	Examination
9.2.3	Advanced Statistics	6	Examination
9.2.4	Ecology: Classics and Trends	6	Examination
9.2.5.	Water Quality	6	Examination
9.2.6	Environmental Toxicology	3	Examination
9.2.7	Academic Argumentation Skills in Writing and Debate	1.5	Credit
9.2.8	Management Skills	1.5	Credit
10	Criterion L: Form of attestation		
10.1	Requirements for	Master's thesis	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Marine Systems
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	The lectures deal with the principles of (marine) ecology and the governance of marine systems. The core element of the course is a case study, done by groups of four

		students and dealing with prominent issues in the management of marine systems all over the world.
8.	Prerequisites for studying the course/module, connection with other educational components	Ocean and Coastal Governance; Aquaculture and Fisheries; Introduction Marine and Estuarine Ecology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to be able to:
- demonstrate insight in the principles of marine and coastal ecosystems, including:
a.- the principal physical, chemical, biological processes
b.- the functioning of marine systems and their response to changes
c.- the economic, social and political forces affecting marine systems;
- integrate and apply obtained knowledge by analysing a particular marine issue;
- apply sampling techniques commonly used in sea research;
- present the results to a critical audience;
- discuss a scientific concept in their role as a critical scientist;
- apply academic and communicative skills and experience what skills should be improved.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

7. Nature;
8. Fisheries;
9. Shellfish aquaculture;
10. Recreation;
11. Urbanisation;
12. Transport and energy.

The course includes training of academic and communication skills. An essential part of the course is a weekend on the island of Texel (10-14 September 2013) including a boat trip on the North Sea and the Wadden Sea with limited capacity. As this course serves as an entrance course for the MSc Aquaculture and Marine Resource Management, students of this programme are given priority; the same is true for students for the specialization Marine Biology in the MSc Biology.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- attending lectures: - active participation in a group assignment and field work; - report writing and presentation of a poster.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #2

1	The name of the course/module	Life History of Aquatic Organisms
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	The course Life History of Aquatic Organisms deals with the biology and ecology of aquatic organisms, with an emphasis on life history theory. The focus in the course lies with animal species, especially those which are important for fisheries, aquaculture and nature conservation.
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge on the principles of organismal biology and ecology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to be able to:
1. analyse and integrate the different aspects of the life histories of aquatic organisms in relation to physical, chemical and biological characteristics of their aquatic biota;
2. identify and measure the main freshwater zooplankton groups and extract relevant data for life-history comparisons;
3. analyse and evaluate food-web related scientific viewpoints;
4. explain and apply the concepts of adaptation, constraint and trade-off;
5. analyse the evolutionary background and concepts of adaptation, niche differentiation and adaptive radiation using eco-morphological principles;
6. perform morphological measurements and dissection on fishes and mollusks supporting eco-morphological analysis;
7. analyse the different patterns and scales of swimming and migration, using a cost - benefit model;

8. design, perform and analyse simple laboratory experiments, including the application of basic statistics; 9. - explain the main reproductive strategies in aquatic organisms, including the mechanisms of sex change and how these can be used in aquaculture.	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
A wide array of subjects is treated, from the organism (reproduction, feeding, homeostasis, migration, habitat use), the population (population ecology) and the community level (fish communities), as well as a large variety of aquatic systems and diverse organism groups. To understand the life history of organisms, i.e. to comprehend why they are like they are and why they behave like they do, evolution is the leading principle. Evolutionary mechanisms can explain how organisms have adapted to certain environmental circumstances, but also that not all structures and behaviours are necessarily adaptive, or the best possible solution. From the perspective of the life history of organisms there are three concepts that are leading in this course: 1) adaptation, which is a phenotypic change in a species, caused by environmental pressures, leading towards better fitness; 2) constraint, which means that adaptations and patterns of traits in a species are restricted by the phylogeny (evolutionary history) of the species; and 3) trade-off, which is an (evolutionary) compromise in the structure, physiology, or behaviour of a species. Trade-offs occur when the development of several traits is coupled, prohibiting the independent optimization of all these traits.	
TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- follow lectures; - perform exercises in tutorials and practicals; - study course book.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #3		
1	The name of the course/module	Environmental Quality and Governance
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	Environmental quality is fundamental to the healthy functioning of ecosystems which in turn support human cultural, social and economic activities. To estimate and reduce the risk of poor environmental quality, policy makers require a sound technical understanding of biological and physico-chemical processes, as well as the social, administrative and economic forces determining the use of the environment. This course enables students to explore the possible role of science in the public policy process by bringing together key concepts in environmental toxicology, water quality, public administration, and environmental governance.
8.	Prerequisites for studying the course/module, connection with other educational components	As students participating in this course can have a background in ecology, policy making and environmental sociology or environmental toxicology and water quality, no specific knowledge is assumed. We do assume, however, that you are very eager to learn more about the 'other' fields of science in the knowledge that this is vital for everyone aspiring to a future in environmental management.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
On completion of the course you should be able to: 1. explain the basic principles and indicators of environmental quality and appraise their application in environmental risk assessment; 2. evaluate a range of toxicological and water quality research methods and analyse the uncertainty scientists and policy makers face when using the results of environmental risk assessments; 3. use social science concepts such as risk society and uncertainty to explain and assess the role of public and private actors in negotiations over environmental policy; 4. - critically analyse the formulation of policy goals, as well as technical and political strategies for engaging public and private sector actors to improve environmental quality.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
In the first half of the course you will become acquainted with technical skills required to gathering, processing and interpreting data on environmental toxicology and water quality, as well as relevant social science theories on the relationship between science and politics in the public policy process. In the second half of the course you will participate in a policy simulation in which you must generate, interpret and present scientific data needed to estimate and reduce the risk associated with poor environmental quality. The course caters for students with a background in either natural or social sciences by providing a unique opportunity to integrate both perspectives into practical environmental research and policy.		
TEACHING AND LEARNING METHODS		

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
1. the course will consist of 12 lectures in which key concepts in each discipline will be introduced; 2. students will then have an opportunity to develop practical skills in toxicology and water quality assessment; 3. a policy game or simulation will provide students with a chance to put skills and theories into practice; 4. students will be asked to hand in an individual major paper in which they will reflect on the linkages between the theory introduced in the lectures and their experiences in the simulation; 5. - finally there will be an exam to test the basic knowledge and understanding gathered during the course.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics. Students will be assessed on tasks set through the simulation and practicals, and a final exam designed test the basic knowledge and understanding gathered during the course. The breakdown of marks is as follows: practicals and related assignments (30%), simulation participation and related assignments (30%), and a final exam (40%). All assessments will be marked out of 10 and to pass the course you must get at least 5.5 on each of the tasks.

GENERAL INFORMATION ABOUT THE COURSE #4		
1	The name of the course/module	Academic Argumentation Skills in Writing and Debate
2.	Faculty/department	Faculty of Plant Sciences and Social Sciences/ Department of Plant Sciences and Social Sciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	1.5
6.	The total number of hours	45
7.	General description and purpose of the educational component	Are you thinking of a career in science? Maybe doing a Research Master or a PhD? And do you wonder how you can best get your scientific messages across to a scientific audience? Or even a public audience? In Academic Argumentation Skills, you learn how to improve your scientific writing using knowledge about the nature of argumentation.
8.	Prerequisites for studying the course/module, connection with other educational components	Does not require additional or special knowledge.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After following this course, students will be able to effectively structure their argumentation when writing a scientific paper, abstract and/or a research proposal. Students are expected to learn and understand the philosophical basis of argumentation in science, and adjust a scientific message to both scientific and public audiences.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course also addresses the philosophical basics about what is science, what constitutes a good argument, and how argumentation is used in scientific writing.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Learning activities include writing, analysing and structuring scientific abstracts, improving argumentation of current writing projects, literature study, lectures and scientific discussion and debate.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #5		
1	The name of the course/module	Management Skills
2.	Faculty/department	Faculty of Plant Sciences and Social Sciences/ Department of Plant Sciences and Social Sciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	1.5
6.	The total number of hours	45

7.	General description and purpose of the educational component	The course focuses on enhancing students understanding and application of management skills.
8.	Prerequisites for studying the course/module, connection with other educational components	Does not require additional or special knowledge.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to:

1. be able to understand and analyse a range of management roles and competencies needed in different management contexts;
2. have trained various management skills such as bringing bad news, self-presentation, meeting skills, time management, leading a job interview, conflict management;
3. have gained insights and are able to reflect on own management competencies, strengths and challenges;
4. - have designed an action plan for becoming a manager.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course starts with presenting and interactively discussing various roles, and competencies relevant nowadays when being a manager, taking into account different management contexts. Then, students are trained in a number of management skills. Those include: self-presentation skills, meeting skills, bringing bad news, time management, leading a job interview and conflict management. Through theatre acts and role-plays the practice of management roles and skills is further deepened, taking into account personal strengths and challenges. Students are finally engaged with the development of an action plan to develop their management skills.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- lectures; - awareness building exercises; - training of skills; - theatre role plays; - writing an action plan.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #6

1	The name of the course/module	Academic Consultancy Training
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	9
6.	The total number of hours	270
7.	General description and purpose of the educational component	The course is, only on request of the study adviser. Teams students are assigned a project. These consultancy teams are composed on the basis of required disciplinary mix for the execution of the project and the interests students have expressed in an application letter to the course coordinator. In their application letter students indicate what their disciplinary knowledge will add to the execution of the project. Each team has an assigned process coach and is required to find at least one content coach/expert relevant to the project.
8.	Prerequisites for studying the course/module, connection with other educational components	Before starting an ACT the student should have successfully completed at least 24 credits of MSc-level courses or a first MSc-thesis. Furthermore the student should master Information literacy, computer literacy and presentation skills on minimally the level of the MOS-modules; English verbal and writing skills should minimally be on a level which allows self-reflection and feedback and full independent functioning in a student team.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After this course students are expected to be able to:

1. determine, with a team and in interaction with a client, the goals of a project and formulate tasks and a project plan on the basis of their disciplinary knowledge and general academic skills and attitude;
2. adjust, with their team and in interaction with the client, the formulated project goals and plan when and if necessary;
3. defend and sell their viewpoints and conclusions in a professional and representative way and academically correct;
4. contribute at an academic level to the execution of an interdisciplinary project both in terms of process and content related to their own disciplinary training by gathering, selecting and analysing information and integrating this into project deliverables;
5. implement reflective learning by an assessment of their personal functioning in and contribution to a professional team and reflection on this in writing and during an assessment interview;

6.	- assess the contribution of other team members and other stakeholders on team functioning and execution of project tasks and appropriately reflect on these and give feedback in writing and verbally.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The multidisciplinary and preferably multicultural team will carry out a design type project for a client. This may be design of new technologies, but also policy papers, business plans, communication plans or draft research plans for integrated research programmes. Crucial is that teams reach an interdisciplinary synthesis of the compiled information and translate this into an advice on future actions for their client.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- Team meetings: During the course, teams have formal meetings, which the process coach attends regularly. With the assistance of the coach students regularly reflect on the functioning of the team and of individual members. - Assigned team functions: Prior to starting, the students will be assigned functions with a clear task description: team manager, secretary, financial controller, member. - Meetings with commissioner: Students organize and prepare meetings with the commissioner. During at least one the coach will be present as observer. - Work plan: Teams prepare a project plan, a first concept is discussed with a project planning expert. Work plans should at least address the mission/vision of the group, the planning chart, the stakeholder analysis, go/no-go decisions and involved risks. The plan is further assessed by the client and a content coach/expert before a final plan is made. When needed, the group will negotiate with the client in order to meet client wishes, on condition academic standards and project limitations are respected. During project execution the group checks the work-plan and negotiates adjustments when and if needed. - Project execution: During project execution a certain division of tasks is needed, yet the group should not start to work as a task group, with only one or two persons working on the integration of elements. Interdisciplinarity requires that all members actively work on synthesis and participate in the formulation of the final product and recommendations to the client. - Project deliverables: All groups deliver an oral presentation, in English, to their commissioner, peers and coaches involved in the ACT. Further deliverables for each project are defined in the work-plan in interaction with the commissioner and the content and process coach. - Individual assignments: Students compile a (self) assessment dossier. This includes the: application letter, expectation paper, reflection forms, mid-term reflection paper and final reflection paper. During the starting, mid-term and final interviews the coaches give feedback on the dossier. Elements of this dossier are discussed during group meetings. - Additional skills training: Lectures are given on theory of project planning and the preparation of a work plan. Training sessions are organized for a revision of the theory on communication, group dynamics and self-reflection and for team building exercises and training on multicultural communication.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics. All parts: written self-assessment, project proposal, product, team process and individual process.

GENERAL INFORMATION ABOUT THE COURSE #7

1.	The name of the course/module	European Workshop Environmental Sciences and Management
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	12
6.	The total number of hours	360

7.	General description and purpose of the educational component	In this course a group of 30 students of different nationalities and disciplinary background work together on an environmental problem commissioned by a client.
8.	Prerequisites for studying the course/module, connection with other educational components	Before starting an ACT the student should have successfully completed at least 24 credits of MSc-level courses or a first MSc-thesis. Furthermore the student should master Information literacy, computer literacy and presentation skills on minimally the level of the MOS-modules; English verbal and writing skills should minimally be on a level which allows self-reflection and feedback and full independent functioning in a student team..

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to be able to:

1. apply their academic knowledge and general academic skills and attitude to a project dealing with a complex problem commissioned by a client outside the university;
2. design solutions for an environmental issue by analysing it, using theory and methods in the field of environmental sciences and environmental management;
3. work as part of a multi-disciplinary and -cultural team and value the contribution of different perspectives in designing solutions for complex (environmental) problems;
4. develop a project management plan (including a data generation plan), execute it and adjust it if circumstances make it necessary;
5. reflect on aspects that are of importance for successfully executing a project, like project management, decision making in a complex situation, team roles and team building;
6. reflect on their own functioning and contribution to the execution of a project in terms of disciplinary knowledge, academic skills, group dynamics, intercultural setting;
7. - communicate their findings orally or in writing to the client, in a manner that is consistent with the client's needs and level of knowledge.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course consists of three phases. In the preparation period students apply their knowledge of environmental sciences and management to make a project plan based on the Terms of Reference received from the client. In this period an applied training in project management, data collection & interview techniques, and team work is offered. A few lectures are given that provide students with additional background information to tackle the issue. The second phase consists of two weeks of field work mainly dedicated to data collection on site. At the end of this phase the preliminary results will be presented to the client. Finally students are expected to analyse the data, incorporate the feedback from the client and write a concise report for the client. In this final phase supporting lectures on data analysis and consultancy report writing are given as well as feedback on the draft reports. Every student is expected to contribute his / her own knowledge and expertise to the group assignment and to reflect on this.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The main task is to prepare and execute a project for a real client in an interdisciplinary and intercultural team and contribute to a report for this client. Lecturers, seminars and training sessions are included to support the group project. A two-week field work period dedicated to data collection on site is part of the workshop. Students are expected to participate in the above mentioned activities and perform several group- and individual assignments.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #8

1.	The name of the course/module	Research Master Cluster for Animal Sciences
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	12
6.	The total number of hours	360
7.	General description and purpose of the educational component	Acquire professional skills in writing a scientific research proposal in the domain of Animal Sciences.
8.	Prerequisites for studying the course/module, connection with other educational components	A BSc giving admittance to one of the Wageningen MSc programs, as well as approval of your study advisor that you follow the research variant within your MSc.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

4. have gained knowledge and professional skills in designing a project in the Animal Sciences domain; 5. are able to collect relevant information in your field, identify existing gaps in knowledge and translate them into research objectives; 6. - are able to write and defend a PhD-research proposal.	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
Not available	
TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- acquire professional skills related to scientific writing, project planning, management and presentation. - write your own PhD-proposal under supervision of a staff member. - interact with your fellow students in discussion groups. - the final project proposal is assessed by two PhD's (in their final year) and one of the lecturers; - the rebuttal to this assessment and the final presentation for a scientific jury are assessed by the jury and the lecturers; - the final product in combination with the process contribution are marked by the lecturers; - the final grading is worked out individually based on these assessments.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #9		
1	The name of the course/module	Laboratory Animal Science: Design and Ethics in Animal Experimentation
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	3
6.	The total number of hours	90
7.	General description and purpose of the educational component	The LAS course entails scientific, ethical and practical aspects of animal experimentation. The main purpose of the course is to enhance a positive attitude towards animal needs and well-being.
8.	Prerequisites for studying the course/module, connection with other educational components	Human and Animal Biology, Human and Animal Biology, Vertebrate Structure and Function.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
The participant has a critical and analytical attitude towards the scientific knowledge underlying Laboratory Animal Science related activities. The participant demonstrates the ability to assess her/his scientifically based knowledge and skills. From a participant, who successfully passed the course, one can expect that he/she: 1. is familiar with legislation concerning the use of laboratory animals; 2. knows about basic principles, which guide towards the ethical judgment of animal experiments; 3. knows about the possibilities and limitations of alternative techniques; 4. has knowledge of the requirements of laboratory animals with respect to housing, nutrition and care; 5. possesses the necessary knowledge for responsible animal handling and also obtained some practical experience in this respect; 6. has taken note of the different methods for the collection of body fluids; 7. has taken note of a number of other frequently used experimental techniques (amongst others cannulation, insertion of catheters); 8. possesses the knowledge to recognize pain as well as discomfort in laboratory animals and to define humane end points; 9. has knowledge of the most important methods of anesthesia, analgesia and euthanasia, which can be used in various laboratory animal species; 10. has knowledge of the possible impact of environmental and procedural factors on experimental results; 11. has knowledge of the importance of hygienic measures and barrier systems; 12. has knowledge of the impact of diseases in laboratory animals on the experimental approach and knows about possible health monitoring; 13. knows about the specific demands that are necessary for a correct preparation and performance of animal experimental techniques and research; 14. - knows the possibilities that statistics can offer to optimize the use of laboratory animals.		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
Not available		

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- compulsory participation to lectures and practical class; - active participation to project learning and literature study.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #10		
1	The name of the course/module	Marine Resources Management
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	That is, based on realistic problem formulations by those involved in management ecologically sound, economically feasible and socially acceptable objectives are formulated.
8.	Prerequisites for studying the course/module, connection with other educational components	Aquaculture and Fisheries, Life History of Aquatic Organisms.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to be able to:
1. demonstrate insight and apply the concept of (adaptive) management as a continuous decision-making process based on uncertain information in marine resources management;
2. analyse the trade-offs between conflicting objectives in marine resources management and develop effective ways to deliberate among objectives from marine resource ecological and environmental economic viewpoints;
3. explain major ecological and economic drivers and impacts of marine resource use and measures available to adapt to or regulate them;
4. use economic and ecological research tools to evaluate the influence of (international) regulations and the outcome of management measures;
5. demonstrate insight in the information needs of various stakeholders in the management process and economic and ecological concepts and tools to acquire that information;
6. - integrate and present selected case studies of marine resources management problems.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

You will gain insights in basic fisheries and marine ecological and environmental economic concepts; and you will practice ecological and economic information tools as for instance historical trend analysis, population dynamic and bio-economic models, risk-based approaches to assessment ecological valuation and game theory analysis. You will practice the management cycle through case studies presenting distinct resource use management problems in different ecosystems - oceans, tropical and temperate coastal ecosystems and large lakes. You will participate in the analysis of these problems, review information and design management options taking into account the perspectives of stakeholders with different objectives related to exploitation and conservation, of aquatic organisms and the use of marine habitats. The course focuses on fisheries on fish, shellfish and crustaceans, though examples of other organisms (mammals, birds and seaweed) will also be given.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- follow lectures; - perform practical exercises with recirculation systems containing fish; - calculate designs of production systems.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #11		
1	The name of the course/module	Fisheries Ecology
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	6

6.	The total number of hours	180
7.	General description and purpose of the educational component	The course Fisheries Ecology deals with the ecology of fishes and other aquatic organisms in relation to the exploitation of aquatic resources.
8.	Prerequisites for studying the course/module, connection with other educational components	Aquaculture and Fisheries, Life History of Aquatic Organisms.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to be able to:
1. identify the main vertebrate and invertebrate species in world fisheries as well as their main biological and life-history characteristics that influence their vulnerability to fisheries;
2. explain how the main developments in effort and technology in the world's fisheries have influenced marine and other aquatic ecosystems over the last century;
3. apply first-stage data-processing, parameter estimation, and basic statistical concepts involved in fisheries ecology;
4. apply basic models of fish population dynamics, fisheries yield models, and mass-balance models using computer-supported simulations;
5. assess the assumptions underlying widely-used models in fisheries ecology;
6. analyse how bottom-up and top-down processes can influence marine and other aquatic communities;
7. analyse the evolutionary and community effects of fishing and conservation on fished and unfished species and populations;
8. - construct a management advice, following a stock assessment, using the major steps used world-wide by fisheries scientists in providing the scientific base for single species management.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Direct and indirect effects of fishing are treated at the organism, population, community and ecosystem level. Subjects include the main categories of organisms involved in global fisheries and their biological characteristics, principles of fish population dynamics, data collection, stock assessments and ecosystem effects of fisheries. Interactions with marine mammals and birds will also be treated. Special attention is given to the environment - fish - fishery interactions. In the tutorials the principles of population dynamics, simulation models, and virtual population analysis are taught.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- follow lectures, studying textbook and tutorial notes; - perform exercises in tutorials.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #12

1	The name of the course/module	Advanced Statistics
2.	Faculty/department	Faculty of Plant Sciences and Social Sciences/ Department of Plant Sciences and Social Sciences
3.	Status of the educational component	Optional
4.	Semester	1/2
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	The purpose of the course is to reveal the basics of statistical analysis and mathematical modeling.
8.	Prerequisites for studying the course/module, connection with other educational components	The student should be familiar with 1) The principles of probability calculus and the subjects: estimation, construction of confidence intervals and hypothesis testing from statistical inference 2) Application of these principles to inference about central values (mean or success probability) for the 1-sample and 2-sample situations, in case of Normal observations and binary (0,1) observations 3) Methods of analysis for simple (one explanatory variable) linear regression.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After the course the student should (within the limits of the subjects treated) be able to:
5. translate a research question into a statistical hypothesis: make a plan (type of design or sampling procedure) for the data collection.
6. choose an appropriate model with an understanding of the ingredients of the model in relation to the data;

7.	analyse the data (with SPSS);
8.	- interpret the results and form conclusions relevant for the actual problem.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Brief overview of (a) the principles of inference and (b) inference about means in the 1- and 2-sample situation, including non-parametric procedures.
Choosing the sample size required to obtain a given precision in the 1- and 2-sample situations.
Multiple linear regression: 1) model formulation and meaning of model parameters and 2) inference on (a) a single parameter (b) a linear combination of model parameters (c) several model parameters simultaneously (d) checking model assumptions (e) prediction.
Factorial designs: completely randomized design for 1 and 2 factors, block designs.
One-way and two-way analysis of variance: additive and interaction models, (overparametrization) , F-tests for interaction and/or main effects, t-tests for one mean or a difference of two means, multiple comparisons.
Analysis of covariance and use of a model with a quantitative and a qualitative factor.
Inference (notably Chi-Square tests) for (count) data summarized in a contingency table.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- lectures: follow classes; - study the book and make exercises; - computer practical's (compulsory): (learn how to) use SPSS and PQRS, work on case studies.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #13

1	The name of the course/module	Ecology: Classics and Trends
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	This course deals with some theoretical fundamentals of ecology. General principles are studied with shallow lakes as model ecosystems, completed with examples of other systems.
8.	Prerequisites for studying the course/module, connection with other educational components	Water Quality; Water Quantity and Quality.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

At the end of the course students are expected to be able to;

1.	recognize, explain and quantify key biological processes in various (aquatic) ecosystems;
2.	recognize and explain the relationships between biological processes and chemical and physical processes;
3.	recognize and assess driving mechanisms and feedbacks in various ecosystems;
4.	relate classical and modern ecological themes to aquatic ecosystems;
5.	evaluate the value or significance of scientific information;
6.	analyse reasoning and argumentation in scientific articles;
7.	recognize own interpretation from other views;
8.	- set science and scientist in a broader social context.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Main ecological themes (e.g. biodiversity, predator-prey relationships) are highlighted in relation to various ecosystems. Theory will be clarified by applying some relatively simple models. A number of important scientific articles on different themes are criticized by the students. Each article is briefly introduced by the lecturers. The students individually read and analyse four of these key publications for weak and false points. The results are discussed in plenary sessions. Furthermore, students in small groups (3 to 4 members) analyse some key scientific papers and a contrasting paper. Together they prepare a short presentation. Again the findings are discussed in a plenary session.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- lecture attendance; - reading and analysing a number of selected scientific articles modelling in MATLAB, group discussions.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #14		
1	The name of the course/module	Water Quality
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	This advanced course provides a critical overview of the processes and quantitative process descriptions that are essential to understanding surface water quality and systems analysis of aquatic systems.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic chemistry, differential equations, introductory knowledge of surface water quality and aquatic ecology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After this course the student is capable of:

1. - quantifying and critically evaluating the importance of physical, chemical and biological processes in freshwater and marine aquatic (eco)systems, such as chemical reactions in lakes and rivers, solute transport, sedimentation and re-suspension, gas-water exchange, sediment-water exchange, adsorption and bioaccumulation, oligotrophication and eutrophication, nutrient behaviour and retention, C-, N-, and P- behaviour in aquatic systems, light climate and algal growth, carbonate and aragonite formation, marine geochemistry and ocean acidification.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Chemical and physical processes are emphasized and treated in the context of policy and risk assessment developments. Six themes will be treated: (1) Advanced aquatic chemistry, (2) Transport and exchange processes, (3) Fate and bio-magnification of micro-pollutants, (4) Nutrient behaviour, and algal nuisance, (5) Basic water quality modelling, (6) Oceans. Each theme takes one week of the course. For each theme a recent scientific paper is critically analysed, in order to identify key innovations in the field. These papers are updated annually.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- PC practical basic water quality modelling; - preparing and attending lectures; - independent study; - practising problem solving; - reading and discussing selected scientific papers.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #15		
1	The name of the course/module	Environmental Toxicology
2.	Faculty/department	Faculty of Animal Sciences / Department of Animal Sciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	This course gives an overview of different aspects playing a role in the challenging field of environmental toxicology. The course is set-up as an integration between lectures, practical's, computer sessions, videos and excursion.
8.	Prerequisites for studying the course/module, connection with other educational components	General Toxicology; Thesis Toxicology, Internship Toxicology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to:

1. know the most relevant terms and methods in environmental toxicological research and governance;
2. know the main sources and types of environmental pollutants;
3. understand the basic principles of environmental toxicology including the 'human-wildlife connection' and risk assessment;

4. understand the relevance of compound, ecosystem and organism characteristics for the consequences of environmental contamination; 5. perform practical experiments in a comprehensive way; 6. analyse and critically discuss the results of practical experiments and report (written); 7. assess the environmental and human risk for a topical environmental contamination case in a written and oral presentation; 8. give due consideration to the ethical, legal, social and policy implications of environmental toxicological research, uncertainties and communication; 9. - design an experimental approach with meaningful endpoints to assess the environmental and human risk for a topical environmental contamination case.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
9. Toxicology itself already is very interdisciplinary, but environmental toxicology even adds (environmental) chemistry, earth sciences, biology of a wide range of species and ecology to this. Special attention will be paid to ethical issues such as animal use and ethical, legal, social and policy implications of research and communications, and to job perspectives for environmental toxicologists. 10. The book 'Principles of Ecotoxicology' is used to develop a basis for the rest of the subjects in the course. About half of the lectures will focus on a variety of timely additional issues. In the practical part of the course you will study the toxic properties of 1 specific toxicant yourself. Applying a set of modern in vitro assays you will address the mutagenicity, cytotoxicity, estrogenicity and general toxicity of the compound. In addition you will perform a risk assessment of the compound involving toxic evaluation of literature data, combined with your own experimental results. This will be presented both orally as well as in a small report. The course will contain a dedicated risk assessment module for students marine sciences.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- lectures, practical's; - excursion, risk assessment for a specific compound; - presenting results, studying the book; - discussing ethical issues and videos. The different activities are closely related to each other.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

UNIVERSITY OF ROSTOCK

1	**Criterion A: University profile**		
1.1	Name of the University	**UNIVERSITY OF ROSTOCK**	
1.2	Classical or applied	Public university	
2	**Criterion B: Profile of the educational program (Curriculum)**		
2.1	Number of Aquaculture disciplines	15	
2.2	The name of the educational program	Aquakultur (Master of Science)	
2.3	Type of diploma	Master	
2.4	Total number of credits (ECTS)	78 credit points	
3	**Criterion C: Setting the educational program (Curriculum)**		
3.1	Duration of the program	4 semestres	
3.2	The purpose of the educational program	The master's course Aquaculture is a science orientated university program with a duration of two years, where core competences of marine fish aquaculture, sea-ranching and the aquaculture of algae is taught. Further, knowledge in economical sciences, fishing, nature conservation legislations and the construction of technical facilities is impaired. Thus, our students are enabled to work on complex problems that occur in the development and application of Aquaculture.	
4	**Criterion D: Characteristics of the educational program (Curriculum)**		
4.1	Subject area (field of knowledge, specialty, specialization (if available))	The master's program is offered with a focus on biology, technology and economics and is divided into a compulsory and elective area.	
5	**Criterion E: Teaching and assessment**		
5.1	Teaching and learning methods	1.Lecture / Repetitorium 2.Seminar 3.Exercise 4.(Laboratory) Internship 5.Internship 6.Practical Seminar 7.(Large-scale) Internship 8.Project Work 9.Project Event 10.Exkursion 11.Consultation (to supervise scientific work) 12.Tutorial 13.E-Learning	
5.2	Assessment	examination at the end of the semester	
6	**Criterion F: Software competencies**		
6.1	Integral competence	Students acquire core competences in the field of fish aquaculture, sea ranching and gain an insight into special aquaculture methods.	
6.2	General competences		
6.3	Professional competences		
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	1. 2. ...	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support		
8.2	Material and technical support	Aquaculture & Artemia Reference Center, engineering office, environmental event, etc.	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
	1 semesters		
9.1.1	Biology, Ecology and Physiology of Fish	6	examination
9.1.2	Introduction to Aquaculture	6	examination
9.1.3	Habitat Sea	6	examination
9.1.4	Major area[2]' Major areas includes biology, technolgy and economics.	6	examination
9.1.5	Major area[2]' Major areas includes biology, technolgy and economics.	6	examination
	2 semesters		
9.1.6	Aquaculture Systems	6	examination
9.1.7	Technology of	6	examination

	Fish Aquaculture		
9.1.8	Elective area	6	examination
9.1.9	Major area[2]' Major areas includes biology, technolgy and economics.	6	examination
9.1.10	Major area[2]' Major areas includes biology, technolgy and economics.	6	examination
	3 semesters		
9.1.11	Genome Biology and Pathobiology	6	examination
9.1.12	Sustainable Use of Aquatic Ressorces[1]'	6	examination
9.1.13	Special Aquaculture Systems	6	examination
9.1.14	Elective area 2	12	examination
	4 semesters		
9.1.15	Master thesis Aquaculture	30	
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Special areas of aquaculture - Statistical bases, design and Analysis of experiments in laboratory and outdoor	6	examination
9.2.2	Electronic course offering	6	Examination
9.2.3	Geoinformatics/GIS	6	Examination
9.2.4	Diseases and parasites of aquatic organisms	6	Examination
9.2.5	Water quality	6	Examination
9.2.6	Introduction to Computer Science	6	Examination
9.2.7	Hydraulic fluid machines	6	Examination
9.2.8	Control Systems / Automation	6	Examination
9.2.9	Design and calculation of sea-based aquaculture systems	6	Examination
9.2.10	lightweight materials	6	Examination
9.2.11	Introduction to the basics of Business Administration	12	Examination
9.2.12	Financial accounting	6	Examination
9.2.13	General business studies: organization and human resource management	6	Examination
9.2.14	General business studies: Strategic Marketing	6	examination
9.2.15	Cost and Performance Accounting (KLR)	6	Examination
9.2.16	Private business law	6	Examination
9.2.17	Environmental law and marine conservation	6	Examination
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Master‘s thesis	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Biology, Ecology and Physiology of Fish
2.	Faculty/department	Faculty of Agricultural and Environmental Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	The aim of the course is study of fish biology from molecule to whole organism. The topics will be fish diversity and basal groups, evolution and developmental biology. Physiological mechanisms: sensory modalities, density regulation, adaptations to unusual environments.

8.	Prerequisites for studying the course/module, connection with other educational components	Fish biology, reproductive physiology, endocrinology, population ecology and aquaculture.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

This course will provide basic coverage of the diversity and biology of fishes (both freshwater and marine) and briefly introduce concepts related to fisheries management. Emphasis will be placed on species inhabiting the Great Lakes basin.
After the successful completion of this course, student will be able to:
1. Describe the major groups of fishes and their evolutionary relationships.
2. Describe the morphology, physiology, and biology of fish.
3. Identify Michigan fishes to the level of family, genus, and species.
4. Apply basic strategies to manage fish populations. 5. Summarize and critically evaluate scientific papers related to fisheries biology.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Introduction & major groups of fishes
2.	Classification & systematics
3.	Passive fish capture techniques; Jawless fishes
4.	Chondrichthyes
5.	Sarcopterygii
6.	Electrofishing techniques; Actinopterygii
7.	Fish identification (Cyprinidae)
8.	Active fish capture techniques; Osmoregulation
9.	Circulation
10.	Fish identification (Percopsidae, Apredoderidae, Gadidae, Fundulidae, Atherinopsidae, Gasterosteidae, Cottidae, Moronidae, Centrarchidae)
11.	Gas bladder & buoyancy
12.	Auditory, mechanosensory & electrosensory systems
13.	Fisheries management; quantifying age & growth
14.	Estimating population parameters

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory lectures: lectures based on powerpoint presentations	Lab quizzes—The goal is for students to become proficient at identifying Great Lakes fishes and prepare for the fish identification exam. Participation in Sampling Fieldtrips—Students are expected to attend all fieldtrips. Participation will be evaluated based on your involvement with sampling and identifying fishes. Fieldtrip Assignment—Students are required to compile a species list with photographs for the fishes encountered during fieldtrips. For each species, students should take a photograph of a representative specimen. Discussion Questions—Students will be given a set of questions to answer regarding a discussion paper to facilitate critical thinking.

GENERAL INFORMATION ABOUT THE COURSE #2

	The name of the course/module	Introduction to Aquaculture
	Faculty/department	Faculty of Agricultural and Environmental Sciences
	Status of the educational component	Mandatory
	Semester	1/1
	Number of ECTS credits	6
	The total number of hours	180
	General description and purpose of the educational component	This is an introductory course in aquaculture. It provides the student with an understanding of the basic principles of aquaculture while giving the student the opportunity to experience hands-on activities associated with the culture and husbandry of aquatic animals.

	Prerequisites for studying the course/module, connection with other educational components	Many disciplines are related to aquaculture and accordingly; sections covered in the course include biology, chemistry, history, nutrition, seafood safety; as well as the primary area of emphasis, the management and/or husbandry of aquatic animals.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

To become familiar with the design and operation of extensive and intensive culture facilities (ponds, net pens, flow-through systems, recirculating aquaculture systems, integrated aquaculture operations, etc.)
To understand species-specific culture requirements (temperature, water quality etc.), and how to maintain optimal conditions in the various culture systems
To become familiar with practical aspects of aquaculture (feeds and feeding; stocking, transport, and harvest techniques; marketing and economics; disease prevention, diagnosis and treatment; etc.)
To evaluate the state of aquaculture in the abroad.
COURSE OBJECTIVES:

- To become familiar with the design and operation of extensive and intensive culture facilities (ponds, net pens, flow-through systems, recirculating aquaculture systems, integrated aquaculture operations, etc.)
- To understand species-specific culture requirements (temperature, water quality etc.), and how to maintain optimal conditions in the various culture systems
- To become familiar with practical aspects of aquaculture (feeds and feeding; stocking, transport, and harvest techniques; marketing and economics; disease prevention, diagnosis and treatment; etc.)
- To evaluate the state of aquaculture in the U.S. and abroad

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Introduction to aquaculture
2	Regional aquaculture perspective
3	Water sources Water recirculation systems
4	Farm ponds Ocean-ranching and other systems
5	Hatcheries
6	Chemical aspects of water quality
7	Physical aspects of water quality
8	Natural and prepared feeds
9	Vitamin and mineral requirements Protein demand
10	Lipid and carbohydrate requirements Feeding strategies
11	Broodstock management Aquaculture genetics and ploidy manipulations
12	Disease prevention and diagnosis, therapeutants in aquaculture
13	Harvest and transport techniques
14	Economics and marketing in aquaculture
15	Foodfish aquaculture, restoration aquaculture, and everything in between
16	Trends in domestic and global aquaculture

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory lectures: lectures based on powerpoint presentations	

GENERAL INFORMATION ABOUT THE COURSE #3

	The name of the course/module	Habitat Sea
	Faculty/department	Faculty of Agricultural and Environmental Sciences
	Status of the educational component	Mandatory
	Semester	1/1
	Number of ECTS credits	6

	The total number of hours	180
	General description and purpose of the educational component	1.Review biological and oceanographic concepts to understand marine ecosystems as habitat for Earth's biodiversity, including humans. 2. Apply basic concepts and methods from the disciplines of 'human ecology' and 'ethnoecology' to studying human-environment interactions; understand the links between these disciples and the fields of biology, anthropology, archaeology, history, and economics. 4. Explore the different knowledge systems employed by human societies to understand ocean environments, including traditional knowledge and scientific knowledge. 5. Compare and contrast modes of marine transport, types of ocean resource extraction and use, and civilization development across our global voyage. 6. Examine the effects of resource use and urban development on ocean environments and biodiversity over time and across locations
	Prerequisites for studying the course/module, connection with other educational components	Our investigations will draw on information from a range of disciplines—including biology, oceanography, anthropology, archeology, and economics—to study the reciprocal relationships between people and marine environments. In particular, we will look at why coastal areas are hotspots for human settlement, how ocean phenomena have influenced spiritual beliefs, the role of maritime travel in connecting and expanding societies, the importance of marine organisms as food and medicine, and the future of energy production in the ocean. Locations visited during the semester will serve as case studies. Using these topics as our backdrop, we will consider how rapid human population growth, urbanization, and technological development are leading to the degradation of marine ecosystems and resources. Finally, we will consider options for restoring and conserving marine environments and species (including our own).

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Student Learning Outcomes – At the end of this course you will be able to:
1) Describe the co-varying effects of temperature, pressure, oxygen and light levels on the adaptations of deep-sea organisms.
2) Evaluate the influence of variables co-varying with depth on communities, populations, and species.
3) Describe the various sources of energy available to deep-sea organisms and their controls on community processes.
4) Compare and contrast various deep-sea habitats and their faunas.
5) Describe the potential impacts of anthropogenic activities on deep-sea communities.
6) Read and understand a scientific paper, evaluate its findings and discuss the implications of those findings.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	The physical environment and history of investigation (CRS) Data collection techniques (CRS)
2	Bioluminescence (JCD) Physiological adaptations (JCD)
3	Deep Sea Microbes (Matt Church)
4	Energetics (JCD)
5	Depth zonation, trends in body size and the source-sink hypothesis (CRS)
6	Pelagic-benthic coupling – Food supply (JCD)
7	Canyons and Trenches (JCD and CRS)
8	Hydrothermal vents (CRS) Cold seeps and whale falls (CRS)
9	Mineral Exploitation (CRS)
10	Oxygen Minimum Zones (JCD)
11	Discussion: OMZ Fisheries (JCD)
12	Climate change (JCD)

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theory lectures: lectures based on powerpoint presentations	discussion of each paper on PowerPoint, presenting

GENERAL INFORMATION ABOUT THE COURSE #4

1	The name of the course/module	Aquaculture Systems
2	Faculty/department	Faculty of Agricultural and Environmental Sciences

3	Status of the educational component	Mandatory
4	Semester	1/2
5	Number of ECTS credits	6
6	The total number of hours	180
7	General description and purpose of the educational component	The program gives you broad and interdisciplinary strength and specialisation in subjects of your choice. We offer courses in fish breeding, fish nutrition and planning and design of aquacultural plants, and you will get insight and knowledge about how those components/factors affect the effectiveness of production and influence the economic yield.
8	Prerequisites for studying the course/module, connection with other educational components	Definition and biological characteristics; water quality management; pond management; fish farming systems; fish breeding, nursing and rearing; common fish diseases and parasites.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Upon the completion of the course, the students will be able to explain the characteristics of cultivable and cultivated fish species, and their management practices.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

9	Introduction: Definition of fish, fishery and aquaculture, General characteristics of fish, desirable characters of fish for culture, Importance of fish.
10	Biology of cultivated fish species: Morphological characters, feeding habits, growth rate, and reproductive behavior of Common carp, Chinese carps, Indigenous major carps, Tilapia, Trout, Catfishes, Sahar, Silver barb, and Freshwater prawn.
11	Water quality management: Physical parameters–Temperature and Turbidity; Chemical parameters-DO and pH; Biological parameters- Plankton
12	Pond management: Site selection for pond construction, Liming, fertilization, Feed and Feeding, Aquatic weeds, and Predator control
13	Fish farming systems (FFS): Introduction; Classification of FFS on the basis of intensity, enclosure, fish species, and integration
14	Fish breeding: Basic principles of fish breeding; Breeding of common carp, Chinese carps, and Indigenous major carps, Fish seed rearing and transportation
15	Common fish diseases and parasites: Introduction, causal organisms, symptoms and control measures of Saprolegniasis, Tail rot/fin rot, White spot disease, Dactylogyrosis, Argulosis; and Asphyxiation

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #5

1	The name of the course/module	Technology of Fish Aquaculture
2	Faculty/department	Faculty of Agricultural and Environmental Sciences
3	Status of the educational component	Mandatory
4	Semester	1/2
5	Number of ECTS credits	6
6	The total number of hours	180
7	General description and purpose of the educational component	The aim of the Aquaculture Technology Syllabus is to develop in students a capacity to design, produce, evaluate, sustain, use and manage and water-related environments.
8	Prerequisites for studying the course/module, connection with other educational components	Fishing gear and techniques, design and construction of fishing gear, gear selectivity, fish behaviour, environmental impacts of fishing gears, fishing methods and fish quality, acoustics.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- identifies the nature and scope of the aquatic environment.
- identifies and describes the components of ecosystems.
- identifies and describes a range of aquatic ecosystems and investigates their complex interrelationships.

▪	identifies, describes and evaluates the social and economic importance of ecosystems.
▪	investigates attitudes towards the environment as a fisheries resource.
▪	investigates the effects human activity has had on native fish stocks.
▪	identifies, describes and evaluates the effects humans have had on the environment.
▪	explains why aquaculture provides an economically sustainable source of food.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Fishing gear and techniques
2	Design and construction of fishing gear
3	Fish behaviour
4	Fishing gear selectivity
5	Environmental impacts of fishing gear
6	Fishing methods and fish quality
7	Fisheries Acoustics
8	Naval architecture
9	Fishing gear research and development

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The syllabus also includes classroom lecture notes, students' assessments, lesson planning, schemes and records of work.	

GENERAL INFORMATION ABOUT THE COURSE #6

1	The name of the course/module	Genome Biology and Pathobiology
2.	Faculty/department	Faculty of Agricultural and Environmental Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1/2
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	The aim of Genome Biology and Pathobiology course focused on genomes and genome analysis. This course will cover a range of topics in genome biology.
8.	Prerequisites for studying the course/module, connection with other educational components	DNA technologies, genome structure, comparative genomics, functional genomics, personal genomics, genome-wide association studies, and population variation.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1.Develop critical and scientific thinking skills to analyze and solve problems.
2. Synthesize information regarding key features of genome structure.
3. Understand and explain major biological concepts in evolution, ecology and organismal biology as it relates to genomes.
4. Use scientific literacy and knowledge of genomes to communicate to the scientific community. 5. Critically read popular press articles in genomics.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Introduction/Genetics Review
2.	Mapping Genomes, Sequencing Technologies
3.	Comparative Genomics
4.	Evolution
5.	Prokaryotic genomes/Metagenomics
6.	Eukaryotic genomes
7.	Ancestry
8.	Domestication
9.	Genomics Core Tour
10.	RNAseq
11.	Transcriptomics
12.	Chromatin / Splicing
13.	Epigenetics
14.	Systems Biology

TEACHING AND LEARNING METHODS

	Study methods (what types of educational activities should be performed by the student independently)

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	

GENERAL INFORMATION ABOUT THE COURSE #7		
1	The name of the course/module	Sustainable Use of Aquatic Ressorces
2.	Faculty/department	Faculty of Agricultural and Environmental Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1/2
5.	Number of ECTS credits	6
6.	The total number of hours	180
7.	General description and purpose of the educational component	This course examines ways to value, manage and sustain water systems for agriculture, industry, the built environment, recreation and ecosystems.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- demonstrate critical thinking about sustainable water systems.
- engage with major policy issues and concepts including water regulation, governance, and the water-energy-food nexus.
- discuss theoretical and substantive areas of water management for different human and natural uses.
- articulate methods used in evaluating sustainable water systems such as modeling, demand and supply management and water accounting.
- • employ tools to evaluate real world case studies.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	Introduction
2	Humans and Water:
3	Sustainable development and water; Indigenous perspectives on water
4	Balancing diverse needs for water: environment, ecosystem services, and the human right to water
5	Water Foot-Print and Accounting; Integrated Water Resources Management
6	Agricultural water use
7	Cities and Towns, the urban environment
8	Water use, reuse and stewardship within the industrial sector
9	Designing water systems and understanding trade-offs
10	Water governance, legislation and law
11	Water pricing and privatization
12	Partnerships for sustainable water governance

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
This course combines lectures (including high-profile guest lectures from experienced water professionals), student-led discussions, and in-class group activities. Discussions, policy briefs and reports will require demonstrated knowledge of lectures and readings.	

GENERAL INFORMATION ABOUT THE COURSE #8		
	The name of the course/module	Special Aquaculture Systems
	Faculty/department	Faculty of Agricultural and Environmental Sciences
	Status of the educational component	Mandatory
	Semester	1/2
	Number of ECTS credits	6

	The total number of hours	180
	General description and purpose of the educational component	This course provides field-based training in production aquaculture and applies the principles (Aquaculture) to real world production situations. Students will learn about production of major aquatic species in various culture systems and will use real research/production data to understand these principles.
	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

a) Apply the principles of aquaculture and understand how they influence the carrying capacity, water quality, and growth and yield of cultured aquatic species.
b) Learn principle management practices for culturing major aquatic species.
c) Learn to culture live feeds for aquaculture species.
d) Develop skills to identify when fish are stressed either because of water quality or health issues and how to avoid and deal with these problems.
e) Develop technical and managerial skills required to raise a variety of aquatic species.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1	Concept of Commercial Fish Production
2	Site, Species, System, Business Selection/Evaluation/Permits and Regulations
3	Production Planning/Types of Production Systems
4	Water Budgets
5	Pond Preparation- Liming and Fertilizing
6	Pond Preparation- Insect & Unwanted Fish Control
7	Handling/Grading/Transportation/Harvesting
8	Water Quality Monitoring/Maintenance-DO,
9	Water Quality Monitoring/Maintenance-pH, ammonia, etc.
10	Feeds and Feed Management
11	Disease Prevention/Management
15. 2	Aquatic Weed Management
16. 3	Effluent Management
14	Flow-Through System Production Considerations-Tanks & In-Pond Raceways
17. 5	Aerated Microbial Reuse Systems
16	Catfish Production/Processing/Marketing

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
the lecture, field trips and homework assignments.	

UNIVERSITY OF PLYMOUTH

1	Criterion A: University profile	
1.1	Name of the University	**UNIVERSITY OF PLYMOUTH**
1.2	Classical or applied	Classical
2	Criterion B: Profile of the educational program (Curriculum)	
2.1	Number of Aquaculture disciplines	
2.2	The name of the educational program	MSc Sustainable Aquaculture
2.3	Type of diploma	Masters
2.4	Total number of credits (ECTS)	180
3	Criterion C: Setting the educational program (Curriculum)	
3.1	Duration of the program	2 semestres
3.2	The purpose of the educational program	Our MSc Sustainable Aquaculture programme provides you with an opportunity to engage with world leading research, with access to outstanding aquaculture facilities and immersive field trips that will give you the tools to make the most of the global career opportunities in this field. Develop an appreciation for the growing aquaculture industry within a sustainable agenda for meeting the needs of culturing fish, crustacean, mollusc, aquatic plants and invertebrates for their products. Choose specialised modules and draw on the expertise of research active staff with proven track records of teaching and national as well as international recognition in their fields. Gain experience of the aquaculture industry from a range of field trips, including the possibility of an overseas residential field course, typically to Greece or Scotland (or an alternative field course), to hatcheries, farms and other related facilities. Join a rich research group working on various aspects of nutrition, health, disease, behaviour, microbiomes and welfare of species of fish, crustaceans and molluscs of commercial relevance. Undertake a variety of projects and technical training with our contemporary facilities such as wet labs/aquaria, nutrition and feed analytical suites as well as teaching laboratories, molecular biology and an electron microscopy centre. Gain access to expertise from leaders in industry and commerce in a variety of aquaculture systems, advancing your technical and scientific knowledge. Benefit from our strong relationships with government agencies, commercial enterprising and advisory organisations. Join our well established postgraduate environment where PhD students interact and engage in related specialised areas to foster a sound academic forum for sharing ideas and technical knowledge. Graduate opportunities include various career paths within the aquaculture industry as well as associated fields relating to fish and shellfish health, welfare and research. Previous graduates have progressed into careers in these fields or PhD programmes in the UK, Europe, Asia and Africa.
4	Criterion D: Characteristics of the educational program (Curriculum)	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	The programme reflects key aspects of fish, shellfish and algae production relating to modern aquaculture practices with emphasis on nutrition, feed management, health, welfare and sustainable technology. It also incorporates the socio-economic and geo-political developments in this expanding area as well as marketing and enterprise. Topics include: fish nutrition, feed technology, fish and shellfish health management, disease prevention and genetic improvement of stock for aquaculture; management of fish production, ornamental fish culture and global demand for aquatic trades in captive fish species; environmental and legislative regulations in different countries and the problems of aquaculture expansion in rural areas; economics of the marine environment; seafood processing; and a research project leading to your dissertation.
5	Criterion E: Teaching and assessment	

5.1	Teaching and learning methods	Analysis, Synthesis, Evaluation, Application, Group working, Learning resources, Self-evaluation, Management of information, Autonomy, Communications, Problem solving	
5.2	Assessment	Scientific review, Scientific report/Dissertation, Management/Project Plan, Oral Presentation	
6	**Criterion F: Software competencies**		
6.1	Integral competence	1.different sustainability learning communities and organizations 2. Skills to critically assess current learning for sustainability practice and synthesise their own personal worldview 3. The ability to refer to and analyse case studies 4. Strategic proposals that incorporate environmental concerns into social, economic and political processes 5. The ability to learn through direct experience	
6.2	General competences	1. Work effectively within a group as leader or member, make appropriate use of the capacities of group members and handle conflict sensitively and with confidence 2. Write clearly argued, well-structured and correctly referenced material, with precisely matching referencing and bibliography 3. Communicate in clear English, showing clarity of expression and fluency of presentation of ideas and insights 4. Use a full range of learning resources and ICT 5. Reflect on their own ideas by becoming more acquainted with unfamiliar initiatives and argument 6. Live and work in a multi-disciplinary, multi-cultural environment 7. Critically assess evidence for themselves through independent judgement 8. Improve time management and develop self-discipline.	
6.3	Professional competences	1. Prepare well-supported and critical (written and oral) analyses of theory and empirical evidence 2. Formulate proposals aimed at dealing with the complexity of a range of issues and situations 3. Formulate a conceptual framework and use a range of information sources in research 4. Work in a multi-disciplinary team and relate to new cultural environments 5. Elaborate and communicate proposals, evaluations and strategies.	
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	1. A sound framework of the concepts of sustainability applicable to biological systems 2. A theoretical set of methodologies for evaluating sustainable resource use 3. An understanding of the paradigms applied to concepts of sustainability 4. An understanding of the breadth of the aquaculture industry and its resource demands 5. An appreciation of the key drivers in maintaining profitability in commercial aquaculture and associated enterprises 6. An understanding of the fundamental principles of growth, health and development of fish and other cultured species. 7. An understanding of the importance of biotic and abiotic factors affecting aquaculture output 8. A sound framework of research skills applicable to independent research	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support		
8.2	Material and technical support	Aquaculture & Artemia Reference Center, engineering office, environmental event, etc.	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	BIO5131 Postgraduate Research Skills and Methods [S1]	N/A	Examinations
9.1.2	BIO5125 Sustainable Use of Resources in Biological Systems [S1]	N/A	Examinations
9.1.3	BIO504 Health & Production in Aquaculture [S1]	N/A	Examinations

9.1.4	BIOL5208 Contemporary Issues in Aquaculute [S2]	N/A	Examinations
9.1.5	BIOL5209 (S2) MAR507 (S2)	N/A	Examinations
9.1.6	BIO505 Research Project [Other]	N/A	
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	N/A	N/A	N/A
9.2.2	N/A	N/A	N/A
9.2.3	N/A	N/A	N/A
9.2.4	N/A	N/A	N/A
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Master's thesis	

UTRECHT UNIVERSITY

1	Criterion A: University profile	
1.1	Name of the University	**UTRECHT UNIVERSITY**
1.2	Classical or applied	Applied
2	Criterion B: Profile of the educational program (Curriculum)	
2.1	Number of Aquaculture disciplines	12
2.2	The name of the educational program	Marine Sciences
2.3	Type of diploma	Master
2.4	Total number of credits (ECTS)	120
3	Criterion C: Setting the educational program (Curriculum)	
3.1	Duration of the program	4 semesters
3.2	The purpose of the educational program	If you are a science student with an educational background in biology, chemistry, physics, or earth science, this program offers the perfect preparation for a career as a marine scientist. Students with a Bachelor's degree in another natural science or technical discipline and students from University Colleges who would like to contribute to the sustainable use of sea and ocean resources are also invited to apply. Essentially, all outstanding issues in Marine Sciences are multidisciplinary. A broad, holistic research approach to this rapidly developing field is, therefore, necessary to identify risks, improve future scenarios, and to make the transition towards sustainable interactions between man and seas and oceans. Crucial questions you will investigate during your studies include: • How does global warming and changing ocean circulation impact ecosystem functioning? • How do changing ecosystems affect ocean chemistry? • How does a change in ocean chemistry affect biology?
4	Criterion D: Characteristics of the educational program (Curriculum)	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Marine Biology
5	Criterion E: Teaching and assessment	
5.1	Teaching and learning methods	Educational Methods: Course work Field and laboratory research Independent research Internship/guided research
5.2	Assessment	Examinations: Final research papers Short papers or written exams In-class presentations Active participation and concluding reports Thesis
6	Criterion F: Software competencies	
6.1	Integral competence	1. The courses, which focus on both knowledge and academic skills, will lead to a holistic vision on our changing seas and oceans.
6.2	General competences	5. Moreover, possible legal conflicts of issues such as energy and climate change, mining, pollution, the flow of traffic at sea, fisheries policies and coastal defences are treated.
6.3	Professional competences	1. In the courses you will study a wide range of subjects, i.e. from marine microbes, to geochemistry and ocean circulation, to past ocean reconstructions. You will examine the potential ecological consequences of major stressors of the marine environment, warming, acidification and anoxia in past, present and future oceans. 2. You will approach these complicated societal issues from various perspectives and study their interactions and relationships with physical, chemical, biological and geological processes.
7	Criterion G: Program Learning Outcomes	
7.1	Program learning outcomes	The Marine Sciences Master's program will enable you to gain a broad understanding of marine systems but also specialize in the physical, chemical, biological, and geological processes taking place in seas and oceans. You will investigate how seas and oceans functioned in the past, are functioning at present, and will function in the future.

		You will explore issues such as energy and climate change, mining, pollution, the flow of traffic at sea, fisheries policies, and coastal defenses. Examining the consequences of these themes – such as the fact that the disappearance of the Arctic's summer ice cap will allow drilling for oil and gas – requires a multidisciplinary approach. During your studies in the Marine Sciences Master's program, you will: 11. explore a wide range of marine disciplines and integrate theoretical, experimental, and practical sciences; 12. learn to understand how seas and oceans have functioned in the past, are functioning at present, and will function in the future; 13. explore how marine systems change due to human intervention, crucial for risk assessments; 14. develop your own ideas regarding business opportunities related to the transition towards sustainable oceans; 15. become acquainted with how oceans law and policy govern academic and societal marine issues; 16. have access to research performed under 17 marine sciences chairs - the most extensive in-house expertise in marine sciences of all Dutch universities; 17. be part of leading research in our marine research groups, which participate in international marine programs and projects; 18. get access to seagoing facilities and fieldwork locations in coastal areas; and 19. create an international network and become a member of our academic community of marine sciences students, staff members, and alumni.	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	N/A	
8.2	Material and technical support	Students will receive excellent support from technical and electronic engineers and use state-of-the art laboratory facilities and field instrumentation at Utrecht University and the Royal Netherlands Institute for Sea Research (NIOZ). Students will also have access to excellent computational tools for Earth System and Climate modelling. Furthermore, you get access to seagoing facilities and fieldwork locations in coastal areas	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Introduction to Marine Sciences	7.5	Examination
9.1.2	Oceans Law and Policy	7.5	Examination
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Making, Analyzing and Interpreting Observations	7.5	Examination
9.2.2	Paleoceanography and Climate Variability	7.5	Examination
9.2.3	Aquatic and Environmental Geochemistry	7.5	Examination
9.2.4	Microbes and Biogeochemistry	7.5	Examination
9.2.5.	Introduction to Physical Oceanography	7.5	Examination
9.2.6	Astronomical Climate Forcing and Time Scales	7.5	Examination
9.2.7	Morphodynamics of Tidal Systems	7.5	N/A
9.2.8	Stable Isotopes in Earth Sciences	7.5	N/A
9	Coastal Ecology	7.5	N/A
10	Dynamical Oceanography	7.5	N/A
11	Waves in Geophysical Fluids	7.5	N/A
12	Dynamics of Sedimentary Systems	7.5	N/A
13	Morphodynamics of Wave-dominated Coasts	7.5	N/A
14	Reconstructing Extreme Climate Transitions	7.5	N/A
15	Reactive Transport in the Hydrosphere	7.5	N/A
16	Earth System Modeling	7.5	N/A
17	Waves in Geophysical Fluids	7.5	N/A
18	Ice-Ocean-Climate interactions	7.5	N/A

19	Organic Geochemistry	7.5	N/A
20	Field research instruction geochemistry	7.5	N/A
10			
10.1		Master's thesis	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Introduction to Marine Sciences
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	This course brings all students in the MSc Marine Sciences to the level in Marine Biology, Chemistry, Physics and Earth Sciences, required to successfully participate in thematical courses within the program. The course is also accessible for students in related MSc programs.
8.	Prerequisites for studying the course/module, connection with other educational components	This course requires BSc level knowledge of the ocean regarding at least one of the major themes: Biology, Chemistry, Physics and Earth Sciences.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Have a basic understanding of food webs, ecological properties and anthropogenic impacts on coastal marine ecosystems (carbon transfer, diversity, connectivity & adaptive capacity);
Have a basic insight into biogeochemical processes in the water column and the sea floor and elemental cycling.
Have a basic understanding of the dominant balances in the large- and mesoscale ocean circulation
Have obtained a basic understanding of the dynamics of waves and tides in coastal regions and of the different spatial and temporal scales associated coastal morphodynamic behaviour.
Have gained a basic understanding regarding the application of proxies to reconstruct past ocean conditions.
Have gained understanding of the role of public international law in regulating the relations between states, the role of law and policy for the governance of the oceans, the legal regime for marine scientific research and the role of scientific research in the formulation of oceans law and policy.
Most crucially, realize which aspects of the Marine Sciences might need extra attention during your MSc trajectory.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1. In this course students will gain a multidisciplinary insight into the marine sciences. The aim of the course is to reach a knowledge and integration level required to follow other MSc courses in marine biology, physics, chemistry, and earth sciences. Moreover, basic insights into issues related to law and policy of the sea will be gained.
2. The various disciplines will be integrated using a project theme case study that will be studied from multiple disciplines and will be presented at the end of the course. In groups of ~4-5 students that have different backgrounds, this case study will be treated with a specific research question formulated by the students. Results will be reported in written communication and will be presented in an oral presentation at the end of the course. Within this project you will work on your problem-solving skills, and skills regarding leadership, ability to work in a team, to take initiative in organizing progress and flexibility/adaptability.
3. The first days of the course will encompass a multidisciplinary introduction, and aspects of oceans law and policy. This is followed by two weeks of physics, followed by chemistry, biology, and finally paleoceanography. Individual thematic blocks of two weeks will yield lectures, (computer) practicals offered on Wednesday afternoon and Friday, and an assignment that will be marked.
4. Typically, every week will have about 10 contact hours, of which 4-5 hours of interactive lectures and 5-6 hours of exercises, discussions and practicals to work on your reporting and analytical/quantitative skills. Depending on your background, some themes will be harder to follow than others. For the new themes, you will probably need to invest more time and submit a strong work ethic to keep up. Most themes will include a brief report or exercise that will be graded. About 10 hours will be spent on preparations, the case study and feedback/conversations with instructors.
5. All individual marks must be at least 5.5. Tests that are marked between 4.0 and 5.5 may be retaken once; grades below 4 are typically not accepted. The final result will be the average of the (sub)-weekly assignments (30%), exam (35%) and the marks for the case studies presented at the end of the course (35%).
6. Absence for up to two days should be indicated to the specific instructor of that day and the coordinator of the course. For longer periods of absence, contact the coordinator. An extra opportunity for tests will be created in case of sickness or personal circumstances.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Explanation: Lectures, Self-study, Literature study (multidisciplinary), written reports and oral presentation. Preparation of meetings some preparation to lecture may be needed in the form of literature reading before the lecture. Contribution to group work A section of the course will comprize a literature case study in groups of 4 or 5 (see above). Practical: Attendance requirement Yes Explanation computer exercises or exercises on paper to get an in-depth insight in the theoretical part Preparation of meetings reading literature, different preparation depending on the teacher and the subject Contribution to group work Practicals are usually done individually	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #2		
1	The name of the course/module	Marine Sciences Oceans Law and Policy
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Mandatory
4.	Semester	1/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	The oceans are essential for maintaining life on earth, their mineral resources are increasingly important to the world economy and marine fisheries significantly contribute to ensuring food security. 90% of all international trade is seaborne and most data communication is through submarine cables. Pursuing an effective governance regime for the oceans continues to be a challenge for the international community.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge of public international law

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After successful completion of this course students are expected to be able to:
1. a general understanding of the legal and policy framework for governing the oceans;
2. a general understanding of the different inputs marine science may have in the formulation and implementation of these policy frameworks;
3. the ability to assess the significance of these policy frameworks for specific ocean uses.

Academic skills:
1. ability to analyze text to determine issues of legal relevance;
2. ability to determine the relevant legal framework for scientific research in the marine environment;
3. ability to formulate views of this relevant legal framework orally and in written form.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course will first of all provide the students with some basic knowledge about public international law. That knowledge is essential for understanding the law of the sea as a part of public international law and the actors that play a role in the formulation and implementation of this legal framework.

The current regime for the oceans is built on the United Nations Convention on the Law of the Sea of 1982 (UNCLOS). This framework convention divides the oceans in various coastal state maritime zones and international areas. In all these areas the legal regime seeks to maintain a balance between the rights and interests of individual states and the international community. The course sets out the legal regime applicable to the oceans, how oceans policy to create an effective governance system is taking shape and how disputes over ocean resources may be managed. The course will not only look at the UNCLOS but will also identify and discuss the role of other global and regional conventions and organizations in developing the law and designing effective governance policies.

Science has a role to play in the implementation of the UNCLOS and specific management regimes for ocean uses. The course will illustrate this role of science in oceans law and policy and will also provide an overview of the legal regime applicable to the conduct of marine scientific research.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture Explanation: The course will consist of lectures with discussions that will require active preparation by the students and in addition will contain a couple of role plays simulating international negotiations. Preparation of meetings Students are required to read the read the prescribed materials for each lecture in advance of that lecture and prepare answers to questions that may be posted in Blackboard prior to the lectures Tutorial: Contribution to group work The tutorials will consist of two sessions of moot international negotiations. The class will be divided in four groups. At each tutorial session, two groups will represent a State engaged in negotiating a bilateral agreement and will confront each other. The other two groups will participate in the negotiations as observers, representing civil society interests (NGOs, industry, local communities, etc.).	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #3		
1	The name of the course/module	Making, analyzing and interpreting observations
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	Observations are a key component in climate research. They are essential in process studies and the evaluation of numerical modelling.
8.	Prerequisites for studying the course/module, connection with other educational components	It is assumed that the students have followed or are following the three first year compulsary master courses of MPOC.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
1. Is acquainted with basic data analyses techniques, calibration, data correction, outlier removal etc. 2. Is able to write simple programming codes (Python, mathlab, Fortran, C++.) in aid of the data analyses. 3. Is able to read modern scientific literature about topics in climae research. 4. Is able to describe analyze and interpret data. 5. Is able to present the results in an oral presentation and a written report in a clear and convincing manner 6. Is able to design and implement a project workflow to study a geophysical problem using earth system data

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
In this course you will gain experience with in-situ and satellite measurements related to meteorological, cryospheric or oceanographic processes, and learn how they can help us to better understand the Earth system. When possible you will get the opportunity to participate in (ongoing) experiments.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Explanation: 1. Lectures, Self-study, Literature study (multidisciplinary), written reports and oral presentation. 2. Preparation of meetings 3. some preparation to lecture may be needed in the form of literature reading before the lecture. 4. Contribution to group work	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

5. A section of the course will comprize a literature case study in groups of 4 or 5 (see above). Practical: 6. Attendance requirement 7. Yes 8. Explanation 9. computer exercises or exercises on paper to get an in-depth insight in the theoretical part 10. Preparation of meetings 11. reading literature, different preparation depending on the teacher and the subject 12. Contribution to group work 13. Practicals are usually done individually	

GENERAL INFORMATION ABOUT THE COURSE #4		
1	The name of the course/module	Paleoceanography and climate variability
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	(Paleo)ocean circulation during different climatic regimes and related proxy variability will be discussed while sequentially introducing different concepts and aspects. Theory and application of marine proxies will be illustrated by relevant case studies. In particular the Glacial world will be contrasted to the (present-day) Interglacial, and compared to high-frequency (e.g. El-Nino) paleoceanographic and proxies variations.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge of paleoceanography, experience with spreadsheet programs such as Excel.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

On the basis of realistic scientific data, by the end of the course, student will:
1. be trained to identify, interpret and reconstruct the role of the ocean in past changes in climate;
2. be trained to identify, interpret and reconstruct paleoclimate and variations there in;
3. be trained in general academic skills such as writing reports, presenting scientific concepts.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

In particular the Glacial world will be contrasted to the (present-day) Interglacial, and compared to high-frequency (e.g. El-Nino) paleoceanographic and proxies variations. Amongst the aspects to be discussed are: Glacial climate and its forcing; sediment dating techniques; paleoproductvity; pCO2 reconstruction; oxygenation; sea surface temperature; deep water circulation; and proxy preservation. Current important scientific questions will be addressed and different view points discussed. The course teaches students hands on scientific research so that they can 'hit the ground running' in climate related projects.

Development of Transferable Skills
Ability to work in the team: Presentations, practicals and final research proposal are organized in teams. Students have to distribute tasks, organize the workflow and are responsible for the time planning.
Problem solving: students receive data from previous sea-going expeditions and have to use different approaches to unravel past ocean and climate change.
Verbal communication skills: 50% of the lectures are based on the so-called flip-class room concept in which the students have to transfer expert knowledge to to their peers. This implies that they alos have to set teaching goals, plan a lecture and present the lecture. Subjects are setup in such a way as to stimulate discussion and participate in the discussion.
Analytical / quantitative skills: students have to setup and run simple numerical (inverse) models to to analyse their data. These model runs are subsequently quantitatively compared with real world data.
Technical skills: using the computer programmes Excel for handling large data sets and data transformations. By regularly comparing different analytical approaches students get insight in the prossibilities and limitations of the different techniques.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Computer practical, lectures	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #5		
1	The name of the course/module	Aquatic and Environmental Chemistry
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	The course deals with processes that control the composition of water in aquifers, soils, lakes, and in the ocean. The focus lies on using equilibrium approaches to describe and quantify these processes.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic calculus, derivatives and integration. Basic knowledge of equilibrium thermodynamics. Basic concepts in chemistry and geochemistry.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Wouldn't it be fascinating to understand which chemical principles play a key role in the Earth's near surface environments? At the end of the course, you will have the theoretical foundation and practical skills to interpret and predict the composition of natural or contaminated waters based on equilibrium thermodynamics. You will have an overview of quantitative concepts to describe acid base properties of solids and solutions, redox speciation of certain inorganic and organic compounds in aqueous solution, solubility of solids, metal speciation in aqueous solution, distribution of compounds between different phases, and the adsorption of ions at the solid-liquid interface. You will also have learned how to use computer-based chemical speciation models and practiced your writing and assessment skills.

Development of transferable skills

Ability to work in a team: The quantitative problems related to various projects in the course are solved in teams, typically couples. Important part of the team work is the critical assessment and discussion of results obtained from the chemical equilibrium models.

Written communication skills: students are introduced to the scientific review process. They write a scientific manuscript, review manuscripts from their fellow students and improve their manuscripts based on the comments.

Problem-solving skills: In the projects, students have to find a strategy to answer the given research or practical questions.

Analytical/quantitative skills: Students have to learn to conceptualize processes affecting the composition of natural waters. Conceptual understanding is a prerequisite to properly define problem sets in chemical equilibrium models.

Technical skills: students are introduced to the methodology to solve quantitative problems in the field of aquatic chemistry including chemical equilibrium models.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Speciation of dissolved compounds in aqueous solution:

Acid-base reactions, complexation of metals, redox speciation, introduction into quantitative methods in aquatic chemistry including the tableau method and speciation models.

Partitioning of compounds between different phases:

Thermodynamics of equilibrium partitioning, gas – water partitioning, solid-water partitioning, liquid – liquid partitioning

Adsorption at the solid-water interfaces:

adsorption isotherms, surface reactivity of solids, surface complexation, ion exchange

The course includes project-based work. These projects are devoted to processes controlling the composition of waters in surface and subsurface environments or the phase distribution and transformation inorganic compounds in aquatic environments. Computer equilibrium models will be used to solve quantitative problems related to the different projects.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Computer practicals Explanation Computer equilibrium models will be used to solve quantitative problems related to the different projects. Contribution to group work During computer practicals, you can work in pairs. Lectures Explanation In lectures, we will treat key examples and show controlling principles and material properties that are at work behind the scenes. Lectures will be alternated with exercises. Projects Explanation The course includes project-based work, on which you will mostly work outside class. For these projects, you will write a short	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

geochemistry paper and one project includes a peer-assessment round. While this project is aimed to get in depth understanding of geochemical processes, it is also a great opportunity to work on your writing skills and get prepared to write an MSc thesis. Tutorials Explanation During tutorials, you will learn to apply the taught principles (on paper and computer), starting off fairly simple and ending with complex natural systems. Contribution to group work During tutorials, you can work in pairs.	

GENERAL INFORMATION ABOUT THE COURSE #6		
1	The name of the course/module	Microbes and Biogeochemistry
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	1/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	The objectives of this course are: (1) to provide a mechanistic and qualitative understanding of biogeochemical processes in aquatic environments (in particular oceans) and (2) to describe interactions between microorganisms and the geosphere. The course will focus on organisms that are involved in organic carbon production, transformation and degradation, mineral precipitation and dissolution, and that control the distribution of elements, such as C, N, P, and some other nutrient elements in diverse environments at and below the Earth's surface.
8.	Prerequisites for studying the course/module, connection with other educational components	Essential: BSc. or equivalent degree in Biology or Earth Sciences or related field. Useful background: basic knowledge of geochemistry and general biology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

1. Written communication skills: Students are expected to write term papers and a short research proposal.
2. Verbal communication skills: Students will present a lecture for the general audience about a recent topic in Biogeochemistry.
3. Strong work ethic: students are assigned tasks early in the course with fixed deadlines and have to organize themselves in order to deliver on time.
4. Analytical skills: the material offered comprises many aspects and students are supposed to elucidate complex issues crossing disciplinary boundaries.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

This course deals with the interactions between the biosphere and geosphere, in particular in the marine environment. The focus is on modern environments and the two-way linkage between organisms and their surroundings. We will cover the basic concepts and approaches in biogeochemistry and the organism involved. The distribution, growth and metabolism of selected organism will be related to the major biogeochemical cycles (e.g. C, N, P, S, Fe) and to processes such as redox transformations and mineral dissolution/precipitation. The course also deals with the basis of molecular techniques, use of isotopes in (microbial) ecology and conceptual models for microbial processes and biogeochemical cycles. The course will be useful for those interested in bioremediation, biogeochemical processes in present and past ecosystems, the effect of climate and global change on the functioning of System Earth. Students will present and discuss debated issues at the interface of the biosphere and geosphere.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics. All parts: written self-assessment, project proposal, product, team process and individual process.

GENERAL INFORMATION ABOUT THE COURSE #7		
1.	The name of the course/module	Introduction to Physical Oceanography
2.	Faculty/department	Faculty of Geosciences

3.	Status of the educational component	Optional
4.	Semester	1/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	Physical oceanography is the field of study that deals with the physical properties and dynamics of the ocean, including the influence of the ocean on the climate of the atmosphere. The course will start with describing the ocean properties, such as sea level, temperature, salinity and density and will discuss how they are relevant for the ocean circulation.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic physics and mathematics (BSc level).

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

At the end of the course the students will have developed a generic and intuitive understanding of the physical processes responsible for the present-day ocean and shelf sea circulation.

By the end of the course, students will:
Have an understanding of the physical properties of the sea water
Have a good intuitive understanding of the physical laws that drive the ocean circulation
Appreciate the difficulty of measuring the ocean circulation, and how computer codes are used to simulate this circulation
Appreciate the role that ocean circulation plays in climate and marine ecosystems
Have developed coding and data analysis skills using Python
Are able to communicate recent academic literature to a broader audience

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Both practical measurement techniques and ocean general circulation models will be introduced. The impact of the earth rotation and the associated Coriolis force on the ocean circulation will be used to explain fundamental ocean phenomena such as geostrophic currents, the large-scale wind-driven ocean circulation and western boundary currents (e.g. Gulf Stream). Upper ocean processes in the mixed layer and the Ekman transport will be covered and used to explain upwelling and downwelling phenomena (water moving from depth to the surface and vice-versa). Processes such as the El Nino-Southern Oscillation (ENSO) and water mass transformation associated with the thermohaline circulation will be presented. Finally, specific phenomena such as tides will also be introduced to explain shelf sea circulation.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
1.Lectures Explanation Class meetings will consist of lectures and discussions. Preparation of meetings Go through the slides and read the corresponding literature as indicated on blackboard. 2.Tutorials Preparation of meetings Read the corresponding literature as indicated on blackboard. Contribution to group work In addition to practice (python) exercises related to the theory discussed during the lecture, there will be time to work on the assignments, evaluation of the science communication assignment, and discussions on career perspectives assignments 3. Computer practical Explanation In preparation for the assignment, there will be a python workshop.	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #8

1.	The name of the course/module	Astronomical climate forcing and time scales
2.	Faculty/department	Faculty of Geosciences

3.	Status of the educational component	Optional
4.	Semester	1/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	Paleoclimatic research dedicated to unravel natural climate variability is becoming increasingly important in view of current global warming. Astronomical forced climate change related to the Earth's orbital parameters represent a crucial and integral part of the natural behavior of the climate system in the past on millennial to million year time scales. Paleoclimate studies has solved the problem of the Ice Ages and focused on the orbital theory of the Monsoon. In this course we will focus on climate forcing by the Earth's orbital parameters computed by means of astronomical solutions for the Solar System. In addition, we will focus on the use of (Milankovitch) cycles to construct geological time scales with an unprecedented resolution and accuracy that are necessary for climate studies of the past and on mathematical methods to statistically detect cyclic variability in paleoclimate records.
8.	Prerequisites for studying the course/module, connection with other educational components	Spreadsheet skills. Useful background: Paleo-oceanografie en -klimaat; Paleo-oceanography & climate variability.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Gain comprehensive knowledge about the astronomical influence on climate and the development of high-resolution integrated geological time-scales and their applications in paleoclimatic and other Earth science studies. Training in how to carry out individual / teams assignments by means of computer-practicals and presentation (written/oral) of results.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course is divided in two parts that are intricately linked:
Astronomical time scales and their applications: Introduction and astronomical solutions; Time scale development and spectral analysis; Ar/Ar dating and geodynamic linkages; Cyclostratigraphy and link to sequence stratigraphy.
Astronomical forcing of climate: Astronomical climate forcing and phase relations; Climate modelling of orbital variations; Sub-Milankovitch cyclicity.
During the computer practicals students will operate in teams of 2 and learn how to use statistical methods (spectral, wavelet) to detect astronomical climate forcing in paleoclimatic archives and determine phase relations between cyclic climate changes and insolation forcing. In addition results of climate modeling experiments will be statistically analysed using the same methods.
Students (in teams of 2) will further have to write an essay on a topic related to the contents of the course and based on scientific publications. They will also have to give a powerpoint presentation of 15-20 minutes that will be marked by fellow students as well.
Grading
The course has both a mid-term ("tussentoets") and final examination. The mid-term examination counts for 20% and the final examination for 45% of the final mark. The remaining 35% is equally divided over the essay and oral presentation. Practical reports and paper summaries have to be accepted, but will not be graded.
Final course mark: The final course grade will be satisfactory (pass) or unsatisfactory (fail), expresses in numbers, 6 or higher and 5 or lower respectively. The final grade will be rounded off in one digit. A final course grade of 5 will not have any decimal places; an average grade of 4.50-5.49 is unsatisfactory, an average grade of 5.50-5.99 becomes a 6.
If you have fulfilled all course obligations but failed to obtain a final grade 6 or higher, you will get one chance to repair, via a supplementary test ("aanvullende toets"). However, a non-rounded off final grade <4.00 implies a definite fail, i.e., no right on a repair assignment.
Character and content of the supplementary test will be decided upon in due time. If you pass the supplementary test, a final course grade of 6 will be recorded in the student progress administration system.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Computer practicals, lectures	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #9

1	The name of the course/module	Morphodynamics of Tidal Systems
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	1/2
5.	Number of ECTS credits	7.5

6.	The total number of hours	225
7.	General description and purpose of the educational component	This course is the second course in a series of three (period 1: River and Delta systems, period 3: Morphodynamics of wave-dominated coasts). Other courses in the MSc that focus on delta and coastal systems are Coastal Ecology and Managing Future Deltas. During this course the dynamics of tidal systems will be studied at all relevant time scales (few hours to millennia) and spatial scales (kilometers to global scale). We will follow the pathway of the tidal wave from its generation in the ocean to the dissipation of tidal energy in the shallowest regions of tidal basins and estuaries.
8.	Prerequisites for studying the course/module, connection with other educational components	Participating candidates ought to have basic programming skills in MATLAB or Python. A basic background in Fluid mechanics is desired.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

After the course, the student:
Will understand the basic hydrodynamic and morphodynamic processes caused by tides.
Will be able to develop and use models to analyse tidal time series and to predict the hydrodynamics,sediment transport and morphological change in tidal systems.
Is able to critically read scientific literature and to position detailed research results in the broader picture of coastal research.
Will be able to apply his knowledge in coastal research and consultancy.
Will be able to to present and discuss results in written reports and oral presentations.
Development of Transferrable Skills:
Ability to work in a team: During the course the students have to work in teams to do computer exercises, write reports and do research.
Written communication skills: Students have to deliver reports. You will get feedback on the content.
Problem-solving skills: Students have to work on programming exercises and apply it to analyse data sets or model tidal phenomena.
Verbal communication skills: Students have to give an oral presentation on the results of a case study.
Analytical/quantitative skills: Students have to analyze data sets, to apply equations to field cases, and to program Matlab code.
Technical skills: Students will have to program in Matlab or Python and will learn to use the codes to study tidal phenomena.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Main topics of the course are:
Generation of tides by the gravitational interaction of earth, moon and sun.
Tidal dynamics of shallow shelf seas.Hydrodynamics and morphodynamics of shallow tidal basins.
Tides in estuaries: Effect of geometry on tides, river-tide interactions, estuarine dynamics, fine sediment dynamics and morphological change.
Time series analysis of water level and flow velocity data.
Evolution and depositional architecture of tidal systems under sea level rise.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Computer practicals Lacquer peel practical Practical Lectures Presentations	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #10

1	The name of the course/module	Stable Isotopes in Earth Sciences
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	1/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	First, theoretical principles will be explained for equilibrium vs. kinetic isotope fractionation, mass-dependent vs. mass-independent isotope fractionation, and the temperature dependency of each.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic concepts in chemistry and geochemistry • Basic knowledge of physical chemistry (including statistical mechanics) • Basic algebra and calculus • Basic IT work (e.g., using spreadsheets), knowledge of Matlab or R will be advantageous but is not essential.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

By reading the isotopic composition of a sample—be it solid, liquid, or gaseous—one can tell a story about its origin and history. For example, if the sample is a mineral, one can elucidate the mechanisms or environmental controls involved in its formation or transformation. If the sample is an organism, one can elucidate its activity or eating habits. This course will teach you why this works, where it is applicable, and how it is done in practice. Specifically, you will learn the theoretical principles behind equilibrium and kinetic stable isotope fractionation, understand the principles behind techniques used to analyze stable isotope composition of materials, become acquainted with a broad range of applications of stable isotopes in Earth sciences, and develop practical skills in processing and quantitatively interpreting stable isotope data. Additionally, you will learn how to use certain data processing programs, and develop your writing, analytical, evaluation and communication skills.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
Subsequently, the following applications will be discussed in detail: atmospheric carbon cycle, role of natural (assimilation vs. mineralization) and anthropogenic activity. Tracers: 13C in CO2, 13C and D in CH4. hydrological cycle, and its link to paleo-thermometry. Tracers: 18O and D in H2O, clumped isotopes (13C and 18O) in carbonate minerals. understanding the mechanisms of mineral formation and transformation from their isotopic composition (natural or experimentally perturbed); role of biological activity (assimilation vs. mineralization pathways) on fractionation factors, tracing sources of biogenic minerals and conditions of their formation. Tracers: 13C in carbonates. reconstruction of food-webs. Tracers: 13C and 15N in specific compounds (e.g., lipids or fatty acids). quantification of organism-specific (e.g., microbial) rates of activity, stable isotope probing. Tracers: 13C, 15N, 18O, D.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- lectures; - seminars	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #11		
1	The name of the course/module	Coastal Ecology
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	1/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	Estuaries and coastal waters are among the most biologically productive ecosystems on the planet, critical to the life cycles of fish, other aquatic animals, and the creatures that feed on them. The Coastal Ecology course covers three themes, being (i) environmentalconditions, habitats & ecological interactions, (ii) landscape formation & ecosystem dynamics by ecosystem engineers, and (iii)threats, challenges & opportunities.
8.	Prerequisites for studying the course/module, connection with other educational components	Essential: Bachelor or equivalent degree in Biology, Earth Sciences or related field.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
By the end of the course, the student Has gained a general understanding of the key processes that drive coastal ecosystems Has experience in formulating a research proposal (including research aim, description and timetable) Has obtained the ability to critically read, understand and interpret scientific literature Has developed skills communicating scientific results to a broader audience. Development of transferable skills: Ability to work in a team: research papers, case studies and proposal need to be prepared and carried out in teams.Students have to distribute tasks and organize the workflow; Grant application writing: Formulate clear and well-defined research questions, embed them in existing knowledge and incorporate knowledge transfer Organization and time management: Critically design your research plan by balancing research ambition/innovation with feasibility. Verbal communication skills: emphasis is put on transferring knowledge to both a non-scientific audience and the scientific community; talks need to be prepared to make scientific literature and concepts approachable for the generalpublic and to ‘sell’ their research idea.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
The course will start with introductions on the framework of the course, and how to read and present a scientific paper. Hereafter,every week one to two specific scientific papers will be introduced, comprising new insights on this matter, of which the links will bemade available via the Blackboard. The students are then requested to read the papers thoroughly. Students are requested to prepare questions within small groups todiscuss with one of the authors of the paper. In addition, students (one group per week) will prepare a presentation on the paperindicated for a broader audience, which is presented as the start of the discussion with the invited author. Each topic will be started byan in-depth lecture of the invited author. In addition, students will work in groups on two case studies presented by non-academic experts in the field of coastal ecology (consultancy and NGO). Furthermore, students will learn to write a research proposal within the field of coastal ecology, including giving feedback based on existing criteria, present your research ideas and formulate a rebuttal. You will learn how research is funded and will get tips and tricks for writing research proposals. Finally, if weather and COVID restrictions allow it, we will visit a coastal site within the Netherlands (most likely Sandmotor).

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- lectures; - seminars	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #12		
1	The name of the course/module	Dynamical Oceanography
2.	Faculty/department	Faculty of Science
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	The ocean circulation is driven by wind-forcing and by density differences, the latter arising through gradients in temperature and salinity. Main focus: Physical processes responsible for the present-day ocean and shelf sea circulation.
8.	Prerequisites for studying the course/module, connection with other educational components	Assigned study entrance permit for the master.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
By the end of the course, the student: has in-depth knowledge of the mathematical formulation of the large-scale wind-driven and thermohaline-driven ocean circulation understands the concepts of continuously stratified and multi-layer ocean models, and the effect of density stratification on ocean flows is able to model the adjustment of a midlatitude ocean flow to a time-dependent wind-stress forcing, and knows the role of Rossby waves in this process is able to model and describe the physical concepts of ocean-atmosphere coupled processes and ocean adjustment processes related to El Nino understands how ocean circulation is a key driver for climate and marine ecology knows how to use techniques from science communication to translate recent, technical advancements in physical oceanography to a broader audience

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
After a brief description of the ocean current systems which are presently observed, this course focuses on understanding the physical processes that determine the spatial pattern and amplitude of the currents and their variability. After a recapitulation of basic principles of geophysical fluid dynamics, the theory of the steady homogeneous wind-driven ocean circulation will be presented. It leads to an explanation of the presence of strong western boundary currents in midlatitude ocean basins (i.e., the Gulf Stream in the Atlantic Ocean). Subsequently, the midlatitude theory is extended to include transient phenomena (waves and instabilities) and the effects of stratification. Next, a basic view of the processes governing the Antarctic Circumpolar Current is presented. The ocean's vertical density distribution serves as an introduction to the theory of the planetary density driven (or thermohaline) circulation. Finally, the impact of ocean currents in storing and redistributing anthropogenic carbon and heat is discussed, as well as the role these currents have in transporting organisms and (plastic) litter, thereby shaping marine ecosystems.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture Explanation During the course, several problem sets will be handed out. Students are encouraged to work on these problems and to hand in the solutions. Furthermore, the students work in groups on small projects to get familiar with data visualisation and modelling. Tutorial	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #13		
1	The name of the course/module	Waves in Geophysical Fluids
2.	Faculty/department	Faculty of Science
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	Internal waves are ubiquitous small-scale phenomena in the ocean. Despite their small scale they may yet play a role in both large as well as small scale ocean dynamics and may be of importance in transporting nutrients, plankton and trace gases.
8.	Prerequisites for studying the course/module, connection with other educational components	(Especially relevant for BA-students and students of other faculties): Ordinary and partial differential equations. Fluid mechanics.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Is acquainted with contribution of small-scale eddies, waves and turbulence to mixing and transport and their implication for large-scale ocean dynamics.
Has knowledge of stable, anisotropic geophysical equilibria (hydrostatic, cyclostrophic and geostrophic balances) and their characteristic frequencies.
Recognizes internal gravity and inertial waves; their relation to Rossby, (equatorial) Kelvin and Poincaré waves, their complementarity to surfaces waves, and the prominent role played by geometry in their localization on attractors.
Is familiar with internal waves in theory and nature; knows analytic and arithmetic methods to find exact free and forced wave solutions in 2D, approximations in 3D, and performs wave attractor experiments in stratified fluids.
Is familiar with both traditional and non-traditional f- and beta-plane dynamics on an aquaplanet. Understands inertial oscillations versus equatorial trapping.
Learns general concepts from partial differential equations, dynamical systems wave dynamics and data

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Here, an introduction to internal waves is given by looking at simple theory and laboratory and numerical experiments. Despite the theory being linear, the internal wave fields seem to be riddled by self-similar properties, a feature normally associated with nonlinear dynamics. Internal waves seem in general to be attracted to particular locations where they lead to mixing. Given stratification and basin shape, these wave attractors are highly predictable. Yet, their detection in real ocean basins still poses a challenge. Some field observations of internal waves will illustrate this.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lecture Explanation Attending lectures, handing in assignments (including a numerical experiment), laboratory experiment, paper presentation, exam, retake Seminar	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #14		
1	The name of the course/module	Dynamics of Sedimentary Systems
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	2/1

5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	In this course, students are invited to explore the mechanisms that govern the distribution, architecture, and characteristics of deposits preserved in the geological record at the level of a Master in Science.
8.	Prerequisites for studying the course/module, connection with other educational components	Previous experience in Sedimentology & Stratigraphy courses in Earth Sciences undergraduate programs will be beneficial for the students. However, the class has an inclusive academic attitude and welcomes people with diverse backgrounds. There is no prerequisite knowledge.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Throughout the thematic treatment described below, students will be confronted with the mechanisms "at work" in modelling exercises both in the silicon environment of numerical modelling as well as the gritty environment of the flume laboratory. These practical exercises will allow the students to strengthen their skills in modeling approaches and data treatment.
An optional three-day fieldtrip to Holocene and Jurassic tidal, coastal and shallow marine deposits will allow the students to use elementary observations on sedimentary facies to build models and interpretations of the evolution of past sedimentary systems.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Early in the course, emphasis is put on the effect the choice of temporal and spatial scales defined by a research question has on our approach to sediment transport dynamics. Following this, the hierarchy and scaling of the architecture of sedimentary successions is investigated. The structure of this architecture will be built on concepts of sequence stratigraphy. Once a clear perspective on the organization of deposits in parasequences, sequences, and shelf-clinoforms has been presented to the student, attention will shift to forcing mechanisms of deposit characteristics within different depositional environments: Alluvial systems; transgressive systems and highstand deltas; tidal systems; and deep marine depositional systems. The course will conclude by challenging the students to investigate the validity and application of two oft (miss-)used concepts of Earth Sciences: "Walther's Law"; and "The present is the key to the past".

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Computer practicals Flume Laboratory Practicals Practical Lectures Three-day fieldtrip Excursion	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics. Theory lectures: lectures based on powerpoint presentations and videos.

GENERAL INFORMATION ABOUT THE COURSE #15

1	The name of the course/module	Morphodynamics of Wave-dominated Coasts
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	Wind-generated waves are the main driving force for the evolution of the nearshore zone (water depths less than 10 m) on time scales of hours (storms) to decades. As waves approach the coast, they transform by altering, among other characteristics, shape, height, length, and orientation. This results in a wide variety of other processes, including alongshore currents and rip currents. Also, it leads to the transport of sand perpendicular to and along the coast. As a consequence, the morphology of the nearshore zone changes continuously as the offshore wave conditions change with time and when mankind intervenes with coastal processes, for example, by artificially placing sand to enhance coastal safety. This makes the nearshore zone one of the most dynamic and complicated regions within the oceanic domain.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic familiarity with coastal processes, statistics as well as programming in MATLAB or Python.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

By the end of the course, the student:
Has acquired an in-depth, quantitative understanding of wave statistics (including time series analysis), wave transformation, wave-induced and aeolian sand transport, and morphological evolution in wave-dominated coasts;
Can program assignments related to time series analysis, modelling and data-model comparison using Matlab or Python;
Can differentiate and recommend modelling approaches for waves and wave-driven morphodynamics;

Is able to critically read scientific literature and to position detailed research results in the broader picture of coastal research; Can describe and motivate the choices in the management of the wave-dominated coasts (with a focus on the Dutch context), including dunes. The course contributes to the following transferable skills: Ability to work in a team: All computer assignments are performed in teams of 2 or 3 persons. Although each team is to provide a report, co-operation between teams during the assignments is encouraged. Written communication skills: Results of all computer assignments are presented in reports. Problem-solving skills: The teams have to define a strategy how to implement code to solve allocated scientific questions. Analytical/quantitative skills: The students have to use the developed code, together with knowledge from the lectures, to answer allocated scientific questions. Technical skills: The students will (further) develop their programming skills for data analysis and modelling.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
Main topics of the course include: cross-shore transformation of wind-generated waves, and the resulting currents; sand transport and morphological evolution; modelling of waves, currents, and sand transport; at a range of time scales (hours - decades) and in natural and humanly altered wave-dominated coastal settings. The later setting provides the student with insight into issues related to present-day coastal zone management.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Computer practical, lectures	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #16		
1.	The name of the course/module	Reconstructing Extreme Climate Transitions
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	The main aim of this course is to illustrate how large scale abiotic processes reshaped the evolutionary history of biota and their communities and how, in turn, the changes in biota (as evidenced by the fossil record) inform us about past environmental changes. We will focus in the course on several key transitions in earths climate and biota, in the Mesozoic and Cenozoic.
8.	Prerequisites for studying the course/module, connection with other educational components	BSc in Biology, Earth Sciences or equivalent. Students may contact the coordinator to ask for entry requirements in case a different study path was followed. Students are supposed to have firm background in Biology and Earth history. Students from Utrecht University have ideally attended bachelor courses such as Earth History, Evolutionary Biology, Paleoecology, Paleontology, Ecology and Evolution, Marine Sciences (BIO), Paleoceanography, Sedimentary Systems, Paleoclimatology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
To work with (large) dataset for qualitative and quantitative paleo-reconstructions, decide the best strategy to simplify complex the data and validate data by means of statistical analyses; To integrate multi-proxies data providing the student with a broad vision on time scales and simultaneous changes in different environments (terrestrial and marine); To think critically about the potentials and pitfalls of the various methods used and decide which method is most suitable to find the adequate solution Written and verbal communication skills by means of presenting data as written reports and oral presentations To work individually and in teams (leadership skills) Technical skills (e.g., microscope, computer software) To critically analyze literature as presented in scientific papers and reported in the media (social media and/or press, etc.) thereby learning how reliably (and how ethically) scientific information are presented to a wide audience.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course deals with the evolution, biology and ecology of selected marine microorganisms and terrestrial vegetation and their use as fossils for past environmental and climate reconstructions during the Mesozoic and the Cenozoic. The course will focus on organic and calcareous microscopic remains/fossils (foraminifers, dinoflagellates, pollen and spores). Much attention will be given to the importance of linking changes that occurred simultaneously in the marine and terrestrial environment. The course also deals with the (biologically-mediated) process of incorporation of chemical elements into foraminifer shells and thus shells' chemical composition as proxy for reconstructions of past water column properties. Next to fundamental knowledge on evolution, paleoecology, and palaeoenvironmental reconstructions, the course will train the students' taxonomical skills. Students will learn to work with complex data, to perform quantitative and statistical analyses, to think critically, and to present their results orally. All these skills are desired and/or required for successful job applications.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Computer practical Lecture Explanation Lectures are not compulsory but highly recommended as the practical are related to lectures. Preparation of meetings Students are asked to present scientific finding from the news, which are then discussed in class every week. Students may be asked to read literature before class session. Students will work toward a final presentation and write reports during the course. Practical Explanation Missed practicals must be rescheduled, completed and will be checked. The rules of the course and what is expected from the students are explained at the beginning of the course and made available on Blackboard. Contribution to group work Several exercises are done in groups. Each student is expect to contribute to group work (reports, presentations)	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #17

1.	The name of the course/module	Reactive Transport in the Hydrosphere
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	2/1
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	The course teaches students how to create and use mechanistic and spatially explicit models to study (bio)geochemical processes in the various compartments of the Earth's hydrosphere including sediments, aquifers, rivers, lakes, and oceans.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge of aquatic chemistry, linear algebra, and differential calculus. Basic computer literacy.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

By the end of the course, students will
have a general understanding of concepts and methods needed to quantitatively describe (bio)geochemical reactions and transport processes in various compartments of the hydrosphere;
be able to formulate models (conceptually and with mathematical equations) to describe transport and reactions in Earth's surface environments;
be able to solve models numerically using appropriate modeling software (R, with relevant packages ReacTran & deSolve);
be able to perform sensitivity analyses to understand model implications;
be able to interpret the results of the models in the relevant context (e.g., geochemical processes in rivers, lakes, aquifers, sediments, oceans);
be able to report the results in written and oral forms.
The course will also help develop the following transferable skills:
Ability to work in a team: Practical exercises and group projects will be done in teams of 3-4 students. Students will need to distribute the tasks, organize and execute the workflow, and share responsibility for presentation of the results.
Written communication skills: results of group projects will be presented as reports. Feedback will be given after report submission.

Verbal communication skills: results of group projects will also be presented orally, as a group effort. Students will receive feedback on the quality of their presentations. Analytical/quantitative skills: Throughout the course students will solve quantitative tasks using numerical methods. They will also interpret their results in the wider environmental context. Strong work ethic: Students will be required to follow fixed deadlines for delivering results of group projects. Computer skills: Students will write their own code to solve models. This will develop their programming skills in the programming language R. Preparation of written reports and oral presentation will help them develop skills in programs used for word processing and slide shows.
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)
Model formulation: from conceptual diagrams to differential equations Introduction to R Spatial components and parameterization of models Model solution (using R-packages deSolve and ReacTran) Applications and case studies: coupled chemical reactions: atmospheric ozone dynamics surface reactions: mineral dissolution/precipitation acid-base chemistry: pH dynamics ecology: aquatic food-webs epidemiology: COVID pandemic global-scale models: Earth's global carbon cycle biogeochemistry in water bodies: anoxia in an estuary biogeochemistry in porous media: early diagenesis in sediments It is anticipated that students attending the course will have highly diverse levels of prior knowledge and experience in maths, programming and biogeochemistry, as well as diverse expectations from the course. The course can therefore be conducted at two levels, one aimed at students who want to use modeling as a way to improve their analytical skills, the other aimed at students who want to be challenged and think about modeling as a possible direction of their future career. To facilitate this, students will be required to develop and maintain a degree of mutual understanding and co-operation.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Computer practicals Lectures Student presentations Presentation	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #18		
1.	The name of the course/module	Earth System Modeling
2.	Faculty/department	Faculty of Science
3.	Status of the educational component	Optional
4.	Semester	2/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	Numerical modelling is widely used for understanding and predicting processes in the Earth System or components thereof (atmosphere, oceans, land ice, sea ice, biosphere…). These Earth System Models (ESMs) cover a whole range from low-dimensional conceptual modes that can be run on your PC to highly complex ones that require a supercomputer to run.
8.	Prerequisites for studying the course/module, connection with other educational components	A firm basis of python (second best: matlab) is very helpful — basics of climate physics, geophysical fluid dynamics

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
— understand basics of temporal and spatial discretisation, and how to choose them appropriately — acquire “bird-eye’s view” on the components of the Earth System and their interactions — develop understanding for capturing climate processes in model equations, including parameterisations — practice designing and evaluating model experiments — gain an overview about current research using ESMs
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The course starts with some mathematical basics on discretisation (Part 1), followed by lectures and hands-on projects with an actual, intermediate-complexity ESM (Part 2). Finally, we will discuss some ongoing developments and applications of ESMs (Part 3).

Part 1 - Discretisation. As opposed to the real world, numerical models operate on discrete time steps and spatial grid points (or, for spectral methods, wave numbers), and the discretisation method has impact on the accuracy of the eventual result. Bad choices of discretisation can even make the simulation blow up (instability). Resolution (distance between grid points) determines the spatial scales that can be modelled, but also computational costs.

Part 2 - Working with an ESM: The Earth System consists of interacting components, atmosphere, oceans, land ice, sea ice, biosphere. In each of them, physical and chemical processes take place, which have to be captured by governing equations. For some of them we know the basic equations (such as the Navier-Stokes equations which govern fluid motion), while others may be semi-empirical relations, e.g. inferred form lab experiments (cloud droplet microphysics). In addition, the components interact: For example, plant growth may be affected by rainfall fluctuations, while the plants themselves influence the atmosphere by taking up CO2. In the course, we will discuss one intermediate-complexity ESM, i.e. fairly detailed, but not so large as to require a supercomputer, which you will then use for your own model experiments (in groups).

Part 3 - Applications and current developments: Here we discuss large ESMs like CESM, their application by IMAU researchers and beyond, multi-model experiments such as the Climate Model Intercomparision Project, their validation, strengths, weaknesses and biases.
In addition, you will each read and present a paper on recent ESM research.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Computer practicals, Lectures	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #19

1.	The name of the course/module	Waves in Geophysical Fluids
2.	Faculty/department	Faculty of Science
3.	Status of the educational component	Optional
4.	Semester	2/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	Internal waves are ubiquitous small-scale phenomena in the ocean. Despite their small scale they may yet play a role in both large as well as small scale ocean dynamics and may be of importance in transporting nutrients, plankton and trace gases.
8.	Prerequisites for studying the course/module, connection with other educational components	(Especially relevant for BA-students and students of other faculties): Ordinary and partial differential equations. Fluid mechanics.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Is acquainted with contribution of small-scale eddies, waves and turbulence to mixing and transport and their implication for large-scale ocean dynamics.
Has knowledge of stable, anisotropic geophysical equilibria (hydrostatic, cyclostrophic and geostrophic balances) and their characteristic frequencies.
Recognizes internal gravity and inertial waves; their relation to Rossby, (equatorial) Kelvin and Poincaré waves, their complementarity to surfaces waves, and the prominent role played by geometry in their localization on attractors.
Is familiar with internal waves in theory and nature; knows analytic and arithmetic methods to find exact free and forced wave solutions in 2D, approximations in 3D, and performs wave attractor experiments in stratified fluids.
Is familiar with both traditional and non-traditional f- and beta-plane dynamics on an aquaplanet. Understands inertial oscillations versus equatorial trapping.
Learns general concepts from partial differential equations, dynamical systems wave dynamics and data

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Here, an introduction to internal waves is given by looking at simple theory and laboratory and numerical experiments. Despite the theory being linear, the internal wave fields seem to be riddled by self-similar properties, a feature normally associated with nonlinear dynamics. Internal waves seem in general to be attracted to particular locations where they lead to mixing. Given stratification and basin shape, these wave attractors are highly predictable. Yet, their detection in real ocean basins still poses a challenge. Some field observations of internal waves will illustrate this.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Seminars, Lectures	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #20		
1.	The name of the course/module	Ice-Ocean-Climate interactions
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	2/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	The cryosphere on both poles represent key elements of System Earth. They drive deep ocean circulation, promote ocean CO2 uptake, cool the earth, store fresh water and attract and sustain an enormous biodiversity. There are concerns in the society about the resilience of the polar cryosphere to anthropogenic climate changes, and what consequences a decline in the polar cryosphere would have on climate systems worldwide: for ocean circulation, sea level rise, and atmospheric circulation and regional weather.
8.	Prerequisites for studying the course/module, connection with other educational components	Students enrolled in the master programmes Earth Life and Climate, Marine Sciences, Earth Surface and Water and Earth, Structure and Dynamics are automatically admitted. Students outside these programmes with a BSc degree in Earth science and Biology are also admitted. Other students should contact the coordinator first.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

By the end of the course, the students should be able to:
Understand the dynamics of, and interactions between ice (sheets, shelves, sea ice) the polar ocean (basal melt), atmosphere (surface melt), solid earth (topography, isostasy and rheology), and marine ecosystem.
Acquire understanding of the abilities of models to simulate ocean, ice sheet and climate models, and their limitations
Acquire in-depth understanding of the applicability and limitations of proxies (organic, sedimentological and geochemical) and archives (sediment cores, ice cores) available to reconstruct past ice, ocean, climate and ecosystem interactions in polar regions
Critically interpret past conditions of polar ice, ocean climate and marine ecosystem from these proxies and archives
Place past, present and future polar cryosphere changes into context of global climate change.
Transferrable skill development:
Analytical/numeric skills: spatial and time series data transformation/visualization in R
Team/initiative and leadership skills: group project on developing a science proposal
Writing skills: progress reports of research project, assignments
Oral presentation skills: presenting the research proposal
Problem solving skills: programming in R, assignments

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Here, an introduction to internal waves is given by looking at simple theory and laboratory and numerical experiments. Despite the theory being linear, the internal wave fields seem to be riddled by self-similar properties, a feature normally associated with nonlinear dynamics. Internal waves seem in general to be attracted to particular locations where they lead to mixing. Given stratification and basin shape, these wave attractors are highly predictable. Yet, their detection in real ocean basins still poses a challenge. Some field observations of internal waves will illustrate this.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
1.Lectures Explanation Interactive Q&A in lectures Preparation of meetings For all lectures it is expected that the students have prepared themselves by reading the provided literature. Lectures will be in the form of interactive discussions of the read literature 2.Tutorials Explanation	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

Written reporting of assignments Transformation and visualization of both spatial and time series data in R 3.Group work Tutorial Explanation Group research project and presentation. Students will work in groups of 3/4 on a drilling proposal on Antarctica/in the Southern Ocean or the Arctic Ocean. The proposal must outline the scientific question, the approach, the expected results and the impact of the proposed drilling. 4.Instructed self-study	

GENERAL INFORMATION ABOUT THE COURSE #20		
1.	The name of the course/module	Organic Geochemistry
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	2/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	To provide detailed insights into the molecular processes that affect organic matter which becomes part of the geosphere. The products formed and preserved are discussed with reference to diagnostic signals, e.g. molecular and isotope proxies, relevant to fossil fuel formation, palaeoenvironmental - and palaeoclimatic reconstructions (i.e. Molecular palaeontology).
8.	Prerequisites for studying the course/module, connection with other educational components	Essential background: BSc. or equivalent degree in Earth or Environmental Sciences, Biology, or a related field; basic knowledge of general chemistry. Useful background: basic knowledge of geochemistry, (paleo)oceanography, and essential biology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

By the end of the course, the students should be able to:
learn the basics Biochemistry, organic molecules and sources of organic matter: chemical evolution of organic molecules, isotopes, phylogenetic tree of life, membranes.
define macromolecules: sugars, proteins and peptides, DNA and RNA, resins, lignins, biopolyesters, biopolymers.
to study the preservation and quality of organic matter: chemical stability against depositional environment, chemical taphonomy; Study preservation models: neogenesis, selective preservation, in-situ polymerization.
learn the basics of molecular paleontology: Biomarkers: molecular markers based on the carbon skeleton, the position and nature of functional groups, and/or the stable isotopic composition of carbon.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

Biochemistry, Organic molecules and Sources of organic matter: Chemical evolution of organic molecules, isotopes, Phylogenetic tree of life, Membranes: Lipid biochemistry, different lipids, i.e. fatty acids, alkanes, acyclic isoprenoids, steroids, terpenoids; Macromolecules: sugars, proteins and peptides, DNA and RNA, resins, lignins, biopolyesters, biopolymers.
Preservation and the Quality of organic matter: Chemical stability versus depositional environment, chemical taphonomy; Preservation models: neogenesis, selective preservation, in-situ polymerization; Export productivity, Oxygen exposure time (OET); Marine versus terrigenous sources; Preservation versus production; Sulphur and Oxygen incorporation, Lignin, soil organic; Soil organic matter.
Molecular palaeontology: Biomarkers: molecular markers based on carbon skeleton, position and nature of functional groups and/or stable carbon isotope composition. Biological markers as indicators of evolution of Life on earth. Biomarkers in relation to the phylogenetic tree of life; Age-related biomarkers: Molecular proxies for palaeoenvironmental and palaeoclimate reconstructions: sea surface temperatures, photic zone anoxia, anaerobic methane oxidation, C3/C4 vegetation shifts, atmospheric pCO2 changes.
Diagenesis, catagenesis, fossil fuel formation, petroleum geochemistry: Diagenetic transformation reactions; Chemical transformation reactions during catagenesis; Coalification; Oil and gas formation; biomarkers as indicators for thermal maturity, oil-source rock correlation and biodegradation; oil exploration and oil exploitation.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures Excursion Practical Presentation	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

GENERAL INFORMATION ABOUT THE COURSE #21

1.	The name of the course/module	Field research instruction geochemistry
2.	Faculty/department	Faculty of Geosciences
3.	Status of the educational component	Optional
4.	Semester	2/2
5.	Number of ECTS credits	7.5
6.	The total number of hours	225
7.	General description and purpose of the educational component	In this course students learn how to perform a field campaign and biogeochemical experiments in order to answer research questions related to the nutrient dynamics in aquatic environments. This includes: testing and preparing analytical and experimental methods, collecting and analyzing environmental samples, performing experiments, interpretation of analytical and experimental data, and presentation of the results orally and in a written form.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge of geochemical processes and aquatic chemistry.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The students become familiar with the key processes controlling nutrient dynamics in aquatic environments.
They obtain knowledge about the societal, economical, and environmental implications of anthropogenic perturbations of the nutrient dynamics in aquatic environments. Students learn how to design experiments or how to plan the collection and analyses of environmental samples in order to answer research questions.
Furthermore, they learn how to combine experimental data and field measurements and to integrate them with knowledge from scientific literature in order to answer the research questions and to evaluate the obtained information in a broader context.
Development of transferable skills
Leadership: Students work in teams; each day someone takes the task of the team leader who takes the responsibility that the team activities are target orientated and who reports about the team activities.
Ability to work in a team: All tasks are performed in teams. The teams often operate independently during field campaigns. Important hereby is making decisions about the selection of sampling sites and sampling approaches.
Written communication skills: Results of fieldwork are presented in reports. Feedback is given on the reports and students have to revise the reports based on the comments.
Verbal communication skills: Students have to give scientific presentations about a subject related to nutrient dynamics in aqueous environments.
Problem-solving skills: In the field, teams often have to define a strategy for fulfilling the assigned tasks, including the identification of sampling sites and performing the sampling.
Analytical/quantitative skills: students have to integrate the data collected in the field and in the laboratory, in combination with knowledge from scientific literature and model calculations, in order to answer the allocated research questions.
Flexibility/adaptability: Depending on conditions and observations during field campaigns and during laboratory work, the sampling programme or the analytical / experimental approach have to be adjusted.
Technical skills: students are introduced to a variety of methods to characterize the chemical and physical properties of water or sediment samples. They are introduced to methods to determine processes and fluxes in situ or in laboratory experiments.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

The fieldwork consists of three parts: a preparation period in Utrecht, a field campaign, and a period of data interpretation and report writing in Utrecht. During the preparation period, the students give presentations related to the subject and the objectives of the fieldwork. Furthermore, they practice analytical procedures and experimental methods which are required during the fieldwork. During the fieldwork campaign, water samples from rivers, estuaries, and marine locations are collected and analyzed. Additionally, sediment cores will be taken and analyzed. Laboratory experiments are conducted in order to quantify individual processes related to the nutrient fluxes in the investigated environments. The analytical and experimental data are finally integrated in order to characterize the trophic state of the investigated systems, to determine the nutrient fluxes between the different compartments of the systems, and to investigate the interplay between physical and biological processes in controlling the nutrient dynamics. The results of the fieldwork are presented in reports

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures Field work Seminar	Work with lecture notes, work with references, work with lecturer presentations, generalization, systematization, deepening of the material, calculations according to the topics.

UIT'S THE NORWEGIAN COLLEGE OF FISHERY SCIENCE

1	**Criterion A: University profile**	
1.1	Name of the University	**UIT'S THE NORWEGIAN COLLEGE OF FISHERY SCIENCE**
1.2	Classical or applied	Applied
2	**Criterion B: Profile of the educational program (Curriculum)**	
2.1	Number of Aquaculture disciplines	28
2.2	The name of the educational program	Marine Biotechnology program
2.3	Type of diploma	Master of Science in Marine Biotechnology
2.4	Total number of credits (ECTS)	120
3	**Criterion C: Setting the educational program (Curriculum)**	
3.1	Duration of the program	4 semester, 2 years
3.2	The purpose of the educational program	The purpose is to educate candidates in modern biotechnological expertise, with particular empasis on use of marine resources, bioactive compounds, gene products and marine rest raw materials. You will qualify for careers in fields such as marine value creation, innovation and research. A good marine biotechnologist must have a broad base of knowledge and skills in basic molecular biology, chemistry and techniques and processes that use marine micro-organisms, plant and animal cells, or parts of these, to manufacture, develop or modify commercially useful products. On successful completion of the programme, the degree of MSc in Marine Biotechnology is awarded.
4	**Criterion D: Characteristics of the educational program (Curriculum)**	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Marine Biotechnology
5	**Criterion E: Teaching and assessment**	
5.1	Teaching and learning methods	The study programme uses a variety of teaching methods, depending on the courses/subjects and may include: lectures, seminars, laboratory work, working in teams, fieldwork and industrial visits - or preferably a combination.For some of the subjects, specific work requirements may have to be met prior to exam entry. There may be compulsory requirements to submit reports and assignments and attend teaching seminars. Some courses in the study programme are marked on a pass/fail basis, while for others the graded scale of marks from A to E (passed) and F (failed) may be used. The individual course description specifies the marking system used. Individual tutoring is provided for the master's thesis by the department's scientific staff.
5.2	Assessment	compulsory requirements to submit reports and assignments and attend teaching seminars.
6	**Criterion F: Software competencies**	
6.1	Integral competence	• Quantitative problem-solving skills in the context of biochemistry, bioprocess design/operation, analytical chemistry, and synthetic biology • Basic theoretical and hands-on laboratory skills in marine biology, molecular biology, bioprocess operation and analytical chemistry • Interdisciplinary communication skills that enable students to combine different disciplines so that they can effectively collaborate in teams to solve a wide range of technical problems • Basic project management skills gained through the process of completing individual and team-oriented research tasks within industrial and/or academic research environments
6.2	General competences	• The ability to apply contemporary and interdisciplinary knowledge towards biotechnological research, innovation and/or industrial actions, particularly within the marine sector • A general ability to contribute towards natural resource-based industry, research or policy making

		• The qualifications for admission to PhD programmes in biotechnology and related specialist fields that could include molecular biology, synthetic biology, biochemistry, bioengineering, industrial engineering, or analytical chemistry	
6.3	Professional competences		
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	1. Advanced knowledge about scientific theory and practice related to modern molecular biology, biochemistry, and analytical chemistry in the context of marine biology and/or microbiology 2. A general overview of current applications in marine and traditional biotechnology carried out within industry, academia, and public sectors 3. An understanding of ethics and the responsibility for sustainable resource utilization as they are applied to industry and academic research and innovation 4. The basic knowledge over quantitative aspects of natural biological operations, bioprocess engineering and the design-build-test cycle of bioengineering 5. A basic understanding of natural marine resources as the basis for developing food, biochemicals, bioactive compounds and medicines	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support		
8.2	Material and technical support		
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Industrial Biotechnology	10 ECTS	Examination
9.1.2	Marine bioprospecting and bioactive compounds	10 ECTS	N/A
9.1.3	Quantitative Microbial Biotechnology	10 ECTS	N/A
9.1.4	Safety in the laboratory, workshop and on sea and land expeditions	N/A	N/A
	First aid in the laboratory, workshop and on sea and land expeditions	N/A	N/A
	Biological material	N/A	N/A
	2 semester		
	Microscopical imaging Techniques	10 ECTS	N/A
	Academic skills	5 ECTS	N/A
	Strategic economic analysis of the seafood industry	10 ECTS	N/A
	The biology of cancer	10 ECTS	N/A
	Seminar: Molecular Environmental Biology in Microbes and Plants	5 ECTS	N/A
	Protein Production Technology	10 ECTS	N/A
	Human physiology	10 ECTS	N/A
	Human pharmacology and toxicology	10 ECTS	N/A
	Infection, inflammation and immunity	10 ECTS	N/A
	Human molecular genetics: medical and forensic genetics	10 ECTS	N/A
	3rd semester		
	Master's Thesis in Marine Biotechnology	60 ECTS	N/A
	Environmental Molecular Genetics	20 ECTS	N/A
	Matvaretrygghet	10 ECTS	N/A
	Basal and Comparative Immunology	10 ECTS	N/A
	Protein Structure	10 ECTS	N/A
	Immunology	10 ECTS	N/A
	Næringsmiddelkjemi	10 ECTS	N/A
	Master's Thesis in Marine Biotechnology	60 ECTS	N/A
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Fiskeernæring	10 ECTS	N/A

9.2.2	Bachelor Thesis in Marine Biotechnology	10 ECTS	N/A
9.2.3	Molecular physical chemistry and foundations of spectroscopy	10 ECTS	N/A
9.2.4	Bioorganic Chemistry	10 ECTS	N/A
10	**Criterion L: Form of attestation**		
10.1	Requirements for	master theses	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Industrial Biotechnology
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	1/1
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The objective of this course is for students to develop advanced knowledge and skills related to industrial development of marine resources and bioproducts. The emphasis will be on product development including optimizing and expanding bioprocesses as well as raw biological material as value chains can provide sustainable and valuable products into Norwegian and international markets. The course will cover the biotechnological applications of valuable biomolecules (proteins/peptides, enzymes, marine lipids and carbohydrates) that can be produced industrially from marine and other sources. Focus will be placed upon the technical challenges and opportunities related to industrial processes involved in the processing of raw biological materials. Students will be given an introduction to real-world industry and presented with the specific challenges of scale-up and commercialization. Other specific topics will include: how to maintain productivity, proper documentation of products and processes, quality control and assurance, standard practices, regulatory constraints, value propositions as well as customer demands. Case studies will be used by examining examples from members of the marine biotech cluster BioTech North and international industries to introduce the research and challenges that underpin different biotechnological sectors. Challenges posed by scaling-up production methods from lab to pilot and ultimately industrial scale, are omnipresent and require advanced knowledge. This includes a good familiarity of processes that can be exemplified by the marine biotechnological sector regional to northern Norway. The laboratory portion of this course will include assignments relevant to specific industrial processes that the students will be acquainted to during the lectures. The laboratory teaching is carried out under tutorial supervision and suitable safety protocols.
8.	Prerequisites for studying the course/module, connection with other educational components	Fysiologi, Marin Biodiversitet, Generell mikrobiologi, Generell og marin bioteknologi, M Calculus Linear Algebra
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
has advanced knowledge about specific bioprocesses involving the use of biomolecules with unique characteristics understands basic workflows for exploitation of raw materials derived from the marine sector has a thorough understanding of molecules such as proteins/peptides, lipids and carbohydrates knows how raw materials are generated in industry, the importance of them being handled correctly to ensure good quality and how this in turn affects down-stream value chains has a general knowledge over common challenges, both research-wise and financial, in creating and expanding the blue bioeconomy has advanced knowledge of how modern research relates to commercial potential, especially in marine biotechnology has a general understanding over industrial bioprocesses and the challenges involved in scaling up from laboratory to industrial scale has the ability to apply theoretical and practical problem-solving techniques to the different development stages of industrial biotechnology has the ability to independently develop and evaluate value propositions of various value chains related to marine biotechnology has communication skills on an academic level that allows for effective knowledge exchange between scientific and industrial partners. For this, students will develop themselves both individually and within collaborative teams		

has advanced abilities to perform laboratory assignments and compile results in a laboratory report can describe specific and generalized processes for utilizing raw materials can demonstrate a general familiarity with the value propositions and processes used by real biotechnological industries

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
his course will consist of lectures, seminars, and a compulsory laboratory course. We will have guest lectures from domain experts and students will visit local industry. The syllabus is made up of relevant scientific articles and fact sheets that will be given out after the lectures. There will be problem-based assignments for each section. There will be individual and group projects, students will write reports and make at least one oral presentation during the course.	

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Marine bioprospecting and bioactive compounds
2.	Faculty/department	Mandatory
3.	Status of the educational component	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
4.	Semester	1/1
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	Students learn the processes and techniques used to detect and characterise bioactive compounds from marine organisms and their genes in early phases. Research in this field is essential to facilitate further development and document the concept of the bioactive compound(s) and also how to optimise them to make medicines or other commercial products. It can take a long time to develop bioactive components. It is a complicated process from the actual proof of a find ("hit") and subsequent characterisation, until there is documented agreement about whether it is worth investing in further development all the way up to the creation of a commercial product. The topics in the course range from identifying biological resources in the sea to applying various traditional and new biotechnological methods. The course examines the application/analysis of these resources and their genes, characteristics of bioactive components (and genes), their chemical structures, bioactivities and mechanisms of action. The various methods used in bioprospecting are thoroughly reviewed and the opportunities and challenges they present are brought into focus. The bioassay-guided purification method is used during the two-week compulsory laboratory course. The laboratory exercise covers extraction, testing, separation/isolation and introductory characterisation of both bioactive compounds and their mechanisms of action, concentrating particularly on antibacterial activity. The lab course will take place in research laboratories associated with the Bioprospecting Research Group, both at the Department of Norwegian College of Fishery Science and on the screening platform Marbio. Examples of development of natural marine products and their applications will be presented (anti-cancer, antimicrobial activity towards antibacterial resistant bacteria, immunomodulating agents, antioxidants, enzymes and enzyme-inhibiting activity). Other topics, not mentioned above, will be covered in lectures. These are: Other methods in bioprospecting, structure biology with genomic/metagenomics, virtual screening and metabolomics; Natural products and case studies; Ethics, legislation and agreements related to bioprospecting and commercial potential; Different

		phases in drug discovery; Challenges and solutions of supply of more material; Applications and new trends.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic biology, chemistry, cell and molecular biology and organic chemistry, chemistry/biochemistry, microbiology and molecular biology/methods in molecular biology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

has advanced knowledge about what is involved in the concept of bioactivity-focused marine bioprospecting (bioassay guided) and the value chain involved
is familiar with several methods that are used in bioprospecting (genetic and metagenomic approaches and digital screening, as well as methods based on structural similarities)
knows about natural marine substances and their bioactivities
knows about marine resources (including genes) such as animal life (evertebrates), bacteria, microalgae, macroalgae, plants and other marine biomass
understands the practical and legal challenges related to exploitation of biological resources in research and development, and commercialisation
understands research challenges and other demands when using the various methods
has advanced knowledge of various chromographic and mass-spectroscopic methods and analyses related to isolating, bioactivity testing and characterisation of marine molecules and their mechanisms of actions
has sound knowledge of examples of the exploitation of natural marine products, including non-medical applications
has a theoretical and practical understanding of bioactivity-focused marine bioprospecting (bioassay guided) and what this value chain includes
can familiarise him/herself with an experimental protocol and carry out an experimental laboratory exercise in bioprospecting
can analyse result data
can write a laboratory report that summarises the results from the practical laboratory exercise (includes sections on introduction, materials and methods, result and discussion; IMRAD)
can work effectively on his/her own or as a member of a team
knows about various analyses used in bioprospecting; various chromographic and mass-spectroscopic methods and analyses related to isolation, bio-activity testing and characterisation of marine molecules and mechanisms of action, and knows how to exploit natural marine products, including non-medical applications.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures and seminars, compulsory laboratory course, one-day fieldwork trip to demonstrate how to gather marine material. Submission of report and oral presentation of the results. There will be guest lectures.	

GENERAL INFORMATION ABOUT THE COURSE #2

1	The name of the course/module	Microscopical imaging Techniques
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	Stereo microscope and light microscope are important tools to overcome the limitations of the limited resolving power of the human eye. As they are indispensable for the analysis of prokaryotic and eukaryotic cells, they form an integrative part of biological research. The course will introduce standard and advanced techniques of light microscopy such as bright field microscopy, phase contrast microscopy and fluorescence microscopy. The theoretical part of the course will convey the necessary background knowledge and will cover the composition of light and fluorescence microscopes, magnification

		and optical resolution, contrast improvement, specific dyes and staining techniques, autofluorescence and secondary fluorescence. Strong emphasis will be on the practical part. In the first part, the students will be able to familiarize themselves with different techniques by performing a number of exercises. Besides microscope maintenance and the application of various microscopy techniques, we will also treat related topics such as sample preparation (including fixation, sectioning and staining techniques) and the professional documentation of the results by microphotography. In the second practical part, each student will pick an object or technique of their choice and design a small individual project to apply the acquired knowledge. The results of these individual mini-projects will be presented by each student to his peers and to other interested audience in a small workshop. Master course for biology students - principally aimed at MSc-students specializing in Molecular Environmental Biology. Students from Molecular Environmental Biology and other Master disciplines at the department (AMB) will be prioritized.
8.	Prerequisites for studying the course/module, connection with other educational components	biology at university level, molecular lab, chemistry and physics/optics is expected.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

explain how a light microscope works
list different contrasting techniques to visualize organisms
define magnification and resolution
assess the potential and the limitations of different light microscopy techniques
are comfortable and knowledgeable in working with microscopes
perform maintenance on a microscope
perform Köhler illumination
fix, section and stain objects
count, measure and assess viability of objects
use modern software to document microscopic structures
design a poster of their work using PowerPoint
appreciate light microscopy as tool for classical and modern biological research
formulate a research question, choose the appropriate methods and perform the experiments independently
design a poster presenting the results of their work
convey the essence of their project to others
engage in critical discussions with their fellow students

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures 10 hours, laboratory exercises and seminars 50 hours, poster design and workshop (incl. colloquium) 15 hours. Specific safety training regarding the use of microscopy equipment is given in the course.	

GENERAL INFORMATION ABOUT THE COURSE #3

1	The name of the course/module	Academic skills
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	5
6.	The total number of hours	
7.	General description and purpose of the educational component	The course will give students academic skills in the form of scientific writing and giving scientific presentations within the natural sciences. The focus will be on acquiring skills to write a scientific text, structuring a scientific document (Master thesis, publication, including a concise abstract), incorporating

		scholarly resources, addressing methodological issues (including data management), performing literature searches and reviews. We will also devote time in refining academic English skills, and how to present research data, including graphic and oral presentations. Moreover, we will discuss important issues such as use of sources and how to demonstrate academic integrity by showing which sources were used so that the prospective reader will be able to locate and verify the same sources. We will also discuss what is considered plagiarizing and scientific fraud (falsification/fabrication of data), and how a good scholarly reputation is evolving. This course will prepare students for working with their master project and contribute to building a creative and constructive social network of master students at the faculty.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

know about responsible conduct in science
know the structure of a scientific text and the writing process
understand how to critically and ethically use references and other research material
explain the basic principles for good research data management
can prepare and present research results both in written and oral formats in an engaging and understandable way
can give constructive feedback to peers on their writing and presentations
has developed scientific English skills
can use scientific databases for advanced literature searches
can apply a reference tool (e.g. EndNote) when writing
masters techniques for citation of scholarly sources
can plan, evaluate, draft and edit scientific documents such as theses, scientific reports and publications
can summarize and synthesize the key points of a study in an abstract format
can prepare and present communications at scientific conferences and to a general audience (outreach programs for schools and local communities)
understands the relationship between knowledge and communicating knowledge

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The course is organized as interactive sessions combining theory, plenary discussions, group activities, and individual practice. Participants are expected to be active prior to and during the sessions. Reading material and other preparatory tasks will be provided in advance: Powerpoint presentations of the lectures Selected publications relevant to ongoing research in the six disciplines of the Master program The course spans over two semesters. Ten lectures will be given during the first semester. Ten lectures and the group-work seminars will take place during the second semester. Work load: 125 hours (20 h lectures; 20 hours group-work; 85 hours personal work), 15 hours examination preparation and exam.	

GENERAL INFORMATION ABOUT THE COURSE #4

1	The name of the course/module	STRATEGIC ECONOMIC ANALYSIS OF THE SEAFOOD INDUSTRY
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	2/1

5.	Number of ECTS credits	**10**
6.	The total number of hours	
7.	General description and purpose of the educational component	The subject contains a presentation of various theoretical perspectives that have been used to shed light on the company's relative competitive position in an industry. Particular emphasis is placed on theory that directs attention to the company's resource-related prerequisites for success with various strategic choices and theory that emphasizes the importance of distinctive features of the competition arena for success with various strategic choices. The basis for the theory review is Barney's presentation, which first explains what is included in the concept of strategy. Here, it is emphasized that the strategy subject is based on two main elements. A part that is concerned with the resource-related prerequisites the individual company has for making strategic choices. The subject contains a review of what in the literature is called The resource based view of the firm. The second main part of the strategy subject is concerned with how the company's competitive arena affects the strategic options that are relevant to choose. Here the emphasis will be on presenting important parts of what is called contingency theory. After the review of these two main dimensions within the strategy subject, emphasis will be placed on describing the dilemmas that companies face when choosing their own adaptations - between their own assumptions and the opportunities that arise in the company's competitive arena. The focus is then on how the effect of strategic measures can be measured, and in this connection attention will be directed to performance targets. The curriculum literature in connection with the theory review will be Barney's book: Experience from the Norwegian fishing industry is the review example. Here the emphasis will be on presenting what resource-related prerequisites the companies within this industry have and what different characteristics the competitive environment has. Based on the theory review, it will be discussed which strategic options are most relevant for companies in this industry. Among the strategic options that will be further elucidated in the course are scale adaptation, vertical integration and flexibility. There will also be an account of results from empirical studies of the industry where the problem has been concerned with mapping the economic effect that various strategic adaptations have had on the companies' financial performance. An important intention with this part of the course is to illustrate how the theoretical approach can be used to carry out empirical studies. At the same time, it is an aim to give the students an overview of the relevant trade-offs the fishing industry faces on a daily basis in its quest to improve its own financial results. The curriculum literature in connection with the empirical part of the course will consist of reports and articles that present results from relevant empirical investigations in the fishing industry. In addition, students gain up-to-date knowledge of the seafood industry's structure, production and profitability.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Important subject areas within strategy and business economics
The seafood industry's organisation, production and profitability
Challenges and opportunities for the Norwegian seafood industry
Gets a theoretical platform to understand companies' various strategic adaptations in the seafood industry
Understands why some players in the seafood sector achieve better financial results than others
Increased knowledge of the seafood industry's organisation, production and profitability

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #4		
1	The name of the course/module	The biology of cancer
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	**10**
6.	The total number of hours	
7.	General description and purpose of the educational component	The course discusses the nature of cancer including an introduction to cancer pathology and clinical aspects of cancer. Central topics: Tumor viruses, cellular oncogenes, growth factors and their receptors, signaling pathways relevant to cancer development, tumor suppressor genes, the control of the cell cycle and apoptosis, cell immortalization, multistep tumorigenesis, genome integrity and cancer development, angiogenesis, invasion and metastasis, tumor immunology and rational treatment of cancer.
8.	Prerequisites for studying the course/module, connection with other educational components	molecular biology and genetics.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- List the major cancer types with regard to cellular origin.
- Descibe typical histological features and explain the nomenclature of benign and malignant tumours.
- Recite evidence indicating that tumours arise from normal tissues in a multistep process.
- Explain how mutations arise and recite evidence indicating that cancer is caused by mutations.
- Describe which cellular processes go awry in the (multistep) process of cancer development, including genetic and epigenetic changes.
- Describe and give concrete examples of how the cell cycle is regulated by growth factors, receptors, cell cycle regulators, oncogenes and tumour suppressors, and how this affects tumour growth.
- Describe how certain viruses contribute to the cause of cancer.
- Explain the role of pRB in the cell cycle.
- Explain how disruption of the cell cycle contributes to cancer.
- Explain the role of p53 in the regulation of DNA repair and apoptosis.
- Recite various DNA repair mechanisms and explain how defects in DNA repair relate to cancer.
- Describe cellular senescence and the underlying mechanisms.
- Describe the role of telomeres and telomerases in normal cells and how these roles are altered in tumour cells.
- Explain and discuss the cancer stem cell theory.
- Describe the principles of angiogenesis and stroma formation and explain why it is critical for survival of the cancer cells.
- Describe the role of the tumour microenvironment and the inflammatory process for the progression of cancer.
- Describe the necessary steps in the metastatic process.
- List different therapeutic approaches targeting angiogenesis and metastatic process.
- Explain the role of the immune system in cancer biology.
- Explain how the immune system may be exploited to make tumour cells more susceptible to immunologic attack.
- Describe conventional cancer therapy and discuss the tumour microenvironment, immune system/inflammatory process, cell cycle regulation, oncogenes and tumour suppressors as potential therapeutic targets.
- Search, acquire and critically assess advanced knowledge in a specific field of cancer biology.
- Employ current concepts, ideas and expressions through oral presentations.
- Implement and critical evaluate general information gained in the field of cancer biology.
- Discuss different therapeutic approaches based in a general knowledge of cancer biology.
- Communicate knowledge in cancer biology.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The course will consist of lectures, seminars, micro-lectures, group work and a laboratory exercise.	

GENERAL INFORMATION ABOUT THE COURSE #5		
1	The name of the course/module	Molecular Environmental Biology in Microbes and Plants
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	5
6.	The total number of hours	
7.	General description and purpose of the educational component	Subject of the seminar will be molecular biology approaches to analyse the interaction and communication of molecules, cell compartments, cells, microbial communities, microbes and photosynthetic organisms with their respective environments. Examples from ongoing research in the Molecular Environments Research Group will provide the platform for the contributions. Topics include the communication within plant and bacterial cells, communication of cells and organisms with their environment and communication in microbial soil communities as well as plant/microbial and plant/plant associations. Techniques in focus are genomic, transcriptomic, proteomic and metabolomic analyses in plants, microbes and microbial communities.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- know limitations and opportunities of research questions based on current projects at UiT
- have a good understanding of the applicability of molecular techniques
- have an overview over novel developments in their field as well as adjacent research areas
- can present their research results using state of the art media
- are able to exercise constructive criticism in discussion fora
- can explain scientific work (own or from literature) to fellow students and researchers
- can explain scientific work (own or from literature) to fellow students and researchers
- convey the essence of their project to others
- engage in critical discussions with their fellow students

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Seminar: 30 hours spread over up to 4 semesters.	

GENERAL INFORMATION ABOUT THE COURSE #6

1	The name of the course/module	Protein Production Technology
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	**10**
6.	The total number of hours	
7.	General description and purpose of the educational component	Protein expression and protein purification is an art of science and technology. Each protein is unique and needs special treatment. This intensive practical course is dedicated to the current technology and processes available to obtain a pure sample of protein using recombinant DNA techniques, combined with biotechnology of protein production and purification. The course covers cloning and overexpression in bacterial and eukaryotic systems, introduction to fermentation, protein purification and biophysical characterization.
8.	Prerequisites for studying the course/module, connection with other educational components	basic knowledge in biochemistry and molecular biology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- has advanced knowledge in protein production technology including recombinant protein technology, fermentation and protein purification
- has thorough knowledge of methods and techniques applied in protein production
- can apply knowledge to new areas in protein production technology
- can analyse academic problems related to recombinant protein production technology

can analyze and deal critically with various sources of information and use them to structure and formulate scholarly arguments

- can analyze methods, techniques and interpretations in protein production and work independently on practical problems
- can use relevant methods and techniques in protein production for research in an independent manner
- can carry out an independent, limited research or developmental project under supervision

can apply her/his knowledge and skills in protein production technology in order to carry out assignments and projects

- can communicate terminology in the field of protein production including recombinant protein expression and protein purification
- can communicate about academic issues, analyses and conclusions in the field of protein production technology
- can write a scientific report

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Recombinant protein technology Expression systems i (prokaryote systems) Expression systems ii (eukaryote systems) Introduction to fermentation
2.	Initial planning and strategy Biological activity and quantification of proteins General methods for handling enzymes and proteins The protein extract Purification of engineered proteins Fractionation techniques Optimization Scaling up Analysis of purified product

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The course will be taught as a combination of lectures, demonstrations and practical lab work (intensive course). Lectures and demonstrations: 20 h. Hands-on laboratory exercises: 40 h. Compulsory attendance.	

GENERAL INFORMATION ABOUT THE COURSE #7

1	The name of the course/module	Human physiology
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The physiological regulation of body organ systems to maintain body homeostasis in health and disease. i.e., the nervous system, muscles, the respiratory system, the cardiovascular system, the digestive system, excretory organs, the endocrine system and the reproductive system.
8.	Prerequisites for studying the course/module, connection with other educational components	physiology, biochemistry and cell biology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- outline the short- and long-term regulation of blood pressure and discuss the pathophysiology of circulatory shock and essential hypertension
- summarise the regulation of cardiac output by alteration of cardiac inotropy and venous return
- discuss factors affecting pulmonary ventilation, circulation, and pulmonary gas-exchange, and describe the control of breathing
- compare physiological responses to acid/base disturbances and describe examples of metabolic and respiratory disorders
- discuss endocrine and neuroendocrine maintenance of metabolic homeostasis, growth and reproductive function, and describe the pathophysiology of common endocrine disorders
- explain the regulation of gastrointestinal motility, secretion and absorption of nutrients during different physiological settings, and discuss mechanisms that regulate dietary balance and energy expenditure
- explain the development of hypertrophy, atrophy and sarcopenia in skeletal muscles and discuss the muscular adaptations to acute and long-term changes in physical activity
- explain integration of sensory input in the central nervous system, the interplay between different areas of the brain and spinal cord, and the induction of simple and complex motor responses
- critically discuss and assess current (potentially conflicting) hypotheses and ideas within human physiology communicate orally and in writing, relevant issues within human physiology
- apply knowledge within physiology in new areas in order to implement advanced work tasks and project

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Seminars where the students and/or teacher present selected topic, which is followed by a discussion and elaboration of physiological issues.	

GENERAL INFORMATION ABOUT THE COURSE #8

1	The name of the course/module	Human pharmacology and toxicology
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	10
6.	The total number of hours	

7.	General description and purpose of the educational component	The course will give the students an introduction into the general principles of pharmaco/toxicodynamics and -kinetics, with a focus on mechanisms of toxicity and drug action, metabolism of drugs and toxic agents, kinetic calculations and risk assessment. Further, the course will provide insight into the action of drugs and toxicants in central target organs and pathological processes (endocrine-, cardiovascular-, nervous- and immune systems, inflammation, infection and cancer) focusing on molecular mechanisms, interactions and outcomes. In addition, the course also contains visits to university and hospital departments, local research centers and companies working with occupational and environmental toxicology and drug development.
8.	Prerequisites for studying the course/module, connection with other educational components	pharmacology and toxicology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- Explain general principles in pharmacology and toxicology (kinetics, dynamics and risk assessments).
- Explain how drugs and toxic agents affect reproduction, endocrine-, cardiovascular-, nervous- and immune systems, inflammation, infection and cancer focusing on molecular mechanisms, effects, and interactions.
- Search, acquire and critically assess advanced knowledge in pharmacology and toxicology.
- Apply relevant methods to solve pharmaco- and toxicokinetic exercises.
- Apply current concepts and terminology in pharmacology and toxicology through oral presentations, group discussions and written text.
- Describe how the obtained knowledge and skills can be used in a professional setting.
- Describe how the obtained knowledge and skills can contribute to innovation processes in pharmacology and toxicology.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures Seminars (cases) Kinetic calculations/exercises Work-place visits	

GENERAL INFORMATION ABOUT THE COURSE #9

1	The name of the course/module	Infection, inflammation and immunity
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The course is an elective course for students accepted to the Master´s program in Biomedicine.
8.	Prerequisites for studying the course/module, connection with other educational components	animal/human immunology and microbiology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- discuss central characteristics of viral, bacterial, and eukaryotic infectious agents
- explain what is the human microbiome, and give examples of how the human microbiome is linked to health and disease states

• discuss the theoretical background of treatment strategies to infectious agents, including antibiotics and emergence of antimicrobial resistance, and alternative antimicrobial strategies. • explain immune responses to infections caused by bacteria, virus, and eukaryotic organisms • explain what is the human microbiome, and give examples of how the human microbiome is linked to health and disease states • discuss mechanisms used by pathogens to cause infection • explain and discuss causes and hallmarks of sterile inflammation and autoimmunity • describe the basic histopathological features of inflammation caused by bacteria, virus, eukaryotic organisms, and autoimmunity can analyze and assess different information sources about a course topic in a critical manner • identify basic histological features of inflammation in tissue sections • can define a research question within the course topics and identified relevant experimental methods for exploring the question discuss ethical issues related to treatment of infectious agents/antimicrobial treatment • communicate about topics in infection, inflammation, and immunity for peers both orally, and in writing • Critically review a research report on the topics covered by the course

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	• Infectious agents and treatment strategies • Host responses to various types of infection • Bacterial and viral immune evasion • Sterile inflammation and autoimmunity • Histopathology of inflammation
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures, group work, seminars and lab exercise.	

GENERAL INFORMATION ABOUT THE COURSE #10		
1	The name of the course/module	Human molecular genetics: medical and forensic genetics
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	2/1
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The first part of this course will focus on basic topics in human genetics, such as the structure and function of chromosomes, the organization and evolution of the human genome, DNA sequence variation and the characteristics and regulation of protein coding and non-coding genes. The next part will cover different topics in medical genetics, such as Mendelian inheritance, population genetics, mutations, and epigenetics in relation to diseases. Furthermore, lectures will be given on theory and methods for molecular genetic diagnostics as well as classic- and molecular cytogenetics. The last part of the course will give a short general introduction to the discipline of forensic medicine, before focusing on forensic genetics and the analysis of biological traces in criminal cases. Lectures will cover the principles for detecting different body fluids, DNA-profiling using STR-markers, interpretation of the results and statistical calculations for evaluating the strength of DNA evidence. The analyses of alternative markers like SNPs and markers on Y-chromosomes and mitochondrial DNA will also be discussed. The course will shortly cover some ethical and legal aspects related to both medical and forensic analyses and also give an introduction to new molecular methods in these disciplines.

		During a laboratory exercise, the students will analyze evidence from a simulated criminal case using methods that are generally used in molecular genetics.
8.	Prerequisites for studying the course/module, connection with other educational components	general genetics and cell- and molecular biology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- Explain the structure and organization of human chromosomes and the organization of the human genome
- Explain some basic theories for evolution of the human genome
- Explain the characteristics and regulation of protein-coding and non-coding genes
- Explain the biogenesis and function of non-coding RNAs and their role in human diseases
- Explain the structure, function and evolution of repeated DNA-sequences, including transposable elements and tandem repeated DNA sequences.
- Explain the basic principle of cell division, and the importance of meiosis for genetic diversity
- Describe genome-, chromosome- and gene mutations
- Explain key words and concepts in medical genetics
- Explain how heritable factors affect phenotypic traits in humans
- Explain the concepts of Mendelian and non-Mendelian inheritance
- Describe risk assessment in relation to pedigree patterns
- Explain the concept of DNA polymorphism
- Explain the Hardy-Weinberg law and how it can be used as a tool in medical genetics
- Explain how genetic changes can cause disease, how genes associated with disease are inherited in families and how they are spread in populations.
- Explain basic sequence variant- and cytogenomic nomenclature
- Explain how G-banding (karyotyping), locus-specific methods and genomics can be used in medical genetics diagnostics
- Explain the basic principles of epigenetics including DNA methylation, non-coding RNA and histone modification
- Describe X-inactivation in females
- Explain the structure and evolution of short tandem repeat markers and their use forensic genetics
- Explain the role of forensic genetics in criminal cases and the principles of standard laboratory techniques that are used for DNA-profiling, including their advantages and limitations
- Explain the most commonly used statistical methods for evaluating the strength of DNA-evidence and how the allele frequencies that are necessary for these calculations can be obtained for a given population
- Explain how DNA databases are used in crime scene investigations
- Explain the importance of locating and identifying biological body fluids and principles of laboratory techniques that can be used
- Explain the role of alternative genetic markers relevant in forensic genetics, such as Y-STRs, SNPs and mitochondrial sequence variants
- Discuss quality assurance in a forensic laboratory
- Explain the scientific theory of methods and techniques relevant for genetic analysis
- Apply methods performed during the laboratory exercise, interpret and discuss obtained results in a written report
- Apply statistical analysis on good quality DNA traces and discuss the significance of the results
Communicate knowledge and skills acquired from the laboratory exercise using relevant scientific language
- Communicate the role of DNA-analysis in the field of criminal justice in particular, but also in the society in general
- Communicate about medical genetics with specialists in the field and to the community in general
- Discuss legal- and ethical issues related to medical and forensic genetics
- Apply acquired knowledge in genetics from this course in other areas

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

The course will consist of lectures, laboratory exercises and seminars.	

GENERAL INFORMATION ABOUT THE COURSE #11		
1	The name of the course/module	Master's Thesis in Marine Biotechnology
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	3/2
5.	Number of ECTS credits	60
6.	The total number of hours	
7.	General description and purpose of the educational component	he master thesis is the main part of the master study in marine biotechnology. Skills will be developed through independent scientific work and production of a written thesis under the guidance by one or several supervisors. The work should be research related and the thesis should have elements of new basic knowledge or methods. The thesis can be based on literature study, data from field work or laboratory research or a combination of these.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
• Have advanced knowledge about industrial and biotechnological processes for use of marine resources and natural molecules with unique characteristics • Have knowledge that can be applied to solve specific tasks in industry and public administration • Understand our ethical our ethical responsibility for sustainable resource utilization, industrial practice and innovation • Have knowledge of scientific theory and experience in applying scientific methodology • Formulate relevant research questions in an independent manner, and apply theories, concepts and methods pursuant to the scientific and ethical standards in the field • Use advanced skills in genetics, biotechnological and molecular biological techniques • Use multidisciplinary skills that enable students to combine different disciplines so that they can analyze and solve a wide range of technical problems • Demonstrate proficiency in working individually and as a member of a team • Complete a research project in marine biotechnology • Search for and evaluate recent biological research in a critical manner, and to make assessments using scientific knowledge in the field • Present biotechnological knowledge and ideas in an instructive manner to researchers, policy makers, industry and the general public • Have acquired specialized expertise in one of the topics areas offered • Have the competence to analyze biotechnology problems that require skills at a high level • Apply their knowledge and skills in biotechnological theory and methods in new areas relevant to society • Have sufficient competence to participate in and to evaluate research projects or to advance to doctoral studies • Able to present scientific results in written and oral form

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	• Marine resources - characterization and isolation of marine natural compounds (used in industry, ingredients, drug discovery, functional food) • Biological activity and mechanisms of actions of marine natural compounds using modern technology (antibacterial, anticancer, immune modulatory, anti-oxidative etc.) • Marine resources and molecular biotechnology of secondary metabolites (invertebrates, microalgae, bacteria, fungi) • Basic studies on arctic marine animals and microorganism • Marine resources as food - impact on health
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Individual guidance and supervision according to agreement and of two semesters duration. Maximum workload for the supervisor is 80 hours, you will receive supervision within these limits.	

GENERAL INFORMATION ABOUT THE COURSE #12		
1	The name of the course/module	Environmental Molecular Genetics
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	3/2
5.	Number of ECTS credits	20
6.	The total number of hours	
7.	General description and purpose of the educational component	The aim of this course is to give a thorough introduction to molecular genetic methods and bioinformatics used in modern biological research. The course will give a basis for advanced studies in different areas of biology and include practical exercises followed by computer analyses of own data sets. The students will isolate DNA and RNA from sub-Arctic samples, and prepare samples for incubation, GC analyses, sequencing and bioinformatics in the first part of the course. The second part includes the study on the epigenetic regulation of gene expression in plants. The laboratory and computer work is running for four weeks and the results are discussed in plenum. The students have to write individual laboratory reports. The lectures will be closely connected to the practical problems to be solved in the laboratory. Selected articles from the scientific curriculum are topics for seminar presented by the students.
8.	Prerequisites for studying the course/module, connection with other educational components	Green Biotechnology and Bioenergy, Microscopical imaging Techniques, General microbiology

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- Theory of microbial ecology and epigenetics
- Theory of gene and gene expression analyses
- Critical consideration of scientific literature within the topics for the course How to write a laboratory report
- Critical assessment of own results
- Soil incubations and gas analyses
- Isolation of DNA and RNA from environmental samples
- Preparation of samples for sequencing
- Bioinformatics - analysis of sequencing results, sequence assemblies
- Gene expression (qPCR), methylation status analysis
- Present objectives, methods and results.
- Oral and written discussion of results
- Theory of environmental genetics
- Experimental design
- Molecular laboratory work
- Evaluation of methods
- Discussion of results
- Presentation of results

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Lectures 12 hours, laboratory 60 hours during 4 weeks, seminars 16 hours.	

GENERAL INFORMATION ABOUT THE COURSE #13		
1	The name of the course/module	Matvaretrygghet
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	3/2
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The teaching covers central issues in terms of food safety. This includes uptake, absorption and elimination of foreign substances, general toxicology, toxicity testing and determination of limit values, as well as assessment and management of risk. Other topics will be disease-causing microorganisms/agents that are transmitted via foodstuffs and how the presence of such in food production can be avoided. In addition, food-related hypersensitivity reactions, natural toxins, contaminants and additives (E-substances), including food make-up, are covered. Possible health risks of "new" food such as "functional food" and genetically modified food will also be discussed.
8.	Prerequisites for studying the course/module, connection with other educational components	fisheries , aquaculture science , biotechnical

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- introduction to toxicology and the impact of foreign substances on the human body
- knowledge of risk assessment in connection with foreign substances in foodstuffs
- knowledge of which foreign substances can be considered a risk in the food context
- knowledge of the concept of normal microbiota, pathogenicity and virulence factors in microorganisms and the main features of the body's defense against invading microbes
- understanding of the distinction between infectious and intoxicating foodborne pathogens and knowledge of important representatives of both categories
- carry out selected analysis methods related to food safety and report results from such analyses
- sufficient understanding and knowledge to assess the current issues related to food safety that the food industry is regularly faced with

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The course will consist of lectures, laboratory exercises and seminars.	

GENERAL INFORMATION ABOUT THE COURSE #14		
1	The name of the course/module	Basal and Comparative Immunology
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	3/2
5.	Number of ECTS credits	10

6.	The total number of hours	
7.	General description and purpose of the educational component	This course aims to provide an understanding of the components (organs, cells and molecules) of the vertebrate immune system and their mood of action. The lectures will focus both on mammalian species and on bony fish. In the general part, the course will particularly discuss on how the immune system protects the body from infectious microorganisms like virus, bacteria, fungi and parasites. The student will learn how immune responses, including both innate and adaptive responses, are initiated and terminated, and how the immune system "remembers" a pathogenic intruder such that it can respond stronger at subsequent infections (the basis for vaccination). In the fish immunology part, an overview of the immune system in fish, with emphasis on aquaculture species, is provided.
8.	Prerequisites for studying the course/module, connection with other educational components	Introduction to microbiology, General microbiology, Cell- and molecular biology

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- knows the key differences between innate and adaptive immunity
- knows the principal organization of lymphoid organs of mammals and fish
- knows about the most important immunological cell types and their effector mechanisms
- which function various cytokines and the complement system has
- knows the essential immune molecules / receptors - B and T cell receptors and MHC Class I and II
- understand the mechanisms that provide the B and T cells with the great repertoire of molecule detection
- have knowledge about the principles for clonal selection of antigen-specific lymphocytes
- know the main differences in the defense against bacteria and viruses
- is able to understand the immunological principles behind vaccines
- evaluate the effects of different prophylactic treatments including vaccines and vaccination strategies
- evaluate the impact of different immunological parameters, i.e. antibody responses, cellular responses and immune gene profiling by qPCR
- has a good overview of the immune system of vertebrates (mammals and fish)

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures and seminars.	

GENERAL INFORMATION ABOUT THE COURSE #15

1	The name of the course/module	Protein Structure
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	3/2
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	Of all molecules in a living organism, the proteins have the most diverse functions and due to this, they are also the most complex molecules in a cell. Their function is closely related to the complex 3D structure and the course focuses on this close relationship. The course is an introduction to the basic principles of protein structure, including the properties of amino acids, secondary structure elements, motifs, folds, classification based on fold and the relation between 3-dimensional structure and

		function of proteins. Intramolecular forces like hydrogen bonds, ionic and van der Waals interactions are extensively covered. The basic principles of the hydrophobic effect are also included. Basic properties of the amino acids in a protein such as H-binding, pKa, size, shape, polarity and secondary structure propensities are covered. The general principles of secondary structure elements and motif are extensively covered by the syllabus of the course. The students are furthermore expected to learn how the 3D-structure of a protein determines the function. This is taught through a detailed discussion of a series of protein classes; enzymes, DNA-binding and DNA-modifying proteins, receptors, membrane bound signalling proteins, proteins active in the immune system, virus proteins and the fibre type of proteins. Factors affecting the stability of a protein are discussed for all parts of the course. Some important methods for structure determination (X-ray crystallography and NMR), along with basic modelling techniques are also discussed. The content and use of some of the most important databases for protein structure data are examined both theoretically and through hands-on exercises.
8.	Prerequisites for studying the course/module, connection with other educational components	chemistry, biochemistry or equivalent

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- has extensive knowledge about the molecular structure of the natural amino acids
- has in-depth knowledge about the chemical and structural properties of the individual amino acids both in their free form and in a protein
- has insight into the properties of the peptide and the peptide bond and how these properties influence the folding and structure of a protein
- has knowledge about the main intramolecular forces involved in the stabilization of proteins; their origin, magnitude and role in proteins
has knowledge about the main structural levels in proteins; primary, secondary, tertiary and quaternary
- has insight into how structural elements like secondary structures, motives and folds are built and stabilized
- knows about and can distinguish between globular, membrane bound and fiber proteins and can relate the classes to structural features
- has knowledge about classification of proteins based on both function and structure
- has insight into the main functional protein classes and has detailed knowledge about structure-function relationships for typical example proteins for every functional class
- has knowledge about general mechanisms for ligand binding and intermolecular interactions; enzymes active sites and enzyme catalysis, antibody binding sites, protein-DNA interactions, receptor binding responses in signalling etc.
- knows the most important techniques for determination and analyses of 3-dimentional structures at atomic resolutions; their major strengths and limitations and the interpretation of deposited structural information in the relevant data banks
- can describe the properties of the amino acids, peptides, secondary structure elements and motifs, and are able to evaluate their impact and role at various placements in a protein structure
- can outline in details the structure and stabilizing factors of frequently occurring secondary structure elements, motives and folds
- can describe key features of proteins belonging to various functional classes in general terms and describe such features specifically for example proteins for each functional class
- has acquired the basic knowledge to understand how the atomic resolved protein structure is determined and is able to sketch and understand the main steps in the procedure for determine structures by the use of NMR and X-ray crystallography
- can outline the main steps in a molecular modelling procedure and understands the pitfalls and limitations of a modelled structure
- can interpret and manipulate electronic three-dimensional models from a PDB file
- understands the relation between chemical/structural properties of a protein and the function, and can use this knowledge to discuss and interpret structure-function relations
- has the ability to read and understand in general terms, research papers where the structure-function relationships of a protein are discussed

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures: 28 h, Seminars: 8 h, Laboratory: 30 h PC-based exercises	

GENERAL INFORMATION ABOUT THE COURSE #16		
1	The name of the course/module	Immunology
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	3/2
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	This course aims to provide a understanding of the components and principal workings of the vertebrate immune system. The main focus will be on how our immune system protects the body from microorganisms like virus, bacteria, fungi and parasites. We will also examine how immune responses are initiated and terminated, how the immune system "remembers" a pathogenic intruder such that it can respond stronger at subsequent infections (the basis for vaccination), and how erroneous immune responses can result in serious disease. We will also discuss the basis for the immune system to recognize virtually any structure it is exposed to and why the immune system will vigorously reject transplanted foreign tissues.
8.	Prerequisites for studying the course/module, connection with other educational components	Mathematics (R1+R2) Physics (1+2) Chemistry (1+2) Biology (1+2) Information technology (1+2) Geology (1+2) Technology and research teaching (1+2).

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- Explain the principle difference between innate and adaptive immunity and to name and describe each of the different types of cells of the innate and adaptive immune systems with respect to mechanisms of their activation and their main function in immune responses, cellular receptors that mediate these functions, and effector molecules and cytokines produced by the cells. The students should also be able to explain the typical tissue location and the mechanisms for migration and tissue invasion by the different cells.
- Name and functionally describe the most important soluble effector molecules of the innate an adaptive immune systems, including C-reactive protein, mannose-binding lectin, defencins, the complement system and antibodies with respect to effector mechanism and function, the cells that produce the molecules and how the production of these molecules are activated in the respective cells in which they are produced.
- Outline in detail the mechanisms for the generation of diverse antigen receptor repertoires in the T and B lymphocyte populations and the roles of RAG and TdT enzymes in this process.
- explain how and where adaptive immune responses are initiated and the principles of clonal selection and clonal expansion in adaptive immune responses, and the difference between naive, effector and memory lymphocytes. The students should also be able to
- give an over view of signal transduction in lymphocytes from antigen-receptor ligation to transcription factors including the roles of ITAM and ITIM motifs and the antigen receptor-associated signalling molecules in which they are present, membrane-associated Src kinases (Fyn, Lyn, Blk), Lck, Syk, ZAP-70, PLC, Calcineurin, NFkB, NFAT and AP-1.
- Describe how the immune system fights bacterial, viral and parasite infections and cancer, respectively, and examples of mechanism used by these microorganisms and cancerous cells to avoid the immune system.
- Describe the mechanisms that render B and T lymphocytes tolerant to self tissues and to describe at the molecular level examples of defects in these tolerance mechanisms that result in autoimmune diseases. Furthermore, the students should be able to explain the mechanisms of rejection of grafted allogeneic tissues and how at the molecular level the drug cyclosporine can inhibit acute graft rejection by T cells.
- Describe the various mechanisms and outcomes of allergic reactions and other categories (II ,IV) of hypersensitivity reactions.
- Describe the principle components of vaccines, including adjuvants, and mechanisms for induction of immunological memory by vaccination.
- Describe the mechanisms and outcome of HIV infection that results in acquired immunodeficiency.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The course will consist of lectures, colloquia and laboratory exercises.	

GENERAL INFORMATION ABOUT THE COURSE #17		
1	The name of the course/module	FOOD CHEMISTRY
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	3/2
5.	Number of ECTS credits	10
6.	The total number of hours	
7.	General description and purpose of the educational component	The subject includes general food chemistry with an emphasis on seafood. Lectures are given on the structure of nutrients, digestion, function in the body and their importance for health. The focus is on fats and proteins, but carbohydrates, minerals, vitamins and other low molecular weight nutrients are also covered in the course. Emphasis is placed on how the quality of raw materials can vary and how components in food, particularly seafood, are affected by preservation, processing and storage. Other topics covered are sensory analysis, additives, processing aids and environmental toxins in food. Under supervision, the students must complete and report an independent experimental term paper. The assignment may, for example, deal with food chemical or nutritional aspects of marine raw materials or processed products from marine raw materials.
8.	Prerequisites for studying the course/module, connection with other educational components	biological, economic, social science and technological subjects

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- has knowledge of food-related properties of seafood and utilization of marine resources in general
- knows the nutrients' structure, digestion, function in the body and health significance
- has particular knowledge of fats and fatty acids, especially omega-3 fatty acids, in seafood and how the quality of these substances is retained in processed products
- know how the quality of raw materials can vary and how components in food, especially seafood, are affected by preservation, processing and storage
- has knowledge of processes, additives and environmental toxins in food
- can apply professional knowledge of food chemistry with an emphasis on seafood to practical and theoretical issues
- can, under guidance and based on the results of the experimental term paper, write a report in a form corresponding to a master's thesis. The scope of this report will naturally be smaller than a master's thesis
- have knowledge of food chemistry and seafood in the specific areas mentioned in the course content
- can apply their knowledge and skills to carry out independent tasks and projects, both of an experimental and theoretical nature

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #18		
1	The name of the course/module	Master's Thesis in Marine Biotechnology
2.	Faculty/department	**Faculty of Biosciences, Fisheries and Economics (BFE-fak)**
3.	Status of the educational component	Mandatory
4.	Semester	4/2
5.	Number of ECTS credits	60
6.	The total number of hours	
7.	General description and purpose of the educational component	The master thesis is the main part of the master study in marine biotechnology. Skills will be developed through independent scientific work and production of a written thesis under the guidance by one or several supervisors. The work should be research related and the thesis should have elements of new basic knowledge or methods. The thesis can be based on literature study, data from field work or laboratory research or a combination of these.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

- Have advanced knowledge about industrial and biotechnological processes for use of marine resources and natural molecules with unique characteristics
- Have knowledge that can be applied to solve specific tasks in industry and public administration
- Understand our ethical our ethical responsibility for sustainable resource utilization, industrial practice and innovation
- Have knowledge of scientific theory and experience in applying scientific methodology
- Formulate relevant research questions in an independent manner, and apply theories, concepts and methods pursuant to the scientific and ethical standards in the field
- Use advanced skills in genetics, biotechnological and molecular biological techniques
- Use multidisciplinary skills that enable students to combine different disciplines so that they can analyze and solve a wide range of technical problems
- Demonstrate proficiency in working individually and as a member of a team
- Complete a research project in marine biotechnology
- Search for and evaluate recent biological research in a critical manner, and to make assessments using scientific knowledge in the field
- Present biotechnological knowledge and ideas in an instructive manner to researchers, policy makers, industry and the general public
- Have acquired specialized expertise in one of the topics areas offered
- Have the competence to analyze biotechnology problems that require skills at a high level
- Apply their knowledge and skills in biotechnological theory and methods in new areas relevant to society
- Have sufficient competence to participate in and to evaluate research projects or to advance to doctoral studies
- Able to present scientific results in written and oral form

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	• Marine resources - characterization and isolation of marine natural compounds (used in industry, ingredients, drug discovery, functional food) • Biological activity and mechanisms of actions of marine natural compounds using modern technology (antibacterial, anticancer, immune modulatory, anti-oxidative etc.) • Marine resources and molecular biotechnology of secondary metabolites (invertebrates, microalgae, bacteria, fungi) • Basic studies on arctic marine animals and microorganism • Marine resources as food - impact on health
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Individual guidance and supervision according to agreement and of two semesters duration. Maximum workload for the supervisor is 80 hours, you will receive supervision within these limits.	

UNIVERSIDAD DE CÁDIZ

1	**Criterion A: University profile**		
1.1	Name of the University	**UNIVERSIDAD DE CÁDIZ**	
1.2	Classical or applied	applied	
2	**Criterion B: Profile of the educational program (Curriculum)**		
2.1	Number of Aquaculture disciplines	12	
2.2	The name of the educational program	Aquaculture	
2.3	Type of diploma	Unitary. Master's level of education	
2.4	Total number of credits (ECTS)	60	
3	**Criterion C: Setting the educational program (Curriculum)**		
3.1	Duration of the program	4 semestres	
3.2	The purpose of the educational program	This Master's Degree provides a vision at the highest level of theoretical and applied knowledge in aspects Fundamentals of the biology of marine species, fishing, culture, controlled production, environmental management and economics overview of the current state of fishing and aquaculture, as well as the new technologies used in the most relevant aspects of aquaculture and fishing.	
4	**Criterion D: Characteristics of the educational program (Curriculum)**		
4.1	Subject area (field of knowledge, specialty, specialization (if available))	N/A	
5	**Criterion E: Teaching and assessment**		
5.1	Teaching and learning methods	Lectures, seminars	
5.2	Assessment	N/A	
6	**Criterion F: Software competencies**		
6.1	Integral competence	N/A	
6.2	General competences	N/A	
6.3	Professional competences	N/A	
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	N/A	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	N/A	
8.2	Material and technical support	Research labs	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Current situation of fishing and aquaculture activity	5	N/A
9.1.2	Fishery resources	5	N/A
9.1.3	Assessment and management of fishery resources	5	N/A
9.1.4	Physiological bases of aquaculture	5	N/A
9.1.5	Reproduction and biosecurity in aquaculture	5	N/A
9.1.6	Management and conservation of genetic resources	5	N/A
9.1.7	Aquaculture technologies	5	N/A
9.1.8	Marketing of fishery and aquaculture products	5	N/A
9.1.9	Methodology and scientific tools in aquaculture and fishing	5	N/A
9.1.10	Creación de empresas y proyectos innovadores	5	N/A
9.1.11	Creation of companies and innovative projects	5	N/A
9.1.12	Final Master's Project	15	N/A
	Total credits	**60**	N/A
10	**Criterion L: Form of attestation**		
10.1	Requirements for		

FLEMING COLLEGE CANADA

1	Criterion A: University profile	
1.1	Name of the University	**FLEMING COLLEGE CANADA**
1.2	Classical or applied	applied
2	**Criterion B: Profile of the educational program (Curriculum)**	
2.1	Number of Aquaculture disciplines	21
2.2	The name of the educational program	Aquaculture
2.3	Type of diploma	Unitary. Master's level of education
2.4	Total number of credits (ECTS)	34
3	**Criterion C: Setting the educational program (Curriculum)**	
3.1	Duration of the program	3 semestres
3.2	The purpose of the educational program	Training of professionals, who are capable of carrying out scientific research and able to implement the professional approaches to increasing profitability and ecologically safe production and cultivation of hydrobionts, solving complex tasks of research and/or innovative character in the field of aquatic bioresources and aquaculture.
4	**Criterion D: Characteristics of the educational program (Curriculum)**	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	N/A
5	**Criterion E: Teaching and assessment**	
5.1	Teaching and learning methods	Teaching is carried out in the form of lectures (multimedia, interactive), seminars, practical and laboratory work, consultations with teachers. Student-centered teaching, problem-oriented teaching, interactive self-learning, information technologies, the credit-transfer system of learning organization, electronic learning in the Moodle system, and learning based on research and observations.
5.2	Assessment	N/A
6	**Criterion F: Software competencies**	
6.1	Integral competence	N/A
6.2	General competences	N/A
6.3	Professional competences	N/A
7	**Criterion G: Program Learning Outcomes**	
7.1	Program learning outcomes	1. Perform a variety of aquaculture field skills competently, in accordance with established norms, and in a way that provides leadership and direction for others where required. 2. Assess environmental aspects of aquaculture and communicate the results to a variety of stakeholders using current and relevant terminology. 3. Recognize and justify the diversity and potential for aquaculture as alternative source of fish protein. 4. Monitor and assess fish health and environmental conditions at an aquaculture site. 5. Describe and distinguish all life stages and culture techniques of select marine and freshwater species. 6. Examine and evaluate the business viability and potential for various aquaculture operations. 7. Assess the economic and social viability of specific aquaculture technologies and design. 8. Lead and maintain a variety of acquaculture operations, employing the appropriate mechanical and technical skills as required. 9. Supervise and evaluate aquaculture field crews in accordance with established protocols.
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**	
8.1	Staff support	The educational process at the university is carried out by highly qualified teaching staff.
8.2	Material and technical support	Research labs

9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Aquaculture Safety	45 h	N/A

9.1.2	Biology of Aquaculture	30	N/A
9.1.3	Co-op Preparation	30	N/A
9.1.4	Fish Husbandry Procedures and Analysis	150	N/A
9.1.5	Mechanical Systems in Aquaculture	45	N/A
9.1.6	Trout and Salmon Farming Field Trips and Workshops I	45	N/A
9.1.7	Aquaculture Enterprises	45	N/A
9.1.8	Aquaculture in the Modern World	21	N/A
9.1.9	Field Skills	45	N/A
9.1.10	Principles and Practices in Cool and Warm Water Aquaculture	45	N/A
9.1.11	Supervisory Fish Husbandry & Hatchery Management	150	N/A
9.1.12	Trout and Salmon Farming Field Trips and Workshops II	45	N/A
9.1.13	Aquaculture Co-op	320	N/A
	Total credits	**1016 h**	N/A
10	**Criterion L: Form of attestation**		
10.1	Requirements for	State-qualifying exam in the form of testing Public defense of master's qualifying work	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Aquaculture Safety
2.	Faculty/department	School of Environmental and Natural Resource Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	
6.	The total number of hours	45
7.	General description and purpose of the educational component	FIWI 54
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Students will become familiar with health and safety legislation and regulations, common safety hazards in aquaculture settings and the employer/employee relationship. Through self-directed learning, students will acquire safety certifications that are required or desired by many employers in the aquaculture industry (e.g. First Aid, CPR, WHMIS, truck and boat operation).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #2		
1.	The name of the course/module	Biology of Aquaculture
2.	Faculty/department	School of Environmental and Natural Resource Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	3.0
6.	The total number of hours	30
7.	General description and purpose of the educational component	FIWI 53
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
In this course, introductory lectures will be given on the natural history, environmental requirements, reproduction and culture techniques of a common species used in aquaculture. Students will research an aquaculture species relating to their career interest and present their findings in a report and presentation.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #3		
1.	The name of the course/module	Co-op Preparation
2.	Faculty/department	School of Environmental and Natural Resource Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1nd
5.	Number of ECTS credits	
6.	The total number of hours	30
7.	General description and purpose of the educational component	APST 119
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
At the start of the second semester the student should have a good idea of their specific career interest in aquaculture. The intent of this course is to provide the tools to pursue their career interest and establish a connection with a potential business partner. This will be done by researching and networking with the industry, and will be evaluated by in-class presentations on: - Define Scope of Interest - Specific Environmental and Legislative Issues - Progress Report of Networking with contact of a potential Business Partner.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

6.	N/A
7.	N/A
8.	N/A
9.	N/A
10.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

GENERAL INFORMATION ABOUT THE COURSE #4		
1.	The name of the course/module	Fish Husbandry Procedures and Analysis
2.	Faculty/department	School of Environmental and Natural Resource Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2st
5.	Number of ECTS credits	
6.	The total number of hours	150
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

This course will familiarize students with the routine skills and husbandry procedures associated with working in a fish hatchery environment. Each student will clean tanks, observe and feed fish, measure water quality, examine fish health, record fish husbandry data and monitor the operation of the mechanical systems. After the principles and practice of these skills are demonstrated by the professor, students will practice these skills in the Atlantic salmon and muskellunge hatcheries under the guidance of technicians.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #5		
1.	The name of the course/module	Mechanical Systems in Aquaculture
2.	Faculty/department	School of Environmental and Natural Resource Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2-nd
5.	Number of ECTS credits	
6.	The total number of hours	45
7.	General description and purpose of the educational component	MECH 233
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Through weekly lectures and seminars, students will become familiar with the design, operation and maintenance of a variety of production systems used in extensive and intensive aquaculture sectors including pond, flow-through,

recirculation and cage systems. By examining 'what if' scenarios, emergency response procedures will be analyzed and practiced. Students will research, document and compare a mechanical system used in the aquaculture industry and present their findings in a seminar and written report.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	N/A
3.	N/A
4.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #6		
1.	The name of the course/module	Trout and Salmon Farming Field Trips and Workshops I
2.	Faculty/department	School of Environmental and Natural Resource Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	
6.	The total number of hours	120
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
During the first semester the student will take a 5 day tour of the rainbow trout cage farming industry in Lake Huron. At field locations and evening sessions, industry representatives will share their knowledge and experience of the trout and salmon farming industry. At some sites students will get the opportunity to practice net cage skills such as feeding and net changing.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #7		
1.	The name of the course/module	Aquaculture Enterprises
2.	Faculty/department	School of Environmental and Natural Resource Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2rd
5.	Number of ECTS credits	
6.	The total number of hours	45
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Business models for common aquaculture enterprises will be discussed. Students will complete an independent project to demonstrate their knowledge of the business aspects of an aquaculture enterprise, and present it in a seminar.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #8		
1.	The name of the course/module	Aquaculture in the Modern World
2.	Faculty/department	School of Environmental and Natural Resource Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	
6.	The total number of hours	21
7.	General description and purpose of the educational component	FIWI 52
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
The main objective of this course is to provide an overview of the many varied applications of aquaculture in Canada and overseas to assist the student when choosing a particular career path in aquaculture. Through lectures and seminars career opportunities will be discussed in food aquaculture industries (trout and salmon farming, tilapia, carp and catfish culture and shellfish culture), fish hatchery management for recreational fisheries, conservation aquaculture (restoration of species at risk) and small business aquaculture ventures such as the aquaponics, and ornamental pond industries. Environmental issues, legislation pertaining to aquaculture and community interaction and development will also be covered.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
6.	N/A
7.	N/A
8.	N/A
9.	N/A
10.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #9		
1.	The name of the course/module	Field Skills
2.	Faculty/department	School of Environmental and Natural Resource Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2st
5.	Number of ECTS credits	
6.	The total number of hours	45

7.	General description and purpose of the educational component	FIWI 57
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Throughout the second semester students will participate in seasonal aquaculture operations such as fish stocking of Atlantic salmon smolts and muskellunge fingerlings, and walleye egg collections. Also fisheries techniques such as electro fishing, boat handling and setting of trap nets and gill nets will be practiced in the Kawartha Lakes area. Prior to these field trips a mini lecture on the principles of these practices will be given.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #10

1.	The name of the course/module	**Principles and Practices in Cool and Warm Water Aquaculture**
2.	Faculty/department	School of Environmental and Natural Resource Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2st
5.	Number of ECTS credits	
6.	The total number of hours	45
7.	General description and purpose of the educational component	FIWI 56
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Through a series of guest lectures, field trips, and student participation in seminars, culture techniques of the following cool and warm water species will be covered: - Muskellunge Culture - Walleye Culture - Sturgeon culture - Bass Culture - Tilapia Culture - Present and Potential Culture and Restoration practices for Species at Risk - Polyculture - Aquaponics

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #11

1.	The name of the course/module	Supervisory Fish Husbandry & Hatchery Management
2.	Faculty/department	School of Environmental and Natural Resource Sciences

3.	Status of the educational component	Mandatory
4.	Semester	3st
5.	Number of ECTS credits	
6.	The total number of hours	150
7.	General description and purpose of the educational component	FLPL 190
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The objective of this course is to increase the skill sets that students gained from the semester one course, and create an awareness of how the skills are intrinsically linked in the daily operations of a commercial fish hatchery. Each week, two students will be assigned to supervise fish husbandry procedures in the Atlantic salmon and muskellunge fish hatcheries .

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #12

1.	The name of the course/module	Trout and Salmon Farming Field Trips and Workshops II
2.	Faculty/department	School of Environmental and Natural Resource Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	
6.	The total number of hours	45
7.	General description and purpose of the educational component	APST 162
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

During the second semester the student will take a 5 day tour of various land based facilities in Ontario. These may include a processing plant, fingerling rainbow trout grow out, tilapia production, shrimp production, research and state of the art Ministry of Natural Resources and Forestry facilities.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #13		
1	The name of the course/module	Aquaculture Co-op
2.	Faculty/department	School of Environmental and Natural Resource Sciences
3.	Status of the educational component	Optional
4.	Semester	3rd
5.	Number of ECTS credits	
6.	The total number of hours	320
7.	General description and purpose of the educational component	APST 121
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

This course is designed to allow the student the opportunity to obtain aquaculture related experience through a co-op work term of 320 hours with an organization selected by the student and approved by the program coordinator. It provides the student with the opportunity to apply existing knowledge and skill either through observation and/or applications.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

UNIVERSITY OF PORTO (UNIVERSIDADE DO PORTO)

1	Criterion A: University profile	
1.1	Name of the University	**UNIVERSITY OF PORTO (UNIVERSIDADE DO PORTO)**
1.2	Classical or applied	classical and applied
2	Criterion B: Profile of the educational program (Curriculum)	
2.1	Number of Aquaculture disciplines	several
2.2	The name of the educational program	Master Degree in Marine Sciences - Marine Resources
2.3	Type of diploma	MSc degree
2.4	Total number of credits (ECTS)	120 ECTS
3	Criterion C: Setting the educational program (Curriculum)	
3.1	Duration of the program	4 semestres (2 years)
3.2	The purpose of the educational program	The master's degree provides knowledge and promotes skills that guarantee the advanced training of professionals capable of intervening in the research and management of the sea and coastal areas, the sustainable development of aquaculture and fisheries, and creating added value for the marine ecosystem resources and services. Teaching promotes gains in professional and personal skills, emphasizing practical aspects and the progress of initiative and creativity. The master's degree is oriented towards studying the biota inhabiting the oceans and coastal areas, considering them to be part of a dynamic environment that needs to be preserved and as limited natural resources, whose exploration is intense, complex, requiring qualified individuals.
4	Criterion D: Characteristics of the educational program (Curriculum)	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Main areas: Aquaculture and Fisheries, Marine Biology and Ecology, Behavior Sciences, Marine Sciences, Research Methodologies Marine Sciences - Marine Resources - Specialization in Aquaculture and Fisheries (120 ECTS) Marine Sciences - Marine Resources - Specialization in Marine Biology and Ecology (120 ECTS) Course of master in Marine Biology and Ecology (60 ECTS) Course of master in Aquaculture and Fisheries (60 ECTS)
5	Criterion E: Teaching and assessment	
5.1	Teaching and learning methods	In order to guarantee a high diversity and quality of the training offer, the Master's Degree is offered jointly and since its genesis by ICBAS and IPMA (ex-IPIMAR, Fisheries and Sea Research Institute), counting on the permanent and close participation CIIMAR (Interdisciplinary Center for Marine and Environmental Research) and ELA (Estação Litoral da Aguda). There are partnerships with COMPANIES, promoting training internships (via Free Options) and the realization of dissertations and annual internships in a professional environment.
5.2	Assessment	Anual reports about functioning, each 4 years complete external evaluation by a National Accreditation entity (A3E)
6	Criterion F: Software competencies	
6.1	Integral competence	Word, Powerpoint
6.2	General competences	Excel, e-mail
6.3	Professional competences	Not applicable
7	Criterion G: Program Learning Outcomes	
7.1	Program learning outcomes	Highly qualified masters with: 1. General Aquatic Biology knowledge 2. Aquatic Ecology training 3. Water management and quality knowledge 4. Aquaculture technical skills 5. Nutrition management and knowledge 6. Response to hygiene, fish health and disease 7. Water effluents management skills 8. Food preservation, processing and quality skills 9. Marketing, sustainability and welfare knowledge 10. Industrial waste management skills
8	Criterion H: Resource support for the implementation of the educational program (Curriculum)	

8.1	Staff support	Aprox. 20 teachers, 6 technicians, 6 office logistic workers	
8.2	Material and technical support		
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Science and Communication Methods	5 ECTS	N/A
	Experimental Planning and Data Analysis	5 ECTS	N/A
9.1.3	Cellular and Molecular Biology Techniques and Applications in Marine Sciences	5 ECTS	N/A
9.1.4	Economy, Accounting and Management	5 ECTS	N/A
9.1.5	Aquaculture and Fisheries Seminar	5 ECTS	N/A
9.2	**Optional components**	**Number of credits**	**Final control form**
			N/A
9.2.1	Marine Biology and Ecology	5 ECTS	N/A
9.2.2	Population Dynamics	5 ECTS	N/A
9.2.3	General and Aquatic	5 ECTS	N/A
9.2.4	Animal Ethology	5 ECTS	N/A
9.2.5	Applied Ichthyology	5 ECTS	N/A
9.2.6	Physical Oceanography	5 ECTS	N/A
9.2.7	Remote Sensing Principles and Applications	5 ECTS	N/A
9.2.8	Bioactive Marine Natural Products	5 ECTS	N/A
9.2.9	Chemical and Biochemical Techniques and Applications in Marine Sciences	5 ECTS	N/A
9.2.10	Animal Welfare in Aquaculture and Public Aquariums	5 ECTS	N/A
9.2.11	Integrated Management of Oceans	5 ECTS	N/A
9.2.12	Immunology of Aquatic Animals	5 ECTS	N/A
9.2.13	Food Nutrition and Technology	5 ECTS	N/A
9.2.14	Aquatic Animal Pathology and Sanitary Safety	5 ECTS	N/A
9.2.15	Ornamental Fish Production	5 ECTS	N/A
9.2.16	Aquatic Production and Aquaculture Systems	5 ECTS	N/A
9.2.17	Fisheries Technology and Evaluation of Fisheries Resources	5 ECTS	N/A
9.2.18	Technology and Food Safety of Fishery Products	5 ECTS	N/A
9.2.19	Any other subject from any Faculty of the University of Porto	5 ECTS	N/A
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Final theoretical exams, written individual and team work, practical continuous and final exams, oral presentations, participation in classes and thematic discussions.	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Science and Communication Methods
2.	Faculty/department	ICBAS-School of Medicine and Biomedical Sciences, U. Porto,
3.	Status of the educational component	Mandatory
4.	Semester	
5.	Number of ECTS credits	5
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	Present and discuss with students the scientific method and the most frequent failures, increasing their knowledge in topics. Review and discuss forms of scientific communication and their logic, improving critical and execution skills of students in the subject. Make inroads in the management of bibliography, bibliometrics and publication systems, so that students know them and know how to use and interpret them. Address questions of ethics in research, promoting its implementation in the student. Thus, opportunities are provided to gain and improve scientific skills in the

		area and skills transversal. Students are equipped with creative and critical capacity on how to communicate scientific results, orally and in writing. Individual communication skills and the ability to design scientific studies are increased. In general, transversal skills are acquired and improved in accordance with what is recommended for the attribution of a Master's degree.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Present and discuss in detail with the students the scientific method steps and the most frequent failures, boosting their knowledge in such topics. Review and discuss the forms of scientific communication and their logic/soundness, improving critical skills and enforcement capacities of the students in the field. Carry out actions in management of the bibliography, bibliometrics and publishing systems, so that students are aware and know how to correctly use and interpret them. Address ethical issues in research, promoting high standards of the student on the matter. All these offer occasions to earn and improve scientific skills in the area and soft skills; promotes in students creative and critical capacities on how to communicate scientific results orally and in writing; increment the individual s communication skills and ability to design scientific studies.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	The fundamental concepts of scientific methodology.
2.	Common basic errors and systems of validation and dissemination of scientific results.
3.	The scientific world today: publishers, editors, peers, authors. The indexing systems.
4.	Presentation of databases and discussion of indicators of scientific impact.
5.	The planning of a scientific study (e.g., proposals for funding, dissertation proposal).
6.	Brainstorming in group for project definition. Conclusion with mind mapping software.
7.	Preparing and presenting a Scientific Poster.
8.	Preparing and presenting an Oral Communication.
9.	Writing a scientific paper & writing and presentation of a thesis or of a dissertation.
10.	Bibliographic databases and management of references via software.
11.	Communicate science to society.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Lectures. Exposure with interactive discussions. Brainstorming. Work and group discussion. Work and broad discussion. Representation (acting, role playing). Final grades (0 to 20): Task 1 + Task + 2 + Task 3 + Participation Quality Each Task: 0-6 values. Participation: 0-2 values. Participation (P) rewards performance quality (PQ) of each student, weighted by attendance (A) = QD x (% attendance to class). Task 1. Reduced Group (ca. 3 students): Realization and presentation of poster on a theme of student's choice. It is drawn who presents. Presentation: 10 min. Discussion: up to 10 min. Self-assessment is made of each element (0 to 100). Task 2. Enlarged Group (ca. 5 students): Proposal of a Master's Dissertation Project. Delivery (printed and PDF) and oral presentation (up to 15 min), followed by critical discussion (15 min). The group appoints a spokesman for presentation. Self-assessment is made of each element (0 to 100). Task 3. Final exam (multiple choice test).	N/A

KENTUCKY STATE UNIVERSITY

1	**Criterion A: University profile**		
1.1	Name of the University	**KENTUCKY STATE UNIVERSITY**	
1.2	Classical or applied	applied	
2	**Criterion B: Profile of the educational program (Curriculum)**		
2.1	Number of Aquaculture disciplines		
2.2	The name of the educational program	Aquaculture and Aquatic Science	
2.3	Type of diploma	Unitary. Master's level of education	
2.4	Total number of credits (ECTS)	120	
3	**Criterion C: Setting the educational program (Curriculum)**		
3.1	Duration of the program	2 semestres	
3.2	The purpose of the educational program	Upon completion of the program, a student should have knowledge of production and reproduction of primary aquaculture species, basic physiology and nutrition of aquatic vertebrate and invertebrate culture species, mechanics and operation of primary production methods, causes and controls of pathogenic organisms, the function and manipulation of biological and chemical cycles in ponds, basics of marketing and business aspects of aquaculture, and the design and analysis of experiments.	
4	**Criterion D: Characteristics of the educational program (Curriculum)**		
4.1	Subject area (field of knowledge, specialty, specialization (if available))		
5	**Criterion E: Teaching and assessment**		
5.1	Teaching and learning methods	Lectures, seminars	
5.2	Assessment		
6	**Criterion F: Software competencies**		
6.1	Integral competence		
6.2	General competences		
6.3	Professional competences	1. Be able to apply their knowledge to solve practical farming challenges, participate in development and research tasks, and follow knowledge development and innovation in the aquaculture industry	
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	A candidate who has completed the education is expected to have achieved the following learning outcomes, defined in knowledge, skills and competence: 1. Be equipped to summarize theory and practice to meet challenges in industry and society, such as resource-efficient food production, the environment and animal welfare 2. Problem-solving expertise in aquaculture production and business development 3. Dealing with complex sustainability challenges in the aquaculture industry 4. Have the ability to synthesize and utilize acquired knowledge in complex aquaculture matters 5. Have in-depth knowledge in one or more of the fields of production biology, production technology and feed technology applied in aquaculture	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	The educational process at the university is carried out by highly qualified teaching staff.	
8.2	Material and technical support	Research labs	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Fish Genetics	3	N/A
9.1.2	Introduction to Geographic Information Systems	3	N/A
9.1.3	Biostatistics	3	N/A
9.1.4	Fish Diseases	4	N/A
9.1.5	Fish Morphology and Physiology	4	N/A
9.1.6	Aquatic Ecology	4	N/A
9.1.7	Fish Nutrition	3	N/A
9.1.8	Principles of Aquaculture	3	N/A

9.1.9	Aquaculture Economics and Marketing	4	N/A
9.1.10	Fish Reproduction & Spawning Techniques	4	N/A
9.1.11	Survey of Production Methods	3	N/A
9.1.12	Aquaponics	3	N/A
9.1.13	Water Quality Management	4	N/A
9.1.14	Internship: Aquaculture	1-4	N/A
9.1.15	Research Aquaculture	1-9	N/A
	Total credits	**120**	N/A
10	Criterion L: Form of attestation		
10.1	Requirements for	State-qualifying exam in the form of testing Public defense of master's qualifying work	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Fish Genetics
2.	Faculty/department	School of Aquaculture and Aquatic Sciences
3.	Status of the educational component	**Mandatory**
4.	Semester	1st
5.	Number of ECTS credits	3
6.	The total number of hours	
7.	General description and purpose of the educational component	An overview of fish genetics including basic principles and methods of selective breeding in aquaculture.
8.	Prerequisites for studying the course/module, connection with other educational components	Consent of instructor.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
1		
2.		

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #2		
1	The name of the course/module	Introduction to Geographic Information Systems
2.	Faculty/department	School of Aquaculture and Aquatic Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1nd
5.	Number of ECTS credits	3
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	This graduate course will expose students to the concepts, software, data and analysis processes of Geographic Information Systems (GIS). Students will develop a real world, working knowledge of GIS through hands-on work with mapping software, its potential, its limitations and further trends in the mapping industry. Graduate students will develop a project that examines existing spatial data and utilizes modeling software to create a production quality, full scale mapping product.
8.	Prerequisites for studying the course/module, connection with other educational components	Consent of instructor.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
•		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		

3.	N/A
4.	N/A
5.	N/A
6.	N/A
7.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #3		
1	The name of the course/module	Biostatistics
2.	Faculty/department	School of Aquaculture and Aquatic Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1nd
5.	Number of ECTS credits	3
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	Biostatistics including basic principles of experimental design and data analysis with emphasis on their applications in aquaculture research.
8.	Prerequisites for studying the course/module, connection with other educational components	Consent of instructor.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
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CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #4		
1	The name of the course/module	Fish Diseases
2.	Faculty/department	School of Aquaculture and Aquatic Sciences
3.	Status of the educational component	Mandatory
4.	Semester	N/A
5.	Number of ECTS credits	4
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	An in-depth study of clinical diagnosis of fish diseases; necropsy of diseased fish; and formulation of corrective measures for disease control.
8.	Prerequisites for studying the course/module, connection with other educational components	BIO 406 or consent of instructor.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
2.	N/A
3.	N/A
4.	N/A
5.	N/A
6.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	3 hours of lecture, 2 hours of laboratory per week.

GENERAL INFORMATION ABOUT THE COURSE #5		
1	The name of the course/module	Fish Morphology and Physiology
2.	Faculty/department	School of Aquaculture and Aquatic Sciences
3.	Status of the educational component	Mandatory
4.	Semester	N/A
5.	Number of ECTS credits	4
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	A graduate approach to the study of fish morphology and physiology with emphasis on comparative and adaptive aspects among Osteichthyes (true bony fish).
8.	Prerequisites for studying the course/module, connection with other educational components	BIO 311 or consent of instructor.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A
6.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	3 hours of lecture, 2 hours of laboratory per week.

GENERAL INFORMATION ABOUT THE COURSE #6		
1.	The name of the course/module	Aquatic Ecology
2.	Faculty/department	School of Aquaculture and Aquatic Sciences
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	4
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	This course investigates the interaction of aquatic organisms with their biotic and abiotic environment. Sampling and laboratory methods for limnological analysis will be covered.
8.	Prerequisites for studying the course/module, connection with other educational components	Prerequisite: Consent of instructor.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	N/A
3.	N/A

4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #7		
1	The name of the course/module	Fish Nutrition
2.	Faculty/department	School of Aquaculture and Aquatic Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	3
6.	The total number of hours	
7.	General description and purpose of the educational component	A graduate approach to the study of fish nutrition including nutrient requirements, nutrient chemistry, ration formulation, and practical feeding.
8.	Prerequisites for studying the course/module, connection with other educational components	Prerequisite: Consent of instructor.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	N/A	
2.	N/A	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	3 hours of lecture per week.

GENERAL INFORMATION ABOUT THE COURSE #8		
1	The name of the course/module	Principles of Aquaculture
2.	Faculty/department	School of Aquaculture and Aquatic Sciences
3.	Status of the educational component	Mandatory
4.	Semester	N/A
5.	Number of ECTS credits	3
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	Introduction to principles underlying aquatic productivity and management with a survey of domestic and foreign cultures of fish and aquatic vertebrates.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	N/A	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #9		
1	The name of the course/module	Aquaculture Economics and Marketing
2.	Faculty/department	School of Aquaculture and Aquatic Sciences

3.	Status of the educational component	Mandatory
4.	Semester	2st
5.	Number of ECTS credits	4
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	Aquaculture economics, marketing channels and consumer preferences for fish products will be presented
8.	Prerequisites for studying the course/module, connection with other educational components	Prerequisite: Consent of Instructor.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	N/A	
2.	N/A	
3.	N/A	
4.	N/A	
5.	N/A	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)		Study methods (what types of educational activities should be performed by the student independently)
N/A		3 hours of lecture, 2 hours of laboratory per week.

GENERAL INFORMATION ABOUT THE COURSE #10		
1	The name of the course/module	Fish Reproduction & Spawning Techniques
2.	Faculty/department	School of Aquaculture and Aquatic Sciences
3.	Status of the educational component	Mandatory
4.	Semester	2st
5.	Number of ECTS credits	4
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	An overview of basic biology of fish reproduction and techniques of artificial spawning for common aquaculture species.
8.	Prerequisites for studying the course/module, connection with other educational components	N/A
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	N/A	
2.	N/A	
3.	N/A	
4.	N/A	
5.	N/A	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)		Study methods (what types of educational activities should be performed by the student independently)
N/A		3 hours of lecture, 2 hours of laboratory per week.

GENERAL INFORMATION ABOUT THE COURSE #11		
1	The name of the course/module	Survey of Production Methods

2.	Faculty/department	School of Aquaculture and Aquatic Sciences
3.	Status of the educational component	Mandatory
4.	Semester	N/A
5.	Number of ECTS credits	3
6.	The total number of hours	
7.	General description and purpose of the educational component	An in-depth study of alternative production methods including cages, net-pens, ponds, raceways, and recirculating systems with application to suitable species. (Three hours of lecture per week)
8.	Prerequisites for studying the course/module, connection with other educational components	Prerequisite: BIO 251 or consent of instructor.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	N/A	
2.	N/A	
3.	N/A	
4.	N/A	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)		Study methods (what types of educational activities should be performed by the student independently)
N/A		N/A

GENERAL INFORMATION ABOUT THE COURSE #12		
1	The name of the course/module	Water Quality Management
2.	Faculty/department	School of Aquaculture and Aquatic Sciences
3.	Status of the educational component	Mandatory
4.	Semester	N/A
5.	Number of ECTS credits	4
6.	The total number of hours	250
7.	General description and purpose of the educational component	An in-depth study of the understanding and manipulation of the biological, chemical, and physical aspects of water quality in aquaculture production.
8.	Prerequisites for studying the course/module, connection with other educational components	Prerequisite: BIO 260 or consent of instructor.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	N/A	
2.	N/A	
3.	N/A	
4.	N/A	
5.	N/A	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)		Study methods (what types of educational activities should be performed by the student independently)
N/A		3 hours of lecture, 2 hours of laboratory per week.

GENERAL INFORMATION ABOUT THE COURSE #13		
1.	The name of the course/module	Aquaponics
2.	Faculty/department	School of Aquaculture and Aquatic Sciences

3.	Status of the educational component	Mandatory
4.	Semester	N/A
5.	Number of ECTS credits	3
6.	The total number of hours	N/A
7.	General description and purpose of the educational component	AQU 452 This course will provide an overview of principles and practices of aquaponic production. Students will be introduced to a wide range of topics including fish and plants management, system design, water quality, nutrient dynamics, food safety, and others. The class covers proven technology, current practices, and introduced students to future directions and research in the growing field of aquaponcs.
8.	Prerequisites for studying the course/module, connection with other educational components	BIO 251 or consent of instructor.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.	N/A	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)		Study methods (what types of educational activities should be performed by the student independently)
N/A		N/A

GENERAL INFORMATION ABOUT THE COURSE #14		
1.	The name of the course/module	Internship: Aquaculture
2.	Faculty/department	School of Aquaculture and Aquatic Sciences
3.	Status of the educational component	
4.	Semester	2nd
5.	Number of ECTS credits	1-4
6.	The total number of hours	
7.	General description and purpose of the educational component	Intensive experience involving practical on-site participation working at an aquaculture facility (university, state or private) for graduate students.
8.	Prerequisites for studying the course/module, connection with other educational components	Prerequisite: Consent of instructor.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
N/A		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
2.	N/A	
3.	N/A	
4.	N/A	
5.	N/A	
6.	N/A	
TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)		Study methods (what types of educational activities should be performed by the student independently)
N/A		N/A

NORWEGIAN UNIVERSITY OF LIFE SCIENCES

1	**Criterion A: University profile**		
1.1	Name of the University	**NORWEGIAN UNIVERSITY OF LIFE SCIENCES**	
1.2	Classical or applied	applied	
2	**Criterion B: Profile of the educational program (Curriculum)**		
2.1	Number of Aquaculture disciplines		
2.2	The name of the educational program	Aquaculture (Management and Farming Technology)	
2.3	Type of diploma	Unitary. Master's level of education	
2.4	Total number of credits (ECTS)	120	
3	**Criterion C: Setting the educational program (Curriculum)**		
3.1	Duration of the program	2 semestres	
3.2	The purpose of the educational program	The program gives you a broad and interdisciplinary strength and specialization in the subjects of your choice. We offer courses in fish farming, fish nutrition, and aquaculture plant planning and design, and you will gain insight and knowledge of how these components/factors affect production efficiency and affect economic income.	
4	**Criterion D: Characteristics of the educational program (Curriculum)**		
4.1	Subject area (field of knowledge, specialty, specialization (if available))	N/A	
5	**Criterion E: Teaching and assessment**		
5.1	Teaching and learning methods	Teaching methods are varied and include lectures, field trips, group work, independent studies and exercises and seminars by students.	
5.2	Assessment	N/A	
6	**Criterion F: Software competencies**		
6.1	Integral competence	1. Have in-depth knowledge in one or more of the fields of production biology, production technology and feed technology applied in aquaculture	
6.2	General competences	N/A	
6.3	Professional competences	2. Be able to apply their knowledge to solve practical farming challenges, participate in development and research tasks, and follow knowledge development and innovation in the aquaculture industry	
7	**Criterion G: Program Learning Outcomes**		
7.1	Program learning outcomes	A candidate who has completed the education is expected to have achieved the following learning outcomes, defined in knowledge, skills and competence: Knowledge: 6. Be equipped to summarize theory and practice to meet challenges in industry and society, such as resource-efficient food production, the environment and animal welfare 7. Problem-solving expertise in aquaculture production and business development 8. Dealing with complex sustainability challenges in the aquaculture industry 9. Have the ability to synthesize and utilize acquired knowledge in complex aquaculture matters	
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	The educational process at the university is carried out by highly qualified teaching staff.	
8.2	Material and technical support	Research labs	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Sustainability and welfare in aquaculture	5	N/A
9.1.2	Fish physiology	5	N/A
9.1.3	Applied Aquaculture	10	N/A
9.1.4	Internship Aquaculture	10	N/A
9.1.5	Water chemistry - NYTT	10	N/A

9.1.6	E-learning Course: Planning and Scientific Writing of a Master's Thesis in Natural Sciences	5	N/A
9.1.7	Fish Ecology and Management (Norwegian)	10	N/A
9.1.8	Sustainable development goals in plant and animal food systems	5	N/A
9.1.9	Statistical Programming in R	5	N/A
	Sp. Management and Farming Technology		N/A
9.1.10	Production technology in aquaculture	10	N/A
9.1.11	Laboratory course in international aquaculture	5	N/A
9.1.12	Basic Aquaculture Engineering	5	N/A
9.1.13	Planning and Design of Intensive Fish Farms	10	N/A
9.1.14	International Economics	10	N/A
	Special syllabus	**10**	N/A
9.1.15	Intensive aquaculture	10	N/A
9.1.16	Sustainable Ingredients in Aquafeeds	5	N/A
9.1.17	Laboratory Course in International Aquaculture	5	N/A
9.1.18	Fish Health Biology	10	N/A
	Total credits	**120**	N/A
10	**Criterion L: Form of attestation**		
10.1	Requirements for	State-qualifying exam in the form of testing Public defense of master's qualifying work	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Sustainability and welfare in aquaculture
2.	Faculty/department	Faculty of Biosciences
3.	Status of the educational component	**Mandatory**
4.	Semester	1st
5.	Number of ECTS credits	5
6.	The total number of hours	125
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge in biology
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		

Knowledge

- The students will learn how theoretical knowledge can be applied in various practical examples. Furthermore, students are made aware of the benefits and consequences of using biological knowledge in a production situation.
- Knowledge of the production of fish, shellfish and macroalgae as a basis for sustainable aquaculture (focus on salmonids)
- Knowledge of factors that affect fish welfare throughout the production phase

Skills

- Understand how the farming environment affects production parameters and fish welfare
- Understand effects of the surrounding environment
- Be able to assess welfare characteristics of fish in aquaculture and know measures that can improve welfare
- Be able to disseminate research-based knowledge about sustainability and fish welfare

General competence

• Have a good overview of factors that are important for sustainability and fish welfare in farming throughout the production phase **Learning activities:** • Teaching consists of a combination of lectures, demonstrations and exercises. The course also includes a trip to the west coast, where various aquaculture enterprises are visited.	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
8.	N/A
9.	N/A
TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The course teacher is available for support in connection with exercises in working hours, and by e-mail and phone outside of the teaching hours.	N/A

GENERAL INFORMATION ABOUT THE COURSE #2		
1	The name of the course/module	Fish physiology
2.	Faculty/department	Faculty of Biosciences
3.	Status of the educational component	Mandatory
4.	Semester	1nd
5.	Number of ECTS credits	5
6.	The total number of hours	125
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	Fish Health Biology

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: • Acquired knowledge about the physiological and anatomic characteristics making fish adapted to a life in water • Understand the limitations and advantage of living in water versus on land • Got insight in how specific fish groups during evolution have developed unique morphological and functional traits Skills: • Able to present and discuss important differences between fish and land-living animals related to specific physical conditions in water and on land General competence: • Acquired insight in relevant scientific challenges related to welfare in farmed fish • Understand the physiological limitations in fish for sustainable aquaculture

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #3		
1	The name of the course/module	Applied Aquaculture
2.	Faculty/department	Faculty of Biosciences
3.	Status of the educational component	Mandatory
4.	Semester	1nd
5.	Number of ECTS credits	10

6.	The total number of hours	250
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

KNOWLEDGE:

- Current hot topics in the aquaculture industry
- Major challenges in aquaculture production
- Know how to interlink theoretical and business realities
- Know how to synthesize and utilize acquired knowledge in complex real-world aquaculture cases

SKILLS:

- Be able to tackle real-life aquaculture challenges through a business approach; incl implementation of SWOT analyses
- Problem-solving competencies; including negotiations, decision management
- Be able to present complex Real World Cases in a way that is understandable and engaging for people/colleagues within and outside the field in focus - both orally and in writing

GENERAL COMPETENCE:

- Be well-informed about important issues that concern the aquaculture industry after graduation, and thereby well-prepared for working life
- Deal with complex, ambiguous real-world sustainability problems; including strategic competence. Understand required competence for succeeding in sustainability driven entrepreneurship
- Basic understanding of primary success factors required for sustainable growth in the aquaculture business

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

7.	

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Supervision/ mentoring in connection with case studies and oral presentations	N/A

GENERAL INFORMATION ABOUT THE COURSE #4

1.	The name of the course/module	Internship Aquaculture
2.	Faculty/department	Faculty of Biosciences
3.	Status of the educational component	Mandatory
4.	Semester	2st
5.	Number of ECTS credits	10
6.	The total number of hours	125
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	Relevant background in aquaculture. At least third year Bachelor student, or equivalent

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The goal is to strengthen the students practical experiences in animal sciences, and their ability to relate this to theory and methodology in the field. Through the work practice, you should be able to demonstrate cooperation, understanding and practical benefit of the daily operations in the company you work in. You will also, through the reflection report and presentation, identify relevant literature, analyze and describe the practical work. You should be able to work independently in the company and participate as a team member. You should also show ability for reflection and practice-based learning.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A
2.	N/A

3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Canvas, guidance from your supervisor at BIOVIT, and mentor in the company	N/A

GENERAL INFORMATION ABOUT THE COURSE #5		
1	The name of the course/module	Vannkjemi (Norwegian) - Water chemistry
2.	Faculty/department	Faculty of Environmental Sciences and Natural Resource Management
3.	Status of the educational component	Mandatory
4.	Semester	2-nd
5.	Number of ECTS credits	10
6.	The total number of hours	250
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	General Chemistry, Inorganic chemistry

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge: The students will acquire basic knowledge about water chemistry, optical properties and the different reactions that are important in natural water systems (fresh water and seawater) and water treatment. Chemical reactions in water include acid / base reactions, especially the carbonate system, solubility of gases, precipitation, dissolution reactions, complex reactions for metals, reduction and oxidation reactions and surface interaction and colloid/particle transformations. Skills: Based on theoretical and training with exercises, the candidates should be able to explain the processes that determine the chemical composition of fresh water and salt water, sketch and interpret the most important types of diagrams used in the field to describe the chemical equilibrium composition of water. Use software to calculate equilibria of substances in water and apply the knowledge to assess solubility, chemical reactions and transformation in water initiated by mixing or adding substances to the water.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A
6.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #6		
1.	The name of the course/module	Fish Ecology and Management
2.	Faculty/department	Faculty of Environmental Sciences and Natural Resource Management
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	10
6.	The total number of hours	250
7.	General description and purpose of the educational component	N/A

8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge
The student will acquire biological and ecological knowledge of specific species and fish communities, sampling of fish stock data and analysis of such data, and knowledge about different actors¿s role and view on fishery management. The student will acquire knowledge on how to use this background information for stock assessments and alternative management- and measures options.
Skills
The students will obtain a scientific basis for working as advisors/consultants in issues connected to the management of fresh-water fish. They will learn how to combine biological and ecological knowledge of specific species and fish communities, sampling of stock data and analysis of these data, and knowledge about different actors¿s role and view on fishery management, and hence be able to design alternative management plans for fish communities. The course also forms the academic basis for taking advanced courses in fish management / freshwater ecology, and human dimensions of natural resources management, and then be able to start with a master's thesis in this subject area. The student should be able to make academic reports for use in local fisheries management
General competence
The student will be confident with actors, concepts and processes pertinent to fish stock assessments and relevance and effects of the most-used management measures and decisions.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The office door is open for student consultancy every day after lunch.	N/A

GENERAL INFORMATION ABOUT THE COURSE #7

1	The name of the course/module	Sustainable development goals in plant and animal food systems
2.	Faculty/department	Faculty of Biosciences
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	5
6.	The total number of hours	125
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge It is expected that the students, after attending the course:
- Have thorough knowledge of sustainable food systems and can apply the knowledge when complex problems are to be addressed
- Are able to consider the sustainability of a food system in different spatial levels (e.g. local, national, global)
- Are able to consider interactions between the sustainable development goals and make qualified priorities

Skills It is expected that the students, after attending the course:
- Are able to perform in interdisciplinary teams and know his/her strengths and weaknesses
- Are able to analyze sustainable solutions based on advanced, scientific literature
- Are able to reflect and communicate solutions for sustainable food production and how these are related to the sustainable development goals

General competence It is expected that the students, after attending the course:

• Are able to utilize own knowledge and skills to enlighten complex problems regarding sustainability and food production • Are able to communicate at a high, professional level • Are able to accomplish a scientific study of problems related to sustainable food production systems	
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
3.	N/A
4.	N/A
TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #8		
1	The name of the course/module	Statistical Programming in R
2.	Faculty/department	Faculty of Chemistry, Biotechnology and Food Science
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	5
6.	The total number of hours	125
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	Statistics equivalent to https://www.nmbu.no/course/STAT100STAT100.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
KNOWLEDGE: Students will acquire • an understanding of how programming can automate demanding statistical computations. • a working knowledge of concepts, syntax and conventions for describing, fitting and interpreting statistical models in R. SKILLS: Students will be able to • interpret output from R's functions for statistical modelling, such as lm(). • read in data from various file formats including Excel, comma-separated text, and FASTA. • develop their own functions which use existing functions, to solve nontrivial challenges more efficiently than by nonstructured programming. • present results of statistical analysis in a scientific, clear form through reproducible, executable reports which weave together expository text, program code, and output such as tables and graphics. • troubleshoot problems by locating errors, reproducing them on a small subset of the data, step through code line by line, etc. • orient themselves in documentation for R packages that implements statistical methods the student knows. GENERAL COMPETENCES: Students will be well prepared to apply statistical methods in R on datasets they encounter in later studies and working life. This includes loading data into R, transforming it to a structure that the analysis function can use, run analyses with appropriate settings, and interpret and present the results in a form that is useful to the end user.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	
TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The Canvas course pages link to daily tutorial documents, various howtos and free online textbooks. Most R functions has extensive documentation and runnable examples. You will learn to navigate the R help system, walk yourself through the examples, and relate them to your own problems. Online forums such as Stack Overflow are a rich source of support. You will learn to search existing answers, and how to describe problems clearly enough that others can help. Ask questions in Discussions in Canvas. They will be answered, either there or in plenary discussion.	N/A

Teachers are available in the plenary sessions every day until noon. Topics raised in Discussion posts in Canvas will be addressed in next day's plenary session for discussion and reflection. Students are expected to participate actively, reflecting on the problem-solving process as well as helping each other out.	

GENERAL INFORMATION ABOUT THE COURSE #9		
1	The name of the course/module	Production technology in aquaculture
2.	Faculty/department	Faculty of Science and Technology
3.	Status of the educational component	Mandatory
4.	Semester	2st
5.	Number of ECTS credits	10
6.	The total number of hours	250
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	Basic Aquaculture Engineering

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Upon completion of the course, the students will:

- Have general knowledge in production of aquatic organisms, with focus of salmonids.
- Know how to produce broodstock, juvenile and adult fish
- Know how to evaluate and optimize the most important working operations on a juvenile and ongrowing farm.
- Knowledge to make a production plan for a juvenile and ongrowing farm.
- Know which factors are important to optimize the production on a juvenile and ongrowing farm.
- Know which factors affect the production velocity, how they may be changed, and what are the effects of this.
- Know procedures for season independent smolt production.
- Know how to performe site evaluations and know site selection criteria.
- Know how to prepare documents for production control and propose efforts with deviation.
- Be able to prepare working plans for smolt production and ongrowing production farms.
- Know maintenance routines/plans for smolt production and ongrowing production.
- Be able to estimate investment and running cost for main components in smolt and ongrowing farms.
- Know laws and regulations that have affect on the production planning.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The course teacher is available for support in connection with exercises in working hours, and by e-mail and phone outside of the teaching hours.	N/A

GENERAL INFORMATION ABOUT THE COURSE #10		
1	The name of the course/module	**Laboratory course in international aquaculture**
2.	Faculty/department	Faculty of Science and Technology
3.	Status of the educational component	Mandatory
4.	Semester	2st
5.	Number of ECTS credits	5

6.	The total number of hours	125
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	Basic Aquaculture Engineering

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The students shall get practical insight in technical equipment used in international fish farming. The focus is on land-based fish farms and production methods.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The course teacher is available for support in connection with calculation exercises in working hours, and by e-mail and phone outside of the teaching hours. Laboratory exercises are carried out under the guidance and technical assistance from other persons at the faculty that are available during the working day.	N/A

GENERAL INFORMATION ABOUT THE COURSE #11

1	The name of the course/module	Basic Aquaculture Engineering
2.	Faculty/department	Faculty of Science and Technology
3.	Status of the educational component	Mandatory
4.	Semester	2st
5.	Number of ECTS credits	5
6.	The total number of hours	125
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The aim of the course is to give the student basic knowledge on technical equipment, methods and systems that are nessessary for aquaculture production.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	1. Water transport: The module includes an introduction to hydrodynamics, an overview of typical pipes and fittings and an introduction to water pumps.
2.	2. Water quality and water treatment: The module adresses water quality parameters, as well as water purification equipment, typical in fish farming. This includes particles, pH, nitrogen compounds, dissolved gases in water, disinfection and heating / cooling.
3.	3. Production units and other necessary equipment: Various production units, including sea cages, ponds, tanks and hatching equipment. Other equipment includes feeding equipment, measuring instruments and more.
4.	

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #12

1	The name of the course/module	Planning and Design of Intensive Fish Farms

2.	Faculty/department	Faculty of Science and Technology
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	10
6.	The total number of hours	250
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	Aquaculture Production, or similar knowledge in the area Production Technology in Aquaculture, or similar knowledge.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Be able to design a land-based fish farm included a production plan for intensive fish farming

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The course teacher is available for support in connection with exercises in working hours, and by e-mail and phone outside of the teaching hours.	N/A

GENERAL INFORMATION ABOUT THE COURSE #13

1	The name of the course/module	International Economics
2.	Faculty/department	School of Economics and Business
3.	Status of the educational component	Mandatory
4.	Semester	
5.	Number of ECTS credits	10
6.	The total number of hours	250
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	The course is intensive in basic microeconomic principles, which are reviewed during lectures as required. Basic knowledge in microeconomics ECN110 Microeconomics I - How to Think Like an Economist is essential. ECN210 Intermediate Microeconomics - Consumers, Producers, Market and Welfare is very relevant to the course. Welfare analysis related to trade policy is covered in the second half of the course, and is given a quick review. ECN120 Macroeconomics I - Markets, Economic Development, and Welfare are relevant, but prior knowledge is not required. Any reference to macroeconomic concepts are explained in the context of their relevance to the material covered.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The student is expected to develop: an understanding of why nations trade and under which conditions trade occurs; knowledge of the role of supply and demand factors in determining the gains from trade; the ability to evaluate the welfare effects of protectionist trade policies, free trade, managed trade, and the economic implications of other forms of government intervention to foster development; and a conceptual framework for evaluating international competitiveness, comparative advantage, and foreign investment and strategic behavior.
The emphasis is on the microeconomic theory supporting international trade, but there are important macroeconomic problems that are also addressed related to globalization, e.g., the effect of trade on wages and employment, economic issues from labor migration, capital flows and returns to capital owners and laborers, sectoral development and economic growth (manufacturing, agriculture and services), and income inequality among rich and poor nations. Economic sustainability is

addressed through the lens of policy alternatives (opportunity costs and trade-offs) related to globalization (trade in goods and services and international mobility of labor and capital).	

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
A teaching assistant will be available during exercise sessions. The instructor is normally available during exercise sessions and maintains office hours during which a student can seek consultations with the instructor. Should the student prefer to have more feedback on exercises or want to follow up on points made during class lectures, office hours or e-mail contact are appropriate for that purpose.	N/A

GENERAL INFORMATION ABOUT THE COURSE #14		
1	The name of the course/module	Intensive aquaculture
2.	Faculty/department	Faculty of Biosciences
3.	Status of the educational component	Optional
4.	Semester	2nd
5.	Number of ECTS credits	10
6.	The total number of hours	250
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	Introduction to Norwegian animal and aquatic production

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
Knowledge The student will acquire broad knowledge of production methods, management tools and the most important challenges throughout the value chain in intensive aquaculture production, exemplified by Norwegian salmon production. Skills The student must summarise and apply the knowledge of the various production challenges to a comprehensive and balanced assessment of the various considerations for optimal desissions, e.g. in assessments regarding time for de-liceing, time of slaughter, colouring of fish or type of fish that are used at different locations. General competence Through semester assignments and presentations, the student will acquire assessment, collaboration and dissemination competence.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #16		
1.	The name of the course/module	Sustainable Ingredients in Aquafeeds
2.	Faculty/department	Faculty of Biosciences
3.	Status of the educational component	Optional
4.	Semester	2nd
5.	Number of ECTS credits	5
6.	The total number of hours	125

7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge

- Students will acquire a broad overview of alternative feed raw materials for farmed fish and their suitability
- Students will gain knowledge of the use of life cycle assessment as a basis for the selection of sustainable feed raw materials

General competence

- Students are able to participate in the public debate on topics and contribute to the further professional development of new sustainable feed ingredients

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

GENERAL INFORMATION ABOUT THE COURSE #17

1.	The name of the course/module	Laboratory Course in International Aquaculture
2.	Faculty/department	Faculty of Science and Technology
3.	Status of the educational component	Optional
4.	Semester	
5.	Number of ECTS credits	5
6.	The total number of hours	125
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	Basic Aquaculture Engineering

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

The students shall get practical insight in technical equipment used in international fish farming. The focus is on land-based fish farms and production methods.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The course teacher is available for support in connection with calculation exercises in working hours, and by e-mail and phone outside of the teaching hours. Laboratory exercises are carried out under the guidance and technical assistance from other persons at the faculty that are available during the working day.	N/A

GENERAL INFORMATION ABOUT THE COURSE #18		
1	The name of the course/module	Fish Health Biology
2.	Faculty/department	Faculty of Biosciences
3.	Status of the educational component	Optional
4.	Semester	
5.	Number of ECTS credits	10
6.	The total number of hours	250
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/A

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Knowledge:

- Have an overview of the most important diseases in the Norwegian aquaculture industry and preventive measures
- Have basic knowledge about the fish's physiological adaptations to a life in water and how they are affected by disease and stress factors
- Understand the interaction between stress, good health and welfare in farmed fish and the importance of their interaction for a sustainable aquaculture industry

Skills:

- Can update their knowledge of fish health biology by finding and referring to relevant popular science subject litterature
- Can present and exchange views on current challenges in the scientific field

General competence:

- Have insight into relevant issues related to the health and welfare of farmed fish
- Understand that a sustainable aquaculture industry requires an in depth understanding of potentials and limitations regarding fish physiology

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

UNIVERSITY OF WARMIA AND MAZURY IN OLSZTYN

1	Criterion A: University profile	
1.1	Name of the University (+faculty, graduate department)	**UNIVERSITY OF WARMIA AND MAZURY IN OLSZTYN**
1.2	Classical or applied	Applied
2	Criterion B: Profile of the educational program (Curriculum)	
2.1	Number of Aquaculture disciplines	24
2.2	The name of the educational program	Aquaculture and Aquaristics
2.3	Type of diploma	N/A
2.4	Total number of credits (ECTS)	90
3	Criterion C: Setting the educational program (Curriculum)	
3.1	Duration of the program	1,5 years (3 semester's)
3.2	The purpose of the educational program	A graduate is a top-class expert in aquaculture and aquaristics, able to run production activity in compliance with principles of sustainable development and legal regulations related to the fisheries and environment protection. A graduate is able to plan, supervise and run fish production under controlled conditions, is prepared to hold managing positions in specialist farms at all stages of production. A graduate may be employed as an ichthyologist at pond production farms, at fry-stocking centers and at the Polish Angling Union, but also as an inspector of fisheries' management for local and district government; and also at institutions dealing with EU funds acquisition and research and development centers. A graduate may also run specialist cultures of exotic and aquarium fish; and deal with retail sale and wholesale of ornamental fish.
4	Criterion D: Characteristics of the educational program (Curriculum)	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Fisheries
5	Criterion E: Teaching and assessment	
5.1	Teaching and learning methods	lectures, practical classes, laboratory classes
5.2	Assessment	The student should obtain credits for all compulsory subjects according to the effective plan and program of studies (lectures, practical classes, laboratory classes). All subjects end with award of credit or examination. Lecture: Written test Classes: Evaluation of the work and cooperation in the group. Classes: Competency test
6	Criterion F: Software competencies	
6.1	Integral competence	1. Understands the need ad actively pursuits for continuous education 2. Has the ability to work in a group, by performing different functions in the area of execution, management and control of tasks accomplished in the fishing industry 3. Has the ability of unbiased and comprehensive identification and valuation of priorities that enable accomplishing the goals and tasks set in fish production 4. Notices and correctly diagnoses problems of contemporary fisheries, and shows resourcefulness in pursuit of their rational and appropriate solution 5. Understands and is aware of the social, professional and ethical responsibility linked with fisheries and aquaculture, and their impact on the natural environment and fish welfare 6. Is aware of hazards and/or potentially negative effects of the breeding and culture of fish and other aquatic organisms on the natural environment; and knows activities diminishing the risks posed by the fishing industry 7. Appreciates the need for continuous oriented education, and is actively pursuing to improve his/hers skills and competencies in the profession of an ichthyologist 8. Is open to any initiatives and technological innovations that increase the effectiveness and profitability of fish production
6.2	General competences	1. In order to solve a specific problem or task, has the ability to use available sources and forms of information in Polish and selected foreign modern language, and knows how to respect the rights of intellectual property

		2. Has the ability to present elaborated materials, own standpoint and views in various forms; has the ability to conduct comprehensive and rational discussion that allows reaching a common standpoint 3. Uses extended terminology and nomenclature applied in the fisheries discipline and related sciences 4. Makes use of appropriate computer techniques and software for data collection, computations as well as for interpretation and presentation of results 5. Is able to plan on his/her own the course of experiment in the scope of fisheries and related disciplines, and to use appropriate statistical tests and procedures for the analysis and interpretation of results 6. Has the ability to conduct in-depth analysis of production possibilities of the environment considering optimal techniques, technologies and welfare of fish in breeding and culture 7. Has the ability to plan the activity of a fishing enterprise considering the existing computer tools, current macroeconomic and political situation and legal regulations concerning the fishing business, and to elaborate a financial budget and marketing strategy 8. Knows how to establish and develop various forms of individual business in the fisheries sector and other forms of activity that are aimed at improving the life quality of man 9. Has the ability to analyze and evaluate advantages and threats posed by actions undertaken to solve existing problems in the fishing industry; has the ability to analyze them and to make unbiased and proper decisions 10. Has the ability to prepare written presentations, conclusions, reports, M.Sc. thesis and other documents in the scope of fisheries and related sciences in Polish and in a selected modern foreign language, concerning specified issues by using basic theoretical concepts and also other sources 11. Has improved ability to prepare oral presentations, in Polish and in a selected foreign modern language, related to specified issues by using basic theoretical concepts and also other sources 12. Has the ability to analyze biological and abiotic hazards in the fishing industry, is able to implement prophylactic and protective activities, uses principles of cooperation with services of veterinary inspection 13. Has the ability to plan the breeding and culture of aquatic organisms using optimal techniques and technologies; to analyze and solve problems of the sustainable fishing industry with attention paid to various forms of natural environment
6.3	Professional competences	1. Has extensive knowledge related to planning and conducting experiments and to statistical methods used for the elaboration and interpretation of achieved results 2. Knows terms and concepts in a selected modern foreign language in the scope of fisheries and environment protection, is able to select literature devoted to the studied specialization 3. Defines marketing strategies, knows computer technologies applied as tools in marketing, knows the system, organization and control of the sale of fishery and aquaculture products 4. Possesses knowledge linked with legal regulations and solutions in the scope of fisheries and environment protection in the Member States of the European Union 5. Has the ability to identify and characterize appropriate technologies, techniques and related procedures applied in breeding and rearing of aquatic organisms 6. Has extensive knowledge on the design and application of measuring devices, machinery and equipment used in the fish culture 7. Characterizes the role of ichthyofauna on protected areas, methods of protection and restitution of fish species, knows principles of ichthyofauna protection plans 8. Has the ability to indicate the role of sustainable development of rural areas in the global strategy of natural environment protection 9. Knows and understands concepts and principles linked with protection of industrial ownership and authorship; knows how to use resources of patent information 10. Knows the significance and directions of the search for sources of financing enterprises in the fisheries sector

		11. Has the ability to differentiate and select methods applied for fishery activity management and planning 12. Identifies environmental and sanitary hazards that affect health safety of aquatic organisms 13. Knows principles of establishing and developing an individual business in the fisheries sector; has the ability to adjust financial budgets and to propose strategic solutions in the management of entities from the fishing industry 14. Identifies and describes causes of surface waters degradation and explains the impact of various systems of breeding and culture of aquatic organisms on the quality of natural environment 15. Possesses extensive knowledge of processes and technologies for post-production wastewater treatment and the use of unconventional energy sources in the fishing industry 16. Knows diversity and characteristics of microorganisms occurring in the culture of aquatic organisms, possesses knowledge of their use in wastewater treatment and sludge management 17. Knows processes linked with ontogenetic development of aquatic organisms 18. Possesses extensive knowledge on the populations of organisms in water ecosystems and knows methods of their management in natural and culture conditions 19. Possesses factual knowledge that allows to propose solutions and prepare characteristics using geoinformation, and to identify and solve problems using SIP techniques and technologies 20. Has the ability to select appropriate methods and systems of breeding and culture of aquatic organisms that facilitate the development of the natural environment 21. Possesses knowledge on the functioning and on principles of management of recreational and hobby objects linked with water environment that serve to improve the life quality of man 22. Possesses knowledge on modern methods for the assessment of species diversity in water ecosystems 23. Knows principles of safety and hygiene at work in enterprises from the fishing industry
7	**Criterion G: Program Learning Outcomes**	
7.1	Program learning outcomes	1. A graduate from the Fisheries – specialty Aquaristics and Aquaculture possesses advanced knowledge of techniques, technologies and equipment applied in the aquaculture of both freshwater and marine fish and water invertebrates. 2. A graduate knows the principles of sustainable exploitation of natural populations of fish, and principles of applying active and passive methods of ichthyofauna protection. 3. A graduate can select a model of management of a given water region (with predominance of commercial catching or of angling catches, or a mixed model) and prepare a sound long-term fishery plan. 4. Has extensive knowledge on the economy of industrial methods of fish rearing and exploitation in compliance with water, fishery and environment protection laws, with special emphasis put on legal regulations of the European Union. 5. A graduate has advanced knowledge of related terminology in a selected foreign language as well as improved knowledge of computer techniques used in fishery practice and science. 6. He/she is universally prepared for planning, designing and control of technological processes, and for supervision and exploitation of machinery and devices applied in the fishing industry. 7. A graduate has the ability to evaluate the impact of fisheries on the natural environment and to solve problems of the fishing industry. He/she knows universal functions and scope of duties of an ichthyologist in fish farms with different production profiles. 8. A graduate knows bases of research methodology and is prepared to undertake PhD studies and/or work in research and development centers.
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**	
8.1	Staff support	N/A
8.2	Material and technical support	N/A
9	**Criterion I: List of components of the educational program and their logic sequence**	

9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Aquaculture of invertebrate animals	2	N/A
9.1.2	Freshwater fish-keeping	2	N/A
9.1.3	Diseases of Water Invertebrates	2	N/A
9.1.4	Fish culture in illuminated fish cages	2	N/A
9.1.5	Specialistic Fish – Production Practice	6	N/A
9.1.6	Experiments and statistics in ichthyological research	3	N/A
9.1.7	Ergonomics	0.25	Credit (pass/fail)
9.1.8	Intellectual property protection	0.25	Credit (pass/fail)
9.1.9	Aquaculture of warm-water and tropical fish	2.5	N/A
9.1.10	Sea Fish Aquaculture	2.5	N/A
9.1.11	Aquaculture of cold-water fish	2.5	N/A
9.1.12	Marine fish keeping	2	N/A
9.1.13	Larvaculture	2	N/A
9.1.14	Aquaculture Impact To Environment	2	N/A
9.1.15	Etiquette	0.5	N/A
9.1.16	Subject taught as part of the general academic module	2	Graded credit (exam)
9.1.17	Master Thesis	20	N/A
9.1.18	Diploma Seminar 1	2	N/A
9.1.19	Diploma Seminar 2	2	N/A
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Biosecurity in Fisheries and Aquaculture	2	N/A
9.2.2	Applied ichthyology	2	N/A
9.2.3	Outline of fish aquaculture	2	N/A
9.2.4	Management and planning in the fishery industry	2	N/A
9.2.5	Foreign Language	2	Graded credit (exam)
9.2.6	Marketing And Information Technology	3	N/A
9.2.7	EU Policy in Fishery and Environmental Protection	2	N/A
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Master Thesis The student is required to present the diploma dissertation and pass the diploma examination.	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Aquaculture of invertebrate animals
2.	Faculty/department	Department of Lake & River Fisheries Faculty of Environmental Sciences & Fisheries
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	2
6.	The total number of hours	50
7.	General description and purpose of the educational component	N/A
8.	Prerequisites for studying the course/module, connection with other educational components	N/AN/A A prerequisite for enrolment in second degree studies in the field of Fisheries is holding first degree studies graduation diploma or Master of Science diploma and holding a degree of Engineer or Master of Science Engineer. Graduates holding the title of Engineer in agricultural, forestry and veterinary sciences may be enrolled without the necessity of completing any additional documents. Graduates from other fields of education ought to have completed educational effects in: Biological bases of fisheries; Fish rearing and breeding; and Fisheries on open waters. Once admitted for second degree studies, a graduate from a different discipline needs to complete the missing educational effects in the scope of knowledge, skills and competencies stipulated for first degree studies. It may be achieved by the completion of additional

		courses that all together assure maximally 30 ECTS points. A student who decides to complete his/her knowledge, skill and competencies may apply for “individual study plan” and for the supervision of Faculty Tutor. A student should complete the potential differences in study curriculum within three semesters. The qualification criterion is established by the Faculty Board and the main criterion is ranking of the final result from studies - without rounding up to full mark, within the specified limited number of places.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
N/A

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	N/A
2.	N/A
3.	N/A
4.	N/A
5.	N/A

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
N/A	N/A

UNIVERSITY A CORUÑA AND UNIV. OF VIGO

1	Criterion A: University profile	
1.1	Name of the University	**UNIVERSITY A CORUÑA AND UNIV. OF VIGO**
1.2	Classical or applied	applied
2	Criterion B: Profile of the educational program (Curriculum)	
2.1	Number of Aquaculture disciplines	
2.2	The name of the educational program	Aquaculture speciality in AQUATIC PRODUCTION
2.3	Type of diploma	Unitary. Master's level of education
2.4	Total number of credits (ECTS)	90
3	Criterion C: Setting the educational program (Curriculum)	
3.1	Duration of the program	3 semestres
3.2	The purpose of the educational program	To provide the students the basic knowledge, skills and abilities that allow the students to design and carry out the labour and research activity in the aquaculture field. They will learn to design, manage and control different types of continental and marine aquatic facilities, evaluate their environmental impact and answer the R+D+I necessities by introducing strategies that allow the future development of the aquatic industry.
4	Criterion D: Characteristics of the educational program (Curriculum)	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	N/A
5	Criterion E: Teaching and assessment	
5.1	Teaching and learning methods	Lectures/seminars/conferences are taught mainly by teachers from the 3 universities through video conference from the university the teacher is giving the subject (A Coruña, Santiago or Vigo) to the other two universities. The students go to class in the university they enrolled, listening to the teacher on the spot or through video conference. Neither the students or teachers move from their universities for the theoretical teaching. There are three classrooms for the master with video conference in the three centres assigned to it: - Faculty of Biology of the University of Vigo (Classroom 8, video conference 3). - Institute of Aquaculture (mornings) and Faculty of Biology (afternoons) of the University of Santiago. - Faculty of Sciences of the University of A Coruña.
5.2	Assessment	N/A
6	Criterion F: Software competencies	
6.1	Integral competence	N/A
6.2	General competences	N/A
6.3	Professional competences	N/A
7	Criterion G: Program Learning Outcomes	
7.1	Program learning outcomes	N/A
8	Criterion H: Resource support for the implementation of the educational program (Curriculum)	
8.1	Staff support	The educational process at the university is carried out by highly qualified teaching staff.
8.2	Material and technical support	Lectures/seminars/conferences that are taught by teachers from other research public organisms (IEO, CSIC, IGAFA, CIMA, etc.) and companies, are made from one of the three universities with the same modality described in the previous part or in those centres. Practical classes in universities, research centres or companies are carried out in the centre where the responsible teacher is in that moment.

9	Criterion I: List of components of the educational program and their logic sequence		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Introduction to Aquaculture	3	N/A
9.1.2	Biology of cultured Algae	3	N/A
9.1.3	Physiology of Cultured Aquatic Animals	6	N/A
9.1.4	Genetics Applied to Aquaculture	3	N/A
9.1.5	Immunology of cultured animals	3	N/A
9.1.6	Pathology in aquaculture	6	N/A
9.1.7	Feeding and Nutrition	3	N/A
9.1.8	Biology of cultured aquatic animals	3	N/A
9.1.9	Culture of seaweeds	3	N/A
9.1.10	Culture of microalgae and zooplankton	3	N/A
9.1.11	Culture of fish	6	N/A
9.1.12	Culture of bivalve molluscs	6	N/A
9.1.13	Culture of other invertebrates	3	N/A
9.1.14	Disease diagnostics	3	N/A
9.1.15	Water quality and management	3	N/A
9.1.16	Toxicology and toxic tides	3	N/A
9.1.17	Aquaculture farm management	3	N/A
9.1.18	Quality, processing, and traceability	3	N/A
	Total credits	**90**	N/A
10	Criterion L: Form of attestation		
10.1	Requirements for	State-qualifying exam in the form of testing Public defense of master's qualifying work	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Introduction to Aquaculture
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	Subject descriptors Definition and object of study. Brief history of aquaculture. Main production systems. A aquaculture in the world: economic importance, main species and producing countries. Aquaculture in Europe and Spain. Aquaculture as a sustainable activity. Future perspectives.
8.	Prerequisites for studying the course/module, connection with other educational components	As it is an introductory subject, only those required for access to the Degree are required.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
• CG01- Acquire the ability to analyze and survey the current and future situation of aquaculture.
• CG04- Use the appropriate scientific terminologies.
Specific skills
• CE03- Develop and know the cultivation techniques of fish, molluscs, other invertebrates, algae and auxiliary crops.
• CE07- Acquire knowledge about technical characteristics and design of facilities for cultivation.
Basic skills
• CB03- That students are able to integrate knowledge and face the complexity of formulating interpretations and judgments from often incomplete information, including reflections on the social and ethical responsibilities linked to the resolution of specific problems.
Transversal skills
• CT5- Ability to present knowledge and results: oral and written communication; capacity

analytical, critical and synthesis; use of computer resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Concept, definition and object of aquaculture. Origin and historical evolution. 2
2.	Aquaculture in the world: economic importance, main species and countries producers Aquaculture in Europe and Spain.
3.	Classification of aquaculture: aquaculture for food, extraction organic, deposit and inorganic extraction. Main crops and crops auxiliaries
4.	Main facilities, methods and techniques used in fish farming, molluscs, crustaceans, echinoderms and algae.
5.	Aquaculture with an ecosystem approach. Fundamentals and main techniques and systems of Integrated Multitrophic Aquaculture (IMTA). Future perspectives.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical classes. Oral presentation of the subject that includes the program of the subject. The teacher explains the theoretical foundations and the student assimilates, takes notes and raises doubts. Students will have all the power point presentations available on the virtual teaching platforms before classes begin used to develop the topic. Practical classes. They are a fundamental complement to theoretical classes. They are developed in the laboratory where the objectives are presented, the follow-up of the practices is guided and tutored. To make the most of these practices, the student will have the corresponding script with all possible information specifying the formulation of the theoretical foundation, the objective of the practice and the description of the work to be carried out Tutoring. Questions regarding any aspect of the subject will be addressed. Also virtual platforms and e-mail will be used as a tool to non-face-to-face tutoring.	N/A

GENERAL INFORMATION ABOUT THE COURSE #2		
1	The name of the course/module	Biology of cultured aquatic animals
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	Mandatory
4.	Semester	1nd
5.	Number of ECTS credits	3.0
6.	The total number of hours	75
7.	General description and purpose of the educational component	Learning the external and internal morphology of farmed animals. Knowledge of their modes of life and behavior, not only in their juvenile and adult phases but also in their larval stages. Understanding the functioning of the organs. Mastery of reproduction, embryonic development, larva and metamorphosis. Since the success of any crop depends largely on understanding of the life cycles of the species and their ecology, emphasis will be placed on the knowledge of the life cycles of the species and how their understanding is essential when developing a successful crop, either experimental or industrial.
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge of general biology, general zoology and general animal physiology

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
General skills: • CG01- Acquisition of analysis and prospecting capacity on the current and future situation of aquaculture. • CG04- Use the appropriate scientific terms. Specific skills • CE02- Knowledge of the biological and morphological cycle of farmed animals. Basic skills • CB02- It will be guaranteed that the student is able to integrate knowledge and do faced with the complexity of formulating judgments based on information that, being incomplete

or limited, contain reflections on the social and ethical responsibilities linked to application of their knowledge and judgments • CB04- It will be guaranteed that the student has the learning skills that he/she needs allow you to continue studying in a way that will have to be largely self-directed or autonomous Transversal skills • CT7 - Self-criticism; desire for improvement; interest in quality

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	**INTRODUCTIO**N. Concept and characteristics of cultivable species. Main groups of cultivable species
2.	**2. MOLLUSCS** 2.1. General characteristics. Classification Cultivable molluscs.
3.	2.2. Gastropods External morphology. Ways of life Nervous system and organs of the senses locomotion food Water circulation and exchange gaseous Excretion Internal transport. reproduction Development embryonic and larval. metamorphosis Life cycle of Haliotis spp.
4.	2.3. Bivalves External morphology. Ways of life Nervous system and organs of the senses locomotion food Water circulation and gas exchange. Excretion Internal transport. reproduction Embryonic development and larval metamorphosis Life cycles of the main crops
5.	2.4. Cultivable cephalopods. External morphology. Ways of life Nervous system and sense organs. Locomotion and buoyancy. food Gas exchange. Excretion Internal transport. reproduction Development. Life cycles of the main cultivable species
6.	**3. CRUSTACEANS.** 3.1. General characteristics. Classification Cultivable crustaceans.
7.	3.2. Decapods External morphology. Ways of life Nervous system and sense organs. locomotion food Water circulation and gas exchange. Excretion Internal transport. Growth and change. Reproduction. Embryonic and larval development. metamorphosis Life cycles of main cultivated species.
8.	**4. FISH** 4.1. General characteristics. Classification Cultivable fish. External morphology. Ways of life Nervous system and sense organs. locomotion food Water circulation and gas exchange. Excretion Internal transport.
9.	4.2. Growth. Reproduction. Embryonic and larval development. metamorphosis Life cycles of the main cultivable species

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical classes. Oral presentation of the subject that includes the program of the subject. The teacher explains the theoretical foundations and the student assimilates, takes notes and raises doubts. Students will have all the power point presentations available on the virtual teaching platforms before classes begin used to develop the topic. Practical classes. They are a fundamental complement to theoretical classes. They are developed in the laboratory where the objectives are presented, the follow-up of the practices is guided and tutored. To make the most of these practices, the student will have the corresponding script with all possible information specifying the formulation of the theoretical foundation, the objective of the practice and the description of the work to be carried out Tutoring. Questions regarding any aspect of the subject will be addressed. Also virtual platforms and e-mail will be used as a tool to non-face-to-face tutoring.	N/A

GENERAL INFORMATION ABOUT THE COURSE #3		
1	The name of the course/module	Biology of cultured Algae
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	Mandatory
4.	Semester	1nd

5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	The student will be trained and instructed in basic knowledge about the diversity, biology, reproduction, biological cycles and ecology of cultivable algae, as well as their relationship with the environment and the main environmental factors related to nutrition, spawning, survival and reproduction, with the aim of applying them in other master's subjects. Skills and aptitudes necessary for their application in the cultivation of algae and the development of research in aquaculture will be developed, as well as for the design and control of facilities.
8.	Prerequisites for studying the course/module, connection with other educational components	Minimum knowledge of: (a) general characteristics of the main groups of algae and their classification and (b) basic reproduction processes and biological cycles of algae. Skill in the use of observation and description techniques, as well as the dissection and study of microalgae and macroalgae, using the optical microscope and stereomicroscope.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
• CG04- Use the appropriate scientific terminology.
• CG06- Find and consult sources of information and databases; Analyze and synthesize documents.
Specific skills
• CE02- Knowledge of the biological cycle and physiological and morphological aspects of farmed animals and algae.
• CE03- Develop and know the farming techniques for fish, molluscs, other invertebrates, algae and auxiliary crops.
Basic skills
• CB05- That students have the learning skills that allow them to continue studying in a way that will have to be largely self-directed or autonomous.
Transversal competences
• CT2 - Capacity for autonomous work and decision making.
• CT4 - Ability to search, analyze and interpret various sources of information and in different languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Introduction to the study of cultivable algae. Morphology, reproduction and biological cycles: monoxenetic, dixenetic and trizenetic. Biological types and morphofunctional groups.
2.	Morphological, reproductive and physiological diversity of Cyanophyta: Spirulina, Anabaina.
3.	Morphological, reproductive and physiological diversity of Rhodophyta: Porphyra, Chondrus, Eucheuma, Furcellaria, Gelidium, Gigartina, Gracilaria, Kappaphycus, Hypnea, Mastocarpus, Palmaria.
4.	Morphological, reproductive and physiological diversity of Ochrophyta: Phaeophyceae (Cladosiphon, Durvillaea, Fucus, Hizikia, Laminaria, Lessonia, Macrocystis, Nereocystis, Saccharina, Undaria) and Bacillariophyceae (Chaetoceros, Phaeodactylon, Skeletonema, Thalassiosira)
5.	Morphological, reproductive and physiological diversity of Haptophyta (Isochrysis, Phaeocystis), Cryptophyta (Monochrysis, Rhodomonas). Dinophyta (Alexandrium, Ceratium, Dinophysis, Gymnodinium, Prorocentrum) and Euglenophyta.
6.	Morphological, reproductive and physiological diversity of Chlorophyta: Tetraselmis, Chlamydomonas, Chlorella, Dunaliella, Haematococcus, Scenedesmus, Caulerpa, Codium, Monostroma, Ulva.
7.	Regulating factors for the growth and reproduction of cultivated algae (light, temperature, salinity, pH, nutrients, hydrodynamics, tides, substrate).
8.	Morphological and physiological adaptations, and biological interactions (light, temperature, salinity, hydrodynamics, competition, epiphytism, parasitism).

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face classes for presentation of the theory syllabus and for the development of the seminar and blackboard classes. Face-to-face classes in the laboratory to develop the practice syllabus and acquire skills/skills in the manipulation of phycological material. Independent work of the student for the study and understanding of the concepts of theory and practice, as well as for the search for information and bibliography for the realization of the seminar. Personalized tutoring (face-to-face and by e-mail) for the resolution of student doubts and the formulation of new goals and challenges in the subject.	

GENERAL INFORMATION ABOUT THE COURSE #4

1	The name of the course/module	Physiology of Cultured Aquatic Animals

2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	6
6.	The total number of hours	150
7.	General description and purpose of the educational component	Knowledge of the basic principles of metabolism, growth and reproduction in the main groups of animals suitable for use in aquaculture (fish, molluscs and crustaceans). Learning the physiological mechanisms that different animals put in place in their environmental adaptation, in general and specifically, against changes in the physicochemical parameters of the environment. Monitoring and analysis of physiological parameters indicative of the degree of well-being of cultivated species. Knowledge of the effect produced by cultivation and housing conditions, on indicative parameters of animal welfare and its impact on the farm. Knowledge of the rhythmic properties of the physiological parameters involved in vital processes (ingestion, reproduction, motor activity, etc.)
8.	Prerequisites for studying the course/module, connection with other educational components	It is advisable that the student has knowledge of Histology, Cytology, Biochemistry, Animal Physiology and Zoology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Competencias xeráis:
• CG02- Apreciar a importancia do debate e traballo en equipo, a comunicación interpersoal e a responsabilidade.
• CG04- Utilizar as terminoloxías científicas axeitadas.
• CG06- Atopar e consultar fontes de información e bases de datos; analizar e sintetizar documentos.
• CG08- Potenciar o manexo de idiomas estranxeiros.
Competencias específicas
• CE04- Controlar todos os factores fisiolóxicos, metabólicos, inmunológicos, ambientais, de alimentación, etc que afectan ao benestar das especies en cultivo, e implementar os procesos de
reprodución, mantemento, produción e patoloxía de especies clave e especies potenciais en acuicultura.
• CE12- Coñecer as técnicas utilizadas para evaluar o estado do sistema inmunitario así como a metodoloxía utilizada para determinar os efectos da dieta, estrés, inmunoestimulantes e inmunización sobre o sistema inmunitario.
Competencias básicas
• CB04- que os estudantes sepan comunicar as súas conclusións (e os coñecementos e razóns últimas que as sustentan) a públicos especializados e non especializados dun xeito claro e sin ambigüedades;
Competencias transversais:
• CT3 - Capacidade de traballo en equipo: cooperación, debate, negociacion.
• CT5 - Habilidade na presentación de coñecementos e resultados: comunicación oral e escrita; capacidade analítica, crítica e de síntese; uso de recursos informáticos.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Ecophysiology: - Nature, levels and mechanisms of physiological adaptation to changes in environmental parameters - Effect of temperature on animals of interest in aquaculture: mechanisms and adaptations - Effect of salinity on animals of interest in aquaculture: mechanisms and adaptations
2.	Growth and energy: - Characteristics and control of growth in molluscs, crustaceans and fish - Methods of study and quantitative analysis of growth. balance sheet energetic - Breathing and metabolism. Factors affecting energy expenditure - Potential growth and net retention. Abiotic and biotic influences
3.	Reproduction: - Gametogenesis and germ lines - Sex determination and sex change - Reproductive cycles and conditioning - Formation of triploids - Nervous and endocrine control of maturation and reproduction - Control of reproduction by environmental parameters
4.	Animal welfare: - Animal welfare: Concept and implications in aquaculture

	- Stress and its effect on aquaculture species in cultivation - Assessment of animal welfare - Biological rhythmicity: influence on animal welfare and the cultivation of aquaculture species

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical classes. The teacher, after proposing the work system and defining key concepts, will develop, with the participation of the students, each of the topics in the order established in Seminar program. At the beginning of the course, the students will be exposed to a set of possible works to be carried out in pairs on a specific research topic related to one of the 4 blocks of the matter The students will be distributed so that there are no repetitions and there are assignments in each of the four blocks of the subject. Practical classes. The students will carry out practices in the laboratory in groups and prepare a report on them. They will be taught in Uvigo (2 days)	

GENERAL INFORMATION ABOUT THE COURSE #5		
1	The name of the course/module	Genetics Applied to Aquaculture
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	Mandatory
4.	Semester	1-nd
5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	Know the most common genetic diseases that are important in species with interest in aquaculture. Know the mechanisms of sexual determination in species of interest to aquaculture. Acquire basic knowledge of genomics and proteomics and their application to the improvement of production processes in aquaculture. Analysis of the effect of quantitative characters in the improvement of aquaculture species. Acquire basic knowledge for the analysis of genetic variability and its use in the management and conservation of aquatic resources. Understanding the genetic effects of the four evolutionary factors: mutation, migration, genetic drift and natural selection.
8.	Prerequisites for studying the course/module, connection with other educational components	To get a better use of the subject, you need basic knowledge of Biology referring to molecules (polymers, chemical bonds...), cells (prokaryote, eukaryote, cell organelles, gametes, cell cycle, cell division, tissue differentiation...) and organisms (biological cycle, reproduction, biological diversity...). A reasonable handling of concepts of probability and statistics (distribution, mean, variance, association between variables and statistical significance) is also necessary. As in many other subjects, it is highly recommended to have basic computer knowledge, both in terms of using the usual programs for preparing and presenting papers (Word, PowerPoint...) and for searching for bibliographic material via the Internet. Likewise, a level acceptable reading and understanding of English will facilitate the use of the specialized bibliography.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
General skills: • CG04- Use the appropriate scientific terminologies. • CG08- Strengthen the management of foreign languages. • CG09- Apply critical, logical and creative thinking. Specific skills: • CE11- Acquire basic and applied knowledge of genetics, genomics and proteomics applied to aquaculture. Basic skills: • CB03- That students are able to integrate knowledge and face the complexity of formulating interpretations and judgments based on often incomplete information, including reflections on the social and ethical responsibilities linked to the resolution of specific problems. • CB05- That students possess the learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous. Transversal skills

• CT4 - Ability to search, analyze and interpret varied sources of information in different languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	**The inheritance of Mendelian characters and the determination of sex** Chromosomes, loci and alleles. Patterns of inheritance of qualitative characters. Inheritance of color in fish. Karyotypes in aquatic organisms. Mitochondrial inheritance in species of interest in aquaculture. Genetic determination of sex in aquatic organisms.
2.	**Genomics and chromosomal and gene manipulation** Gynogenesis and androgenesis. Induction of polyploidy in aquatic organisms. Introduction to genomics and proteomics. Nuclear transfer techniques.
3.	**Study of genetic diseases Diseases and genetic anomalies in aquatic organisms.** Cancer and apoptosis in species of interest in aquaculture. Applications of gene transfer in obtaining disease-resistant organisms.
4.	**The inheritance of quantitative characters** The nature of continuous variation. Genetic model for quantitative traits: the studies of Johannsen and East. Partitioning of phenotypic variance: genetic and environmental components. Concept of heritability and estimation methods.
5.	**Genetics of populations** Concept of population. Estimators of population genetic diversity. Hardy-Weinberg equilibrium. Evolutionary agents. Types of pairing. Consanguinity and kinship. Small populations. Conservation genetics.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Lectures and blackboard practices They will be the fundamental basis of the teaching methodology, in which the specific contents will be dealt with and typical problems will be solved. The development of the contents is carried out with the help of a PowerPoint presentation together with transparencies, videos, animations, blackboard and any other material that helps and facilitates the understanding of the concepts discussed. • Problem Sheets Students will solve problem sheets of increasing complexity related to Mendelian, Quantitative and Population Genetics concepts. • Internships will be given at the UDC (1 day)	

GENERAL INFORMATION ABOUT THE COURSE #6		
1.	The name of the course/module	Immunology of cultured animals
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	- Have a broad theoretical knowledge of the components (organs, tissues, cells, genes and molecules) of the immune system of fish and marine invertebrates of interest in aquaculture. - Be able to locate and identify the organs and cells of the immune system. - Know the functioning of the immune system. - Know the importance of food and immunostimulants in the function of the immune system and resistance to pathogens. - Know the techniques used to assess the state of the immune system as well as the methodology used to determine the effects of diet, stress, immunostimulants and immunization on the immune system. - Be able to develop an experimental design that allows analyzing immune responses. - Experimentally manipulate the immune system. - Know and handle the main sources of information in Immunology
8.	Prerequisites for studying the course/module, connection with other educational components	It is desirable that students have prior knowledge of cell biology, biochemistry, genetics, histology, basic immunology and animal organography

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT
General skills: • CG04- Use the appropriate scientific terminologies. • CG06- You find and consult sources of information and databases; analyze and synthesize documents.

• CG08- Strengthen the management of foreign languages. • CG09- Apply critical, logical and creative thinking. Specific skills: • CE04- Control all physiological, metabolic, immunological, environmental, nutritional factors, etc. that affect the well-being of the species in cultivation and implement the reproduction processes, maintenance, production and pathology of key species and potential species in aquaculture. • CE12- Know the techniques used to assess the state of the immune system as well as a methodology used to determine the effects of diet, stress, immunostimulants and immunization on the immune system. Basic skills: • CB01 - Students possess and understand the knowledge that gives them the ability to innovate and originality in the development and/or application of ideas, both in the professional field and in one research context. • CB05- That students have the learning skills that allow them to continue studying in a way that will have to be largely self-directed or autonomous. Transversal skills: • CT2 - Ability to work independently and make decisions. • CT4 - Ability to search, analyze and interpret varied and different sources of information languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Introduction to the immune system. 1. a. Generalities of the immune system. 1.b. Cellular and humoral components of the innate immune system. 1. c. Cellular and humoral components of the acquired immune system.
2.	Vaccines
3.	Monoclonal antibodies. Potential uses
4.	The immune system of fish. 4. a. Lymphomyeloid organs in agnathous, chondrichthyan and osteichthyan fishes. General types and characteristics. 4.b. innate immunity Characteristics. Cellular components: monocytes/macrophages, granulocytes, natural cytotoxic cells, mast cells. Humoral components: complement, lysozyme and antimicrobial peptides, antiproteases, lectins, cytokines. A inflammatory response in fish. 4. c. Acquired immunity. B and T lymphocytes. Immunoglobulins: structure and function. Immunoglobulin genes. T cell receptors. Cytokines. Antigen presenting cells. The main histocompatibility system. 4.d. Ontogeny of immune responses. Formation of lymphomyeloid organs. Development of innate and acquired immunity. Influence of temperature and photoperiod on the development and function of the immune system. 4.e. Immunity against bacteria, viruses and parasites. 4. f. Immunization Regulation of the immune response in fish. Adjuvants and inflammatory response. Immunological tolerance. 4.g. Stress and the immune response. Effects of stress on immune function and resistance to disease. 4.h. Nutrition and the immune system. Effect of dietary components (lipids, vitamins, micronutrients...) on the immune response and on resistance to pathogens. 4.i. Immunomodulation. Immunostimulants: types and mode of action. Immunostimulants and resistance to pathogens.
5.	5. The immune system of molluscs and crustaceans. 5. a. Cellular components (hemocytes and hematopoiesis). 5.b. Humoral components (lectins, bioactive peptides, complement,...).

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
- Expository classes. - Seminars, with student work in the preparation of content and presentation in the classroom. - Laboratory practices (1 day, at USC-Campus Vida). - Personalized tutorials to help guide and solve students' problems related to the subject - Students' independent work	

GENERAL INFORMATION ABOUT THE COURSE #7		
1	The name of the course/module	Pathology in aquaculture
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	Mandatory
4.	Semester	2nd
5.	Number of ECTS credits	3
6.	The total number of hours	75

7.	General description and purpose of the educational component	It is intended that the student: • Know the main infectious pathologies that can affect animal species cultivated in aquaculture (fish, molluscs and crustaceans), their etiology and epidemiology • Identify the main clinical signs associated with each disease, the methods most commonly used for its diagnosis and possible control measures • Know the technique of necropsy (complete, orderly and systematic) in fish, differentiating postmortem alterations from injuries and know how to take samples and write necropsy reports properly. • Acquire a basic knowledge of the main groups of lesions and the morphological characters used for their identification and differentiation in fish, using their own terminology to describe and define the lesions. • Know what the application regulations are in pathology
8.	Prerequisites for studying the course/module, connection with other educational components	none

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
• CG02- Appreciate the importance of debate and teamwork, interpersonal communication and responsibility.
• CG06- You will find consulting sources of information and databases; analyze and synthesize documents.
• CG08- Strengthen the handling of foreign languages.
Specific skills
• CE05- Diagnose, prevent and control diseases.
Basic skills
• CB03- that students are able to integrate knowledge and face the complexity of formulating interpretations and judgments based on often incomplete information, including
reflections on ethical social responsibilities linked to the resolution of specific problems;
• CB05- that students possess the learning skills that allow them to continue studying in a way that will have to be largely self-directed or autonomous.
Transversal skills:
• CT1 - Ability to manage time and tasks, and work under pressure and in critical situations (flexibility, predisposition to change, effort).
• CT5 - Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computer resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Necropsy. Sampling. Presentation of practical cases Basic principles of the host response to aggression. Presentation of practical cases
2.	Bacterial diseases in aquaculture. Characteristics of pathogens and symptoms caused. Main diagnostic and control methods. Epidemiology of pathologies most important bacteria. legislation
3.	Viral diseases in aquaculture: Main diseases and emerging pathologies: etiological agents, clinical signs, diagnosis, epidemiology and control methods. legislation
4.	Parasitic diseases in aquaculture: etiological agents, symptoms. Main diagnostic methods and control measures. Epidemiology of parasites. legislation

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
• Attendance to face-to-face classes • Use of the material provided by the teaching staff as a study guide: articles from research, books, information via the Internet... • Use of the recommended bibliographic sources • Regular use of tutoring hours. • Constant work throughout the course.	

GENERAL INFORMATION ABOUT THE COURSE #8

1	The name of the course/module	Culture of microalgae and zooplankton
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	
4.	Semester	2nd
5.	Number of ECTS credits	3

6.	The total number of hours	75
7.	General description and purpose of the educational component	Basic learning of microalgae cultivation techniques in the laboratory and in the cultivation plant Cultivation and handling of live food in Aquaculture Use of different analytical techniques, both for the study of crop growth and for the determination of their biochemical composition Introduction to the production of microalgae for different biotechnological applications
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge of Microbiology and basic microorganism cultivation techniques

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
• CG02- Appreciate the importance of debate and teamwork, interpersonal communication and responsibility.
• CG08- Strengthen the handling of foreign languages.
Specific skills
• CE03- Develop and know the cultivation techniques of fish, molluscs, other invertebrates, algae and auxiliary crops.
• CE09- Organize production ensuring its viability.
Basic skills
• CB02- that students know how to apply the acquired knowledge and their ability to solve problems in new or little-known environments within wider (or multidisciplinary) contexts related to their area of study;
Transversal skills
• CT1 - Ability to manage time and tasks, and work under pressure and in critical situations (flexibility, predisposition to change, effort)

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

	Section I. Culture of microalgae
1.	Generalities of the cultivation of photoautotrophic microorganisms and cultivable species
2.	Isolation and maintenance of strains
3.	Factors that influence growth: physical parameters of cultivation, nutrients and cultivation media
4.	Biochemical composition
5.	Biomass cultivation and collection systems
6.	Biotechnological applications
	Section II. Zooplankton culture
7.	Generalities of live food: Importance and purpose
8.	Cultivation of rotifers: life cycle, cultivation, feeding and enrichment
9.	Cultivation of Artemia: life cycle, decapsulation and hatching of cysts, cultivation, feeding and enrichment
10.	Cultivation of copepods

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Master classes Seminars in which experimental research designs in the cultivation of microalgae and zooplankton will be analyzed and also aspects of the planning of production systems of microalgae in the culture plant. In addition to the personalized tutorials to resolve specific questions of the students, there will be a non-mandatory face-to-face tutorial to carry out the plant production planning exercises. Laboratory practices in Santiago de Compostela (1 day) and at the IGAFA cultivation plant (1 day). Each group will deliver a report of the results obtained in the laboratory practice. Examination of the theoretical knowledge achieved. Implementation of a work on planning the production of microalgae in a plant.	

GENERAL INFORMATION ABOUT THE COURSE #9

1	The name of the course/module	Culture of fish
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	
4.	Semester	2st

5.	Number of ECTS credits	6
6.	The total number of hours	150
7.	General description and purpose of the educational component	Acquire basic knowledge for the cultivation of marine and freshwater fish species. It is intended that the student is able to a) Know the cultivation techniques of different species of fish b) Have a vision of the different stages of fish farming. c) Know the minimum needs of the crop d) Be able to address each and every one of the cultivation phases e) Assess and interpret the parameters that influence reproduction f) Improvement of production
8.	Prerequisites for studying the course/module, connection with other educational components	none

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
• CX06- Find the necessary sources of information and databases; consult them and analyze and synthesize documents
Specific skills
• CE03 - Develop and learn the techniques of growing fish, molluscs, other invertebrates, algae, auxiliaries and production
• CE04- Control all the physiological, metabolic, immunological, environmental, feeding factors, ... that affect the well-being of species in culture, and implement the processes of reproduction, production, maintenance and pathology of key species and potential species in aquaculture.
• CE09- Organize production ensuring its viability.
Basic skills
• CB01 – It will be guaranteed that students and y understand the knowledge that gives them the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a research context;
• CB04- It will be guaranteed that students know how to communicate their conclusions (and the ultimate knowledge and reason that support them) to specialized and non-specialized audiences, in a clear and unambiguous way;
Transversal skills
• CT4 - Ability to search, analyze and interpret varied sources of information in different languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Fish farming systems
2.	Species selection criteria for aquaculture
3.	Location selection criteria.
4.	Installations of the different phases of fish farming
5.	Food in fish farming
6.	Crop controls in the different stages of production
7.	Production management
8.	Biological bases of the species of greatest interest (classification, biological cycle, habitats, behavior, anatomy, food.)
9.	Reproduction: selection and conditioning of reproducers; manipulation, production of ova and gametes, fertilization and development.
10.	Larval culture systems
11.	Prefattening and fattening

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and practical face-to-face classes. Development of commissioned work and face-to-face defense. Tutorials personalized for direct support to students. Student's independent work. conferences Company visits The classes will be taught at the facilities of the IEO (Canido, Vigo; 4 days) and the IGAFA (Island of Arousa; 1 day)	

GENERAL INFORMATION ABOUT THE COURSE #10

1	The name of the course/module	Culture of other invertebrates
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	
4.	Semester	2st
5.	Number of ECTS credits	3

6.	The total number of hours	75
7.	General description and purpose of the educational component	Acquisition of technical skills for the cultivation of crustaceans - Knowledge of the strengths and weaknesses in an experimental culture of great future such as the culture of cephalopods. - Knowledge of the current state and future prospects of possible new invertebrate cultures
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
• CX01- Acquisition of analysis and prospecting capabilities on the current and future situation of aquaculture • CX06- Find the necessary sources of information and databases; consult and analyze them and synthesize documents.
Specific skills
• CE03 - Develop and know the cultivation techniques of fish, molluscs, other invertebrates, algae, auxiliary and production
• CE04- Control all the physiological, metabolic, immunological, environmental, feeding factors that affect the well-being of species in cultivation, and implement the processes of reproduction, production, maintenance and pathology of key species and potential species in aquaculture.
• CE09- Organize production ensuring its viability.
Basic skills
• CB01 – It will be guaranteed that students and y understand the knowledge that gives them the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a research context;
• CB04- It will be guaranteed that students know how to communicate their conclusions (and the knowledge and ultimate reasons that support them) to specialized and non-specialized audiences, in a clear and unbiased way ambiguities;
Transversal skills
• CT4 - Skill in the search, analysis and interpretation of varied information sources and in different languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Biology of cephalopods. Cephalopod crops in the world.
2.	Octopus (Octopus vulgaris): Catch and transport. Conditioning of reproducers.
3.	Obtaining eggs in incubation. Larval culture.
4.	Octopus (Octopus vulgaris): Fattening process in floating tanks and cages. Marking experiences (paralarvae and subadults).
5.	Biology and culture of crustaceans

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and practical face-to-face classes. Development of commissioned works and face-to-face defense. Personalized tutoring for direct support to students. Student's independent work. conferences Company visits Classes will be held at IGAFA (Island of Arousa; 1 day), at ECIMAT (Island of Toralla; 1 day) and at IEO (Canido, Vigo; 1 day)	

GENERAL INFORMATION ABOUT THE COURSE #11

1	The name of the course/module	Feeding and Nutrition
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	
4.	Semester	1st
5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	Knowledge of the basic principles of food and nutrition in the main groups of animals suitable for use in aquaculture (fish, molluscs and crustaceans).
8.	Prerequisites for studying the course/module, connection with other educational components	The use of the subject requires knowing the basics of how animals work. That is why it is highly advisable to study the subjects of Zoology, Biochemistry and Animal Physiology.

		It is also advisable, the knowledge and management of databases and electronic magazines of interest for Aquaculture and that the students have basic knowledge of English that facilitates the mandatory and continuous use of the required bibliography, both essential and complementary, for learning the subject.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
• CG02- Appreciate the importance of debate and teamwork, interpersonal communication and responsibility.
• CG04- Use the appropriate scientific terminologies.
• CG06- Find and consult sources of information and databases; analyze and synthesize documents.
• CG08- Strengthen the management of foreign languages.
Specific skills
• CE04- Control all the physiological, metabolic, immunological, environmental, feeding factors, etc. that affect the well-being of species in cultivation, and implement the processes of
reproduction, maintenance, production and pathology of key species and potential species in aquaculture.
• CE12- Know the techniques used to evaluate the state of the immune system as well as the methodology used to determine the effects of diet, stress, immunostimulants and immunization on the immune system.
Basic skills
• CB04- that students know how to communicate their conclusions (and the knowledge and ultimate reasons that support them) to specialized and non-specialized audiences in a clear and unambiguous way;
Transversal skills:
• CT3 - Ability to work in a team: cooperation, debate, negotiation.
• CT5 - Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computer resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Feeding behavior in fish.
2.	Control of intake in fish.
3.	Digestive physiology in fish
4.	Food in molluscs.
5.	Feeding on crustaceans.
6.	Dietary needs of animals in cultivation.
7.	Proteins and amino acids.
8.	Lipids
9.	Other nutrients
10.	Formulation and elaboration.
11.	Nutrition in larvae

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical classes. The teacher, after explaining the work system and defining key concepts, will develop, with the students' participation, each of the topics in the order established in the program. Seminars At the beginning of the course, the students will be exposed to a set of possible works to be done in pairs on aspects of food/nutrition of specific species (salmon, turbot, sea bream, prawn, etc.). They must prepare a memory (maximum 15 pages) and must present a summary of that topic that will be debated in the corresponding session Practical classes. Diet formulation problems Personalized tutoring for direct support to the student	

GENERAL INFORMATION ABOUT THE COURSE #12

1	The name of the course/module	Disease diagnostics
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	
4.	Semester	2nd
5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	We want the student • know and practice the most basic, up-to-date and advanced diagnosis techniques in the diagnosis of bacterial, viral and parasitic diseases in aquaculture;

		• that you are able to decide which of these techniques you should use in each case, and based on specific situations and concrete cases, and that you are able to interpret the results of a diagnosis and make decisions about it.
8.	Prerequisites for studying the course/module, connection with other educational components	It is recommended to have passed the subject of Pathology in Aquaculture. It is also advisable to supplement with the subjects of Prevention and Control and Epidemiology.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
• CG03- Assess the importance of multidisciplinary analyzes and the relationship between knowledge for solving problems and for the analysis of critical points.
• CG08- Strengthen the handling of foreign languages.
• CG09- Apply critical, logical and creative thinking
Specific skills
• CE05- Diagnose, prevent and control diseases.
Basic skills
• CB03- that students are able to integrate knowledge and face the complexity of
formulation of interpretations and judgments based on often incomplete information, including
reflections on the social and ethical responsibilities linked to the resolution of specific problems;
Transversal skills:
• CT3 - Ability to work in a team: cooperation, debate, negotiation.
• CT4 - Ability to search, analyze and interpret varied and different sources of information
languages (mainly English).

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Reliability parameters and validation of diagnostic techniques
2.	First steps in bacteriological diagnosis
3.	First steps in parasitological diagnosis
4.	First steps in virological diagnosis
5.	Histology and immunohistochemistry techniques
6.	Serological techniques: Methods of obtaining and types of antisera (polyclonal / monoclonal); basis and description of serological/immunological techniques (agglutination and hemagglutination, seroneutralization, immunomarker techniques, ...)
7.	Molecular diagnosis and typing techniques: Nucleic acid hybridization; amplification techniques (PCR, qPCR, NASBA, LAMP). EFTs, RFLPs, HRM, sequencing/Phylogeny
8.	Present and future of diagnosis: DNA chips and arrays; arrays based on qPCR, ddPCR, NGS,
9.	Diagnosis techniques in molluscs: Macroscopic signs and indications. Optical microscopy techniques. Electron microscopy techniques. Techniques based on the detection of nucleic acids. Immunoassays Techniques based on tissue/fluid incubation in culture media. Use of these techniques in European legislation and OIE.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and practical face-to-face classes. Work and resolution of practical cases. Personalized tutorials. Student's independent work.	

GENERAL INFORMATION ABOUT THE COURSE #13

1.	The name of the course/module	Water quality and management
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	Optional
4.	Semester	2nd
5.	Number of ECTS credits	3
6.	The total number of hours	75
7.	General description and purpose of the educational component	Understanding of the physicochemical aspects involved in water quality and control. Mastery of water quality analysis procedures. Knowledge of coastal processes (currents, waves, wind, transport of pollutants and sediment) and their influence on aquaculture. Understanding of the operating principles of hydraulic installations used in aquaculture. Mastery of calculation tools for the design of aquaculture facilities. Technical competence to design an installation.

		Realization of practice design and calculation of facilities.
8.	Prerequisites for studying the course/module, connection with other educational components	Basic knowledge of Mathematics, Physics (especially Fluid Mechanics), Chemistry, Biochemistry and Chemical Engineering.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
• CG03- Assess the importance of multidisciplinary analyzes and the relationship between knowledge for solving problems and analyzes of critical points.
• CG04- Use the appropriate scientific terminologies.
• CG09- Apply critical, logical and creative thinking
Specific skills:
• CE01- Assimilation of the importance of water quality and its supervision.
• CE07- Acquire knowledge about the technical and design characteristics of the facilities for cultivation.
• CE09- Organize production ensuring its viability.
Basic skills:
• CB05- that students possess the learning skills that allow them to continue studying in a way that will have to be largely self-directed or autonomous.
Transversal skills
• CT1 - Ability to manage time and tasks, and work under pressure and in critical situations (flexibility, predisposition to change, effort).
• CT6 - Creativity, initiative and entrepreneurial spirit.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Quality indicators.
2.	Filtration: basics. Classification of filtration systems. Mechanical filtration.
3.	Biofiltration: nitrification, denitrification.
4.	Aeration/oxygenation.
5.	Monitoring and control.
6.	Disinfection: Basic Concepts. Disinfection methods.
7.	Installations and Engineering in Aquaculture.
8.	Types of Installations or Cultivation Systems.
9.	Technical components of an aquaculture plant.
10.	Closed production units and Marine cages.
11.	Dimensioning of the facilities.
12.	Water supply and distribution

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
The teaching development of the subject is structured around face-to-face classes where the theoretical foundations of the subject will be presented and the criteria will be established for the student to develop the basic concepts through readings and assignments. In these classes, the interaction between teachers and students will be sought. Interactive teaching is intended to focus on the application of theoretical concepts. Practical cases of dimensioning of hydraulic installations will be developed in the practices. A technical visit will be made to an aquaculture production or water treatment facility.	

GENERAL INFORMATION ABOUT THE COURSE #15

1.	The name of the course/module	Toxicology and toxic tides
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	Optional
4.	Semester	2nd
5.	Number of ECTS credits	3.0
6.	The total number of hours	75
7.	General description and purpose of the educational component	Understanding the complex process involved in toxic tides or episodes. - Knowledge of the different types of biotoxins, their toxicity and detection systems. - Systems for predicting and mitigating harmful episodes.
8.	Prerequisites for studying the course/module, connection	

	with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

Xerais competitions:
• CG01- Acquire analysis and prospecting capacity on the current and future situation of aquaculture.
• CG02- Appreciate the importance of debate and teamwork, interpersonal communication and responsibility.
• CG08- Promote the handling of foreign languages.
Specific skills
• CE10- Identify relevant research objectives and plan their achievement.
Basic skills
• CB01 - Students possess and understand the knowledge that provides them with the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a
research context;
• CB04- that students know how to communicate their conclusions (and the ultimate knowledge and reasons that support them) to specialized and non-specialized audiences in a clear and unambiguous way;
Transversal competences:
• CT3 - Teamwork capacity: cooperation, debate, negotiation.
• CT5 - Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computing resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Harmful episodes: Definitions, types, consequences, species, groups of compounds and processes involved
2.	Effects of phytoplankton blooms on cultivated organisms
3.	Toxins: structure, chemical properties and associated toxic syndromes
4.	Analytical methodologies for the detection and quantification of toxins and evaluation of their toxicity
5.	Regulation of the main groups of toxins: Bases and current levels
6.	Proliferation of phytoplankton and production of toxins
7.	Accumulation of toxins in bivalves: processes and modelling. Proliferation control systems. Methods of mitigating the consequences of episodes
8.	Quantification of the toxicity of polluting compounds

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and practical classes and practical cases. Development of commissioned work and face-to-face defense. Personalized tutorials. Autonomous work. Conferences. Company visits	

GENERAL INFORMATION ABOUT THE COURSE #16

1.	The name of the course/module	Culture of seaweeds
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	
4.	Semester	2nd
5.	Number of ECTS credits	3.0
6.	The total number of hours	75
7.	General description and purpose of the educational component	Understanding the importance of the cultivation of primary producers such as marine macroalgae in the context of global aquaculture. Recognition of the idiosyncrasies of marine macroalgae and the main aspects that differentiate their cultivation techniques from those of other organisms. Knowledge of the different types of phycoculture, their foundations, advantages and disadvantages and main applications. Description of the cultivation techniques used in the most important species worldwide. Development of the capacity to design cultivation projects of these organisms. Knowledge of the main aspects that can negatively affect the viability of these crops and the future trends of the activity.
8.	Prerequisites for studying the course/module, connection with other educational components	Knowledge of the general characteristics of the main groups of algae and their classification. Knowledge about the reproduction processes and biological cycles of algae. Knowledge about the main factors that influence the growth and reproduction of marine macroalgae.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:

• CG01- Acquire the ability to analyze and survey the current and future situation of aquaculture. • CG04- Use the appropriate scientific terminologies. • CG08- Strengthen the management of foreign languages. Specific skills: • CE02- Knowledge of the biological cycle and physiological and morphological aspects of animals and cultivated algae. • CE03- Develop and know the cultivation techniques of fish, molluscs, other invertebrates, algae and auxiliary crops. Basic skills: •CB02- That students know how to apply the knowledge acquired and their ability to solve problems in new or little-known environments within wider (or multidisciplinary) contexts related to their area of study. Transversal skills: •CT5- Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computer resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Industrial cultivation of marine macroalgae: History, global importance and evolution of the different techniques. Sustaining phytoculture, extensive and intensive.
2.	Cultivation techniques in plants (indoors), in seas (outdoors) and mixed sea-plants.
3.	Main techniques of growing alginophytes. Cultivation of Laminariales
4.	Main cultivation techniques of agarophytes. Cultivation of Gracilaria and Gelidium
5.	Main techniques of carrageenan cultivation. Cultivation of EucheumaKappaphycus and Chondrus
6.	Main techniques for growing food algae. Cultivation of Porphyra and Pyropia species. Other crops
7.	Applications of marine macroalgae cultures in integrated multitrophic aquaculture techniques and environmental bioremediation. Current status and future prospects of marine macroalgae cultivation in Europe and Spain.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Face-to-face classes for exposition of the theory syllabus and interactive teaching Face-to-face classes in the laboratory for the development of practical teaching. Independent student work for the study and understanding of theory and practical concepts. Personalized tutoring for the resolution of student doubts and the formulation of new goals and challenges in the subject. Internship: In the macroalgae cultivation laboratory of the BioCost research group of the Center for Advanced Scientific Research (CICA) of the UDC.	

GENERAL INFORMATION ABOUT THE COURSE #17		
1.	The name of the course/module	Aquaculture farm management
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	Optional
4.	Semester	2nd
5.	Number of ECTS credits	3.0
6.	The total number of hours	75
7.	General description and purpose of the educational component	Identify the international, community, state and autonomous regulations relating to the organization and management of aquaculture. Get to know the public and private organizations involved in the field of aquaculture. Know how to interpret legal techniques and aquaculture management procedures. Deepen the specialization of managers and technicians of aquaculture farms, in particular in the fields of national and international marketing, taxation and financing. The aim is to train students in the criteria for selecting locations, introducing preventive and corrective measures and environmental management of aquaculture farms
8.	Prerequisites for studying the course/module, connection with other educational components	The recommended prior knowledge is: - Basic knowledge of processes in aquaculture. - Elementary knowledge of economics. - Computer tools (word processor and Internet) at user level and for searching for information. - It is required to know how to write, synthesize and present a work in an orderly manner. - English language with an average level of reading comprehension.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		

General skills: • CG01- Acquire the ability to analyze and survey the current and future situation of aquaculture. • CG04- Use the appropriate scientific terminologies. • CG06- Find and consult sources of information and databases; analyze and synthesize documents. Specific skills • CE08- Prevent the potential environmental impact of aquaculture. • CE09- Organize production ensuring its viability. • CE13- Identify and apply international, state and community regulations applied to aquaculture. Basic skills • CB01 - Students possess and understand the knowledge that gives them the capacity for innovation and originality in the development and/or application of ideas, both in the professional field and in a research context; • CB02- that students know how to apply the acquired knowledge and their ability to solve problems in new or little-known areas within wider (or multidisciplinary) contexts related to their area of study; Transversal skills • CT4 - Ability to search, analyze and interpret varied sources of information and in different languages (mainly English)

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1.	Aquaculture and development
2.	Levels of technical development
3.	Production structure.
4.	economy of the aquaculture company.
5.	Marketing, prices and markets.
6.	Traceability and Marketing.
7.	Innovation.
8.	Formation and Training.
9.	Aquaculture policies of the EU, Spain and the CCAA.
10.	Aquaculture and the legal system.
11.	The competence system of aquaculture in Spain.
12.	The comprehensive management of the coast and marine crops.
13.	Measures to control and promote activities related to aquaculture.
14.	The enabling titles for the management and exploitation of aquaculture.
15.	Environmental protection and aquaculture.
16.	General aspects of environmental management.
17.	Environmental aspects of aquaculture.
18.	Available and emerging techniques for environmental improvement.
19.	Territorial planning of aquaculture: Spatial occupation and potential; Conflicts with other uses. Sustainable aquaculture.
20.	Regulations for the environmental management of aquaculture.

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Initial activities: brief review of the knowledge of analysis and theory to familiarize the student with the language and methodology of the program. Master session: presentation and explanation by the teacher of the topics included in the program with ICT support. Assignments: completion of short research papers on topics related to the program.	

GENERAL INFORMATION ABOUT THE COURSE #18		
1.	The name of the course/module	Quality, processing, and traceability
2.	Faculty/department	Faculty of Sciences, University of A Coruña Faculty of Biology, University of Vigo
3.	Status of the educational component	Optional
4.	Semester	2nd
5.	Number of ECTS credits	3.0
6.	The total number of hours	75
7.	General description and purpose of the educational component	This multidisciplinary subject aims to know the parameters that determine the quality of the aquaculture product and the tools that can ensure it. It is also intended to make known the new processes and technologies that allow improving the quality of the aquaculture product in its production chain, transformation and consumption; as well as estimating consumer demands on the quality of the aquaculture product.

		It is also intended to know the different aspects that affect the quality of the products obtained in aquaculture processes, both from different types of animal organisms and marine macroalgae. Aspects ranging from its composition and organoleptic and nutritional properties to the evolution over time and the methods of conservation or extraction of its active principles are discussed; going through issues of both food safety and the types of controls (microbiological and critical points) that must be to perform and its methodology to do so. On the other hand, it is about knowing the fundamentals of molecular traceability and the methodology for the development of integral systems thereof, knowing how to design this type of system for any aquaculture product and applying them in the study of practical cases.
8.	Prerequisites for studying the course/module, connection with other educational components	Having attended specific subjects or courses where the following aspects were dealt with: - Basic knowledge in chemistry (solubility, extractability, nucleophilic and electrophilic character, etc.) and biochemistry (constituents of living matter, essential components, etc.) -Basic knowledge of chromatographic and spectrophotometric analytical techniques. -General Genetics: Genetics of populations and evolution. -Methods in Genetics: Physical-chemical properties of DNA, molecular polymorphism analysis techniques, recombinant DNA technology. -Fishing and animal aquaculture: Management of cultivated stocks, exploitation of fisheries and logistics of commercial distribution. -Marine macroalgae: Morphology, reproduction and life cycles of the main cultivated species.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

General skills:
•CG04- Use appropriate scientific terminology.
•CG08- Promote the use of foreign languages.
Specific skills:
•CE06- Carry out quality controls and traceability.
•CE11- Acquire basic and applied knowledge of genetics, genomics and proteomics applied to aquaculture.
Basic skills:
•CB02- That students know how to apply the knowledge acquired and their ability to solve problems in new or unknown environments within wider (or multidisciplinary) contexts related to their area of study.
Transversal skills:
•CT5- Ability to present knowledge and results: oral and written communication; analytical, critical and synthesis capacity; use of computer resources.

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

1.	Chemical composition of aquatic species and ways of alteration during processing
2.	Food quality and safety in aquaculture products: Methods and molecular biomarkers of quality and freshness.
3.	Application of advanced technologies for the conservation of aquaculture products: Antioxidants and natural antimicrobials, high pressures and liquid ice
4.	Current legislation on food traceability in the EU.
5.	Current situation of research, industry and the market regarding the traceability of fishery and aquaculture products.
6.	Molecular foundations and available methodologies for the calibration of genetic traceability systems. DNA barcodes.
7.	Elements of authenticity contrastable with molecular tools: limitations and trends.
8.	Integrated traceability systems: smart labels and new packaging.
9.	General applications of marine macroalgae. Phycocolloids from algae. Types and applications. Processing of the main cultivated species for the extraction of alginic acid, agar and carrageenans
10.	Marine macroalgae cultivated as a source of biomass for agricultural use or for food and human health. Macroalgae as a source of energy. Biorefineries based on algal biomass.

TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Theoretical and interactive classes. The expository credits that correspond to the theory classes will take place via interuniversity video conference. Face-to-face laboratory practice credits are developed in the laboratories corresponding to the subject and teacher of the subject, following a manipulative-oriented class system, consisting of presentation of objectives and means, experimental development by the student with continuous feedback and final interpretation of results in debate format . The laboratory practices they strengthen the conceptual approach and are scheduled at a rate of one session in each center.	

Development of commissioned work and face-to-face advocacy. Student's independent work. Interactive credits (exercise solutions, subject extension, related readings, assignments for the subject, exam preparation, etc.), will be scheduled in advance with the teacher or the coordinator for their subsequent evaluation. Your defense and the debate system in the classroom will also be coordinated.	

UNIVERSITY OF ST ANDREWS

1	Criterion A: University profile	
1.1	Name of the University	University of St Andrews
1.2	Classical or applied	Classical
2	Criterion B: Profile of the educational program (Curriculum)	
2.1	Number of Aquaculture disciplines	1
2.2	The name of the educational program	Master of Science Sustainable Aquaculture
2.3	Type of diploma	Postgraduate, leading to a Postgraduate Certificate (PG Cert) The University also offers a distance learning Postgraduate Diploma or MSc in Sustainable Aquaculture. Postgraduate Diploma The award of this qualification requires 120 credits gained from taught modules over a two-year period consisting of a series of compulsory core modules and a choice of optional modules matched to students' specific interests.
2.4	Total number of credits (ECTS)	120
3	Criterion C: Setting the educational program (Curriculum)	
3.1	Duration of the program	18 month
3.2	The purpose of the educational program	The award of Postgraduate Certificate requires 60 credits gained from a selection of taught modules. The Postgraduate Certificate provides a shorter programme than the Postgraduate Diploma or MSc Sustainable Aquaculture programme. Students focus either on vertebrate or invertebrate aquaculture species and have a choice of taking two out of the three optional topics.
4	Criterion D: Characteristics of the educational program (Curriculum)	
4.1	Subject area (field of knowledge, specialty, specialization (if available))	Graduates will typically pursue a career in higher level management, research and development or business development within the global aquaculture business.
5	Criterion E: Teaching and assessment	
5.1	Teaching and learning methods	Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework. The Sustainable Aquaculture distance learning modular programme is taught part time via an online e-learning platform offering online tutorial support, direct email contact with tutors, video streams and access to student bulletin boards.
5.2	Assessment	Students on the MSc programme complete a 15,000-word dissertation at the end of their studies for the PGDip. The dissertation involves the study of a defined problem within the field of sustainable aquaculture. Students are required to collate and

		analyse data and to discuss their results in the light of existing literature.	
6	**Criterion F: Software competencies**		
6.1	Integral competence		
6.2	General competences	Both PGDip and MSc students take taught modules covering all aspects of aquaculture - both vertebrate and invertebrate species - over an 18-month period. MSc students then spend the next six months researching and writing a dissertation of no more than 15,000 words to be submitted on a specified date at the end of the course. Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework. The course consists of a series of compulsory core modules and a choice of five optional modules matched to students' specific interests.	
6.3	Professional competences		
7	**Criterion G: Program Learning Outcomes**		
7.1			
8	**Criterion H: Resource support for the implementation of the educational program (Curriculum)**		
8.1	Staff support	Students at St Andrews have the opportunity to build on their study skills as part of a programme of academic support and development. This can be particularly helpful for students who are transitioning from school to university, as well as for students who are new to the St Andrews system. The St Andrews courses are available 24/7 so students are free to study at a time that suits them. Tutors are on hand to answer any questions via the discussion forum or e-mail and the interactive lessons and selfassessments help students to learn in a variety of ways which enables them to engage with the material.	
8.2	Material and technical support	The perfect partnership: pairing the University of St Andrews educational strength with an interactive online delivery.	
9	**Criterion I: List of components of the educational program and their logic sequence**		
9.1	**Mandatory components**	**Number of credits**	**Final control form**
9.1.1	Aquaculture and Fisheries	10	2-hour Written Examination = 60%, Coursework = 40%
9.1.2	Management, Husbandry and Sustainability	10	2-hour Written Examination = 40%, Coursework = 60%
9.1.3	Markets, Products, Processing and Food Safety	10	2-hour Written Examination = 40%, Coursework = 60%
9.1.4	Local and Global Impacts of Aquaculture	10	2-hour Written Examination = 40%, Coursework = 60%

9.1.5	Sustainable Aquaculture Research Dissertation	60	Dissertation of up to 15,000 words = 100%
9.2	**Selective components**	**Number of credits**	**Final control form**
9.2.1	Biology for Aquaculture	20	2-hour Written Examination = 60%, Coursework = 40%
9.2.2	Biology for Aquaculture - Invertebrates	10	2-hour Written Examination = 60%, Coursework = 40%
9.2.3	Biology for Aquaculture - Vertebrates	10	2-hour Written Examination = 60%, Coursework = 40%
9.2.4	Nutrition for Aquaculture	20	2-hour Written Examination = 60%, Coursework = 40%
9.2.5	Nutrition - Invertebrates	10	2-hour Written Examination = 60%, Coursework = 40%
9.2.6	Nutrition - Vertebrates	10	2-hour Written Examination = 60%, Coursework = 40%
9.2.7	Health and Disease	20	2-hour Written Examination = 60%, Coursework = 40%
9.2.8	Health and Disease - Invertebrates	10	2-hour Written Examination = 60%, Coursework = 40%
9.2.9	Health and Disease - Vertebrates	10	2-hour Written Examination = 60%, Coursework = 40%
9.2.10	Breeding and Genetics	10	Coursework = 100%
9.2.11	Advanced Welfare and Ethics	10	Coursework = 100%
9.2.12	Recirculation Aquaculture Systems	10	Coursework = 100%
9.2.13	Ornamental and Aquaria Production	10	Coursework = 100%
9.2.14	Larval Rearing	10	Coursework = 100%
9.2.15			
9.2.16			
10	**Criterion L: Form of attestation**		
10.1	Requirements for	Final graduation examinations for the study programme are the Master thesis, trial lecture and oral examination.	

COMPARATIVE OF THE COURSES/MODULES (SYLLABUSES)

GENERAL INFORMATION ABOUT THE COURSE #1		
1	The name of the course/module	Aquaculture and Fisheries
2.	Faculty/department	School of Biology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning: 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides an introduction to the global importance of aquaculture with fisheries industries worldwide. The module will compare both aquaculture and fishing industries with terrestrial, agricultural sources of food production. The global markets for aquaculture, fisheries and agricultural products will be assessed. The environmental interactions of aquaculture will be discussed with relation to the definition of, and development of, sustainable aquaculture practices. The principles of developing sustainable aquaculture in different global environments/conditions will be discussed.
8.	Prerequisites for studying the course/module, connection with other educational components	All MSc students at Faculty of Biosciences and Aquaculture, UiN, and students qualified for admission to MSc in Aquaculture. Introductory courses in mathematics, statistics and computer programming.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #2		
1	The name of the course/module	Management, Husbandry and Sustainability
2.	Faculty/department	School of Biology
3.	Status of the educational component	Mandatory
4.	Semester	1st
5.	Number of ECTS credits	10

6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of production management and business management of modern aquaculture practices. Environmental, social and economic sustainability of aquaculture depends on an understanding of the interactions of differing but complementary management structures.
8.	Prerequisites for studying the course/module, connection with other educational components	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #3		
1	The name of the course/module	Markets, Products, Processing and Food Safety
2.	Faculty/department	School of Biology
3.	Status of the educational component	Mandatory
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of aquaculture markets, products, processing and food safety. Understanding the processes of ensuring the safety and quality of aquaculture products is central to establishing efficient and sustainable aquaculture practices.
8.	Prerequisites for studying the course/module, connection with other educational components	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #4		
1	The name of the course/module	Local and Global Impacts of Aquaculture
2.	Faculty/department	School of Biology
3.	Status of the educational component	Mandatory
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of the environmental impact of aquaculture practices on both local and global scales. Understanding the environmental impact of aquaculture practices is central to improving and developing sustainable aquaculture.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
1	
2.	
3.	
4.	
5.	

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #5		
1.	The name of the course/module	Sustainable Aquaculture Research Dissertation
2.	Faculty/department	School of Biology
3.	Status of the educational component	Mandatory
4.	Semester	To be arranged.
5.	Number of ECTS credits	60
6.	The total number of hours	Weekly contact: Individual supervision
7.	General description and purpose of the educational component	The research dissertation will involve the study of a defined problem within the field of Sustainable Aquaculture. Students will be required to collate and analyse data and to discuss their results in the light of existing literature. In some cases, projects might also involve the design of experiments or the gathering of data. Each project will be written up in the form of a thesis.
8.	Prerequisites for studying the course/module, connection with other educational components	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
1.		
2.		
3.		
4.		
5.		

TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #6		
1.	The name of the course/module	Biology for Aquaculture
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	20
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)

7.	General description and purpose of the educational component	This module provides an understanding of the fundamental biology of aquaculture species. This includes the anatomy and physiology of both invertebrate and vertebrate aquaculture species. The interaction of aquaculture species with the aquatic environment and the requirements for developing sustainable aquaculture will be assessed.
8.	Prerequisites for studying the course/module, connection with other educational components	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #7		
1.	The name of the course/module	Biology for Aquaculture - Invertebrates
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides an understanding of the fundamental biology of invertebrate aquaculture species. This includes the anatomy and physiology of appropriate aquaculture species. The interaction of aquaculture species with the aquatic environment and the requirements for developing sustainable aquaculture will be assessed.
8.	Prerequisites for studying the course/module, connection with other educational components	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		

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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #8		
1.	The name of the course/module	Biology for Aquaculture - Vertebrates
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides an understanding of the fundamental biology of vertebrate aquaculture species. This includes the anatomy and physiology of appropriate aquaculture species. The interaction of aquaculture species with the aquatic environment and the requirements for developing sustainable aquaculture will be assessed.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #9		
1	The name of the course/module	Nutrition for Aquaculture
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	20
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides an understanding of the fundamental biology of vertebrate aquaculture species. This includes the anatomy and physiology of appropriate aquaculture species. The interaction of aquaculture species with the aquatic environment and the requirements for developing sustainable aquaculture will be assessed.
8.	Prerequisites for studying the course/module, connection with other educational components	This module provides advanced knowledge of the anatomy, physiology and nutritional requirements of key fish and invertebrate species and a critical assessment of the sustainability of feed production technology. It will also assess and discuss the relationship between clinical nutrition and fish health, the role of microbiota in fish nutrition and the importance of nutrition in developing optimal animal welfare.

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #10		
1	The name of the course/module	Nutrition - Invertebrates
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of the anatomy, physiology and nutritional requirements of key invertebrate species and a critical assessment of the sustainability of feed production technology. It will also assess and discuss the relationship between

		clinical nutrition and animal health and the importance of nutrition in developing optimal animal welfare.
8.	Prerequisites for studying the course/module, connection with other educational components	This module provides advanced knowledge of the anatomy, physiology and nutritional requirements of key fish and invertebrate species and a critical assessment of the sustainability of feed production technology. It will also assess and discuss the relationship between clinical nutrition and fish health, the role of microbiota in fish nutrition and the importance of nutrition in developing optimal animal welfare.
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
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TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)	
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.		

GENERAL INFORMATION ABOUT THE COURSE #11		
1.	The name of the course/module	Nutrition - Invertebrates
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of the anatomy, physiology and nutritional requirements of key invertebrate species and a critical assessment of the sustainability of feed production technology. It will also assess and discuss the relationship between clinical nutrition and animal health and the importance of nutrition in developing optimal animal welfare.
8.	Prerequisites for studying the course/module, connection with other educational components	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		

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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #12		
1.	The name of the course/module	Health and Disease
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	20
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of the factors that influence disease processes in cultured fish and invertebrates including viral, bacterial, parasitic and non-infectious disease. The wide range of specific causes of disease and pathology in farmed species will be discussed and the importance of operations and management on the development and impact of disease in optimising fish welfare and developing sustainable and ethical aquaculture practices will be assessed critically.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)

Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #13		
1	The name of the course/module	Health and Disease - Invertebrates
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of the factors that influence disease processes in cultured invertebrate species including viral, bacterial, parasitic and non-infectious disease. The wide range of specific causes of disease and pathology in farmed species will be discussed and the importance of operations and management on the development and impact of disease in optimising welfare and developing sustainable and ethical aquaculture practices will be assessed critically.
8.	Prerequisites for studying the course/module, connection with other educational components	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #14		
1.	The name of the course/module	Health and Disease - Vertebrates
2.	Faculty/department	School of Biology

3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of the factors that influence disease processes in cultured fish species including viral, bacterial, parasitic and non-infectious disease. The wide range of specific causes of disease and pathology in farmed species will be discussed and the importance of operations and management on the development and impact of disease in optimising fish welfare and developing sustainable and ethical aquaculture practices will be assessed critically.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #15		
1.	The name of the course/module	Health and Disease - Vertebrates
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of the factors that influence disease processes in cultured fish species including viral, bacterial, parasitic and non-infectious disease. The wide range of specific causes of disease and pathology in farmed species will be discussed and the importance of operations and management on the development and impact of disease in optimising fish welfare and

		developing sustainable and ethical aquaculture practices will be assessed critically.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #16		
1.	The name of the course/module	Health and Disease - Vertebrates
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of the factors that influence disease processes in cultured fish species including viral, bacterial, parasitic and non-infectious disease. The wide range of specific causes of disease and pathology in farmed species will be discussed and the importance of operations and management on the development and impact of disease in optimising fish welfare and developing sustainable and ethical aquaculture practices will be assessed critically.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #15		
1.	The name of the course/module	Health and Disease - Vertebrates
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of the factors that influence disease processes in cultured fish species including viral, bacterial, parasitic and non-infectious disease. The wide range of specific causes of disease and pathology in farmed species will be discussed and the importance of operations and management on the development and impact of disease in optimising fish welfare and developing sustainable and ethical aquaculture practices will be assessed critically.
8.	Prerequisites for studying the course/module, connection with other educational components	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
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TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)	

Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #16		
1.	The name of the course/module	Advanced Welfare and Ethics
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of the welfare and ethical issues raised by current aquaculture practices. Animal welfare is rapidly developing as a major ethical issue within all areas of food production including aquaculture. Future development of sustainable aquaculture must incorporate ethical practices, optimising animal welfare and as a consequence improving the final product.
8.	Prerequisites for studying the course/module, connection with other educational components	
LEARNING OUTCOMES BY EDUCATIONAL COMPONENT		
CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)		
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TEACHING AND LEARNING METHODS		
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)		Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.		

GENERAL INFORMATION ABOUT THE COURSE #17		
1.	The name of the course/module	Recirculation Aquaculture Systems
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional

4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of the use of recirculating aquaculture systems in modern aquaculture practices. Recirculating aquaculture systems potentially provide environmentally sustainable aquaculture practices but must be assessed and viewed within the context of ethical, financial and social components of sustainability
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)

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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #18

1.	The name of the course/module	Ornamental and Aquaria Production
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of animals produced by the ornamental and aquaria section of the aquaculture business. This sector of the aquaculture business has specific issues with relation to establishing sustainable aquaculture practices. In particular, the sustainability and ethical issues with reference to both captive breeding systems and wild caught fish supply will be examined and assessed for different trade sectors.
8.	Prerequisites for studying the	

	course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #19		
1.	The name of the course/module	Larval Rearing
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of the larval production techniques used in the aquaculture business. Larval production is often the rate limited step in development of new aquaculture species and presents particular ethical and sustainability issues with regard to current production techniques.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS

Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	

GENERAL INFORMATION ABOUT THE COURSE #19		
1	The name of the course/module	Larval Rearing
2.	Faculty/department	School of Biology
3.	Status of the educational component	Optional
4.	Semester	To be arranged.
5.	Number of ECTS credits	10
6.	The total number of hours	Weekly contact: Distance Learning : 4 hours of lectures (x 5 weeks) and 3 hours of tutorials (x 3 weeks)
7.	General description and purpose of the educational component	This module provides advanced knowledge of the larval production techniques used in the aquaculture business. Larval production is often the rate limited step in development of new aquaculture species and presents particular ethical and sustainability issues with regard to current production techniques.
8.	Prerequisites for studying the course/module, connection with other educational components	

LEARNING OUTCOMES BY EDUCATIONAL COMPONENT

CONTENT OF THE EDUCATIONAL COMPONENT (TOPICS)	
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TEACHING AND LEARNING METHODS	
Teaching methods (work to be carried out by the teacher during classroom classes, consultations)	Study methods (what types of educational activities should be performed by the student independently)
Classes are taught through a combination of weekly lectures and tutorials and are assessed through a combination of written examinations and coursework.	