INTERNATIONAL SCIENTIFIC-EDUCATIONAL

CENTER OF NAS RA

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INTERNATIONAL SCIENTIFIC
EDUCATIONAL CENTER

Guidebook on Courses in English
/Upon Demand/

ENVIRONMENTAL MONITORING AND MEASUREMENT DEVICES
Module _1_ credit _4_
Fall semester

for

ENVIRONMENTAL PROTECTION AND NATURE MANAGEMENT
Master's Degree Program

INTRODUCTION

1. Course goal is to develop students' knowledge about modern environmental monitoring programs, its significance, control system and methods, familiarize with some field and laboratory devices and develop the ability to assess environmental pollution levels in field and laboratory conditions.

2. Course objectives

a) to develop students' knowledge about:

- environmental monitoring as a necessary system for obtaining reliable information for solution of the most important ecological problems;
- the levels of environmental monitoring, their hierarchy, principles of formation, limitations of the research and observation
- the local and international standards applied in the environmental monitoring system
- main environmental compartments, peculiarities of their monitoring, and basic controlled processes
- statistical treatment of obtained data

b) to develop students' skills and abilities to:

- select the sampling method
- design a sampling plan,
- perform sampling of various environmental compartments,
- perform some in situ measurements,
- choose the relevant analytical method,
- perform statistical analysis of the obtained data,
- perform assessment of environmental contamination.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

1. **Know**

- the levels of environmental monitoring, their hierarchy, principles of formation.
- the local and international standards applied in the environmental monitoring systems
- the peculiarities of monitoring of different environmental compartments, and main controlled processes and pollutants.

- the analytical provision of monitoring of environmental radioactivity, the main analytical methods and equipment used, as well as their limitations.

2. **Be able to**
- design the sampling plan
- choose sampling method
- perform sampling of different environmental compartments
- perform some in situ measurements
- choose the analytical method
- perform statistical treatment of the obtained data
- assess contamination level of environmental compartments

3. **Master**
- skills to plan environmental studies
- skills of sampling of different environmental compartments,
- ability to perform some in situ measurements
- skills of statistical analysis of obtained data,
- implementation of environmental contamination assessment

COURSE CONTENT

Total 120 hours, out of which lecures 24 hours, 2 seminars and 6 practicals, independent work: 88 hours

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

ENVIRONMENTAL RADIATION PROTECTION
Module _1_ credit _4_
Fall semester

for

ENVIRONMENTAL PROTECTION AND NATURE MANAGEMENT
Master's Degree Program

INTRODUCTION

1. Course goal is to develop students' knowledge about natural and artificial radioactivity, application of radioactive materials and environmental consequences of such applications, principals of radiation protection, to familiarize students with the analytical methods and equipment that applied in environmental radiological monitoring, to develop skills of human dose and dose rate estimation

2. Course objectives

a) to develop students' knowledge about:

- structure of the atom and radioactive decay;
- interaction of ionizing radiation with matter and biological objects;
- modern methods and equipment that applied in radiation identification and measurement;
- naturally occurring radioactive material (NORM) and technological enhancement of natural radioactivity (TENR);
- application of technologically enhanced naturally occurring radioactive material (TENORM) in atomic energy, medicine, nuclear weapons;
- environmental consequences of application of TENORM and artificial radionuclides;
- monitoring of environmental radioactivity;
- principals of environmental and human radiation protection;
- international convention and treaties related to radiation protection.

b) to develop students' skills and abilities to:

- use databases and databases of radioactive decay
- select the analytical method for the radionuclide identification and measurement of activity
- perform in situ measurements of the absorbed dose in air
- calculate the specific activity of a radionuclides based on law of radioactive decay
- identify hazardous radioactive sources in order to inform the relevant authorities.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

Know

- law of radioactive decay, basic parameters of radionuclides, types of ionizing radiation and their effects on living matter;
- methods and modern equipment used in measuring of radioactivity;

- naturally occurring radioactivity and the technological processes that lead to the enhancement of naturally occurring radioactivity;
- application of the technologically enhanced naturally occurring radioactive materials and artificial radionuclides as well as on the environmental consequences of such applications;
- organization and implementation of radiological monitoring of the environment;
- environmental radiation protection and safety principals.

Be able to

- use databases and databases of radioactive decay
- use existing databases and datasets in the field of dosimetry
- choose the relevant analytical methods for identification and measurements of alpha, beta and gamma emitting isotopes;
- identify hazardous radioactive sources in order to inform the relevant authorities;
- calculate individual and collective effective doses based on the specific activity of the radioactive source.

Master

- in situ measurement of the absorbed dose rate in air;
- the calculation of specific activity of radionuclides based on law of radioactive decay;
- the calculation of the individual doses and assess dose rate;
- the calculation of individual annual effective dose;
- the calculation of collective annual effective dose;
- the extraction of information from the existing databases and datasets in the field of radiology and dosimetry.

COURSE CONTENT

Total 120 hours, out of which lecures 24 hours, 4 seminars and 4 practicals, independent work: 88 hours

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived it in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

ENVIRONMENTAL GEOCHEMISTRY
Module _1_ credit _4_
Fall semester

for

ENVIRONMENTAL PROTECTION AND NATURE MANAGEMENT

Master's Degree Program

INTRODUCTION

1. Course goal is to acquaint future specialists with the basic features of geochemical processes, phenomena, the main features of geochemical research methods, to provide the necessary theoretical-practical knowledge and skills for the assessment of the types, scales, levels, hazards, risk and pollution pathways of the various environmental Media. It will also enable them to become familiar with measures to reduce the level of environmental pollution.

2. Course objectives are to introduce:

- The methodological bases, approaches, study objects and subject, scientific goal and problems of the "Environmental geochemistry" science.
- Basic geochemical processes, phenomena, conceptual apparatus
- Basic scientific research methods used in environmental geochemistry.
- Geochemical features of urban, mining and agricultural areas
- Possible directions and application in the researches of environmental geochemistry
- Environmental pollution issues, including Worldwide and RA environmental pollution
- The process of geochemical research, involving students in the actual research carried out within the framework of practical work

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

- **know** the basic principles of the science of "Environmental geochemistry", the methodological basis, the peculiarities of the formation of geochemical phenomena and processes. Main areas of geochemical knowledge application.
- **be able to** conduct research, analyze and evaluate the results of other similar research
- **master** research methods of the Environmental geochemistry

COURSE CONTENT

Total __90__hours, out of which lecures _24__hourse, __4__seminars and __4_practicals

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived it in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

RESEARCH LOGIC
Module _1_ credit _3_
Fall semester

for

ENVIRONMENTAL PROTECTION AND NATURE MANAGEMENT

Master's Degree Program

INTRODUCTION

1. Course goal to develop research skills for early researchers, teach future professionals the basics, stages, methods, and logic of conducting scientific research. To develop students' scientific written-oral skills, in particular, writing skills of master's thesis, scientific article and other scientific works, for oral reports.

2. Course objectives

- The general logic of conducting research and stages implementation
- General-scientific research methods
- The necessary information searching and information coordination Methods
- Use of information sources and citation literacy
- competent writing of master's theses and other scientific works
- competent design of oral reports

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

- **know** fundamentals of scientific research, logic, stages and steps
- **be able to** competently formulation of oral and writing results
- **master** research conducting skills, information search tools, literate use of literature, competent formulation of master's thesis

COURSE CONTENT

Total _90_hours, out of which lecures _24__hourse, __4__seminars and _4__practicals

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived it in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,

- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

LANDSCAPE PLANNING
Module _1_ credit _3_
Spring semester

for

ENVIRONMENTAL PROTECTION AND NATURE MANAGEMENT
Master's Degree Program

INTRODUCTION

1. Course goal is to introduce to the main principles of the landscape planning as a core step of the spatial and human activity planning policy and a platform for scientifically justified decision making oriented to the sustainable development.

2. Course objectives

- Introducing the natural complexes, landscape-forming natural and social-economical factors and to the geoecological properties of the modern landscape.
- Introducing the main principles, definitions, methods and steps of the landscape planning.
- Teaching the regional characteristics of the landscape planning based on the studying the experience of several countries (including Armenia) in the context of spatial planning and regional policy.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

- **know** the geoecological characteristics of modern natural complexes (landscapes), the main principles, definitions, methods and steps of the landscape planning.
- **be able** to analyze and systemize the information related to the state, significance and sensitivity of the natural complexes according to the spatial planning norms and requirements.
- **master** the modern approaches of assessing the geoecological state of the modern landscapes.

COURSE CONTENT

Total _32___hours, out of which lecures _24__hourse, _4___seminars and __4_practicals

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived it in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,

- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

ENVIRONMENTAL TOXICOLOGY
Module 1 Credit 4
Fall semester

for
ENVIRONMENTAL PROTECTION AND NATURE MANAGEMENT

Master's Degree Program

INTRODUCTION

1. Course goal is to acquaint students with the main types of toxins, their fate in the environment, as well as the side effects and potential risks for the human organism.

2. Course objectives

- introduce the terminology of the environmental toxicology;
- get acquainted with the classification of toxins, their properties, toxicity levels and the mechanisms of side effects on living organisms;
- introduce the essentials of toxicokinetics and toxicodynamics;
- describe ա discuss the main mechanisms of target organ toxicology;
- get acquainted with the databases for the toxicology of environmental contaminants.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

- **know** the sources and main types of toxic substances, their toxicological properties, as well as the types and levels of side (toxic) effects.
- **be able** to understand the mechanisms of toxic effects of environmental pollutants on living organisms, as well as the dose-response ratio.
- **master** the basic principles of mitigation and prevention of side effects of toxin subtances on the human organism and environment, as well as the use of databases for the toxicology of contaminants.

COURSE CONTENT

Total 120 hours, out of which lecures 32 hourse, 20 seminars and practicals, 68 hours of individual work.

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present (both written and oral forms) what has been perceived, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination (written) and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	***Point***
1. First midterm	0-4
2. Second midterm	0-4
3. Final	0-10
Attendance	***Point***
Attendance and active participation in classes	0-2

SPATIAL DATA INFRASTRUCTURE AND MANAGEMENT
Module _1_ credit _4_

Fall semester

for

ENVIRONMENTAL PROTECTION AND NATURE MANAGEMENT
Master's Degree Program

INTRODUCTION

1. Course goal is to introduce to the geographical Information systems (GIS) and spatial data infrastructures, as main tools of systemizing spatial data and making scientifically justified decisions.

2. Course objectives
   - Introducing GIS technologies and the skills, methods and principals of the geospatial data processing, maintaining, analyzing, and producing.
   - Introducing the main structural components of the spatial data infrastructures, software, global data repositories and the benefits of their application.
   - Introducing geospatial standards, the experience of creating the nationally distributed processing capacities for geospatial data in Armenia as well as the benefits of geospatial data and metadata sharing and exchange.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

- **Know**
  - The role and significance of geospatial information technologies in scientifically justified decision making in relation to the sustainable land-use planning and development.
  - The structure of GIS, the types of data models in GIS, the methods of data analysis, visualization and generation.
  - The role and opportunities of web-GIS for data standardization and sharing.

- **Be able** to analyze and systemize the information related to the state, significance and sensitivity of the natural complexes according to the spatial planning norms and requirements.

- **Master** the modern approaches and methods of processing, analyzing, visualizing and exchanging and sharing the geospatial data.

COURSE CONTENT

Total _32___hours, out of which lecures _24__hourse, _2_seminars and __6_practicals

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived it in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

ENVIRONMENTAL STATISTICS

Module _1_ credit _3_
Spring semester

for

ENVIRONMENTAL PROTECTION AND NATURE MANAGEMENT
Master's Degree Program

INTRODUCTION

1. Course goal is to familiarize students with the methods of environmental statistics for environmental data acquisition, generation, treatment and analysis by statistical software.

2. Course objectives

1. Study the main descriptive statistical parameters
2. Perform a sample design
3. Test the Normality of data
4. To perform different statistical transformations
5. To perform correlation and regression analysis
6. To understand the peculiarities of principal component analysis (PCA) and cluster analysis (CA) and their role in environmental data treatment

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

- **Know**
  - the main descriptive statistical parameters
  - the main statistical transformations
  - the common methods of the study of the relationship between the environmental variables
  - the environmental variables grouping methods
- **Be able to**
  - select appropriate statistical method based on the features of environmental data set
  - perform statistical transformations
  - use different statistical software
  - study the relationship of environmental variables
  - create and interpret different graphs
  - perform PCA and CA
- **Master**
  - the application of statistical methods in environmental monitoring and assessment

- data sets and conduct statistical analysis
- statistical programs

COURSE CONTENT

Total _90_hours, out of which lecures 24_hourse, __8__seminars and __58_practicals

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

FOOD SAFETY RISK ASSESSMENT

Module 1, credit 4

Spring semester

for

ENVIRONMENTAL PROTECTION AND NATURE MANAGEMENT

Master's Degree Program

INTRODUCTION

1. Course goal is to introduce the basics of food safety defense, highlighting modern and internationally accepted food safety standards and principles.

2. Course objectives

) Investigation of the hazards of the food chain, the main sources and negative effects for human health

2) Expertise of the hygiene requirements and indicators of quality and safety for raw materials and processed food

3) Risk analysis concept, food safety management systems and pre-requisite programs

4) Get acquainted with the RA and international approaches of food safety

5) Get acquainted with the approaches and criteria of food safety risk analysis

6) Get acquainted with modern methods of food safety risk assessment

7) Introduce acute and chronic risk assessment methods

8) Familiarize with the exposure assessment and risk characterization procedures

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

1. know the peculiarities of food contamination at different stages of the food supply chain, as well as the potential hazards and risks associated with food consumption.

2. be able to apply food safety standards, distinguish both counterfeit and potentially dangerous food which can pose adverse health effects.

3. master qualitative and quantitative methods of acute and chronic risk assessment.

COURSE CONTENT

Total 120 hours, out of which lecures 32 hourse, 20 seminars and practicals, 68 hours of individual work.

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived it in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

URBAN ECOLOGY
Module 18, credit 4
Spring semester

for

ENVIRONMENTAL PROTECTION AND NATURE MANAGEMENT

Master's Degree Program

INTRODUCTION

1. **Course goal** of this course intended for students is developing a science-based ecological perception, acquiring a comprehensive knowledge in building an environmentally friendly habitat, gaining relevant decision making skills.

2. **Key issues** to be addressed include the status of urban geo-sociosystem and forecasting the ways of its development as a whole, interaction of its compartments, the influence of urban environment on adjacent sites and their ecosystems.

COURSE OBJECTIVES:

- get acquainted with the environmental problems of the cities, as well as the components of urban systems
- study the magnitudes (volumes) of anthropogenic impact on the urban ecosystem և intensity (intensity),
- get acquainted with the measures of quality protection and regulation of water and air systems of cities, as well as land protection;
- master the theoretical and practical foundations of urban environment monitoring and management methods.

EXPECTED LEARNING OUTCOMES

Students as a result of learning subject modules will

- know urban infrastructure components of urban environment
- be able to assess the problems in the cities
- master all the necessary environmental measures that will lead to their effective solution

COURSE CONTENT

Total 120 hours, out of which 24 hours, 8 seminars and practicals, independent work: 88

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived it in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- assessment forms: midterm examination in writing and oral presentation,
- assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes.
- assessment components: (assessment scale – 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10

Attendance	**Point**
Attendance and active participation in classes	0-2

INFORMATION SECURITY
Module __ credit 5
Spring semester

for

INFORMATICS AND COMPUTER ENGINEERING
Master's Degree Program

INTRODUCTION

1. **Course goal**

   Introduce students to modern information protection issues and methods, as well as the important sections of modern information theory, which are widely used in various branches of science.

2. **Course objectives**

   Students will study the problems of electronic information security, get acquainted with modern means of protection and methods, and classify cryptographic systems.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

- **Know** modern cryptographic systems, basic channel models, various defense solutions.
- **Be able to** find the capacity of a simple channel, to model various telecommunication systems, assess the level of protection of the system.
- **Master** to modern means of protection.

COURSE CONTENT

Total __48__hours, out of which lecures _34__hourse, _14__practicals

1. Introduction
2. The model of secret key cryptosystem
3. Classical ciphers (Caesar, simple substitution, Vigenere, Vernam, Playfair, Hill, Transpositions, Hagelin, Enigma)
4. Entropy
5. Perfect secrecy, necessary condition
6. Standards, DES, AES
7. Stream ciphers, Linear feedback shift register

8. Public key cryptography, RSA
9. Identification, authentication, digital signature
10. Cryptographic protocols
11. Information hiding, watermarking, steganography
12. Mathematical model of communication system
13. Mutual information
14. Optimal coding, Huffman algorithm

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived it in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

CLOUD TECHNOLOGIES
Module __ credit 3
Spring semester

for

INFORMATICS AND COMPUTER ENGINEERING
Master's Degree Program

INTRODUCTION

1. Course goal

Cloud computing provides on-demand computer resources (mainly computing and data storage) via computer network and delivers scalable, flexible, and on-demand services to the end-users. We start by introducing the technological transformations towards exascale computing and give an overview of computing paradigms. We will discuss significant concepts in cloud computing and cloud architectures and the concept of Big Data. We also will compare Infrastructure as a Service solution offered by GAFA (Google, Amazon, Facebook, Apple) and will study the virtualization and containers with a more in-depth focus on Docker and KVM. We will discuss some significant data analysis systems, including Apache Hadoop and Spark, using HDFS distributed file system. We will explore the MapReduce programming model using major frameworks and distributions of analytics applications. Students will work with the Cloud infrastructure provided by ASNET-AM research and education network to develop different applications in several programming paradigms.

2. Course objectives

This course plans to give students a unified and fundamental view of Cloud Computing and an in-depth study into its enabling technologies and central building blocks. The hands-on sessions aim to solve virtualization, cloud computing, and data processing problems through projects utilizing existing public and private cloud infrastructures. The students will develop Cloud execution environments by carrying out research projects in this domain.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

- **Know** the fundamental Cloud Computing ideas - its applicability, benefits, current, and future challenges; cloud management techniques and cloud software deployment considerations;

- **Be able** to use cloud computing fundamental concepts to understand the tradeoffs in power, efficiency and cost; analyze various cloud programming models and apply them to solve problems on the cloud; Illustrate the fundamental concepts of cloud infrastructures; cloud storage and demonstrate their use in storage systems such HDFS.

- **Master** essential technologies that enable cloud computing, such as the virtualization and containers, critical concepts of cloud computing services - like Infrastructure as a Service (IaaS), basics of distributed file systems - NoSQL databases, key concepts of programming models – MapReduce.

COURSE CONTENT

Total 32 hours, out of which lecures 16 hours, 2 seminars and 14 practicals

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived it in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

Books:

- Mastering Cloud by Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi. Computing McGraw Hill
- Mastering Hadoop 3: Big data processing at scale to unlock unique business insights by Chanchal Singh, Manish Kumar.

Project Management
Module __ credit 3
Spring semester

for
MARKETING
Master's Degree Program

INTRODUCTION

1. Course goal

Project Management (PM) encompasses managerial challenges in non-repetitive business activities including new product development, market entry, and organization restructurings. The course Project Management aims at delivering managing and implementing knowledge, skills, and competencies in a way that enables accomplishing projects in a efficient and effective way.
During the course management of knowledge areas such as resources, communication, scope, risks, quality and others are studied. Initiating, planning, executing, and closing process groups will be comprise the second part of the course.
The course aims at studying project chart, project management plan, communication, and quality management models in details. Additional cases studies, exercises, and discussions envision strengthening the practical skills of the students in the project management.

2. Course objectives

The main course objective is providing the students with necessary theoretical framework about the PM knowledge areas and process groups as well as practical skills and competencies to launch their own projects. Finally, this course lays a foundation for preparing for a PMP exam.
Participants will have a common understanding of project management terminology and language.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

- **Know**
  - PM knowledge areas resources, communication, scope, risks, quality etc.
  - PM process groups initiating, planning, executing, closing
  - PM software packages used in the field

- **Be able to**
  - Analyze situational tasks and cases on the real examples
  - Examine project charts, WBS, and project plans
  - Review risk, communication, time, and cost models

- **Master**
  - Theoretical framework about the PM knowledge areas
  - Knowledge about PM process groups

COURSE CONTENT

Total 32 hours, out of which lectures 22 hourse, 10 seminars and practicals

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived it in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

DIGITAL MARKETING
Module _ 1_ credit _3_
Spring semester

for

Management, Business Management, Marketing
Master's Degree Program

INTRODUCTION

1. Course goal is to introduce the digital economy, information technologies, modern digital tools for online marketing activities to the graduate student of the International Scientific-Educational Center of the National Academy of Sciences of the Republic of Armenia.

2. Course objectives

- ✓ To study the features of the formation of a modern global information society
- ✓ To get acquainted with the models of the information economy and the distinctive features of the information civilization
- ✓ To open the negative aspects of the global information revolution and information civilization.
- ✓ To explore the challenges of creating new business models.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

1. Know

- ✓ the history of the development of Internet business
- ✓ the quantitative and qualitative characteristics of Internet users
- ✓ the methods of communication between business structures on the Internet
- ✓ the procedures of registration in search engines
- ✓ the types of website optimization,
- ✓ the types of electronic advertising,
- ✓ the methods of working with your own mailing lists,
- ✓ the types of online advertising
- ✓ the methods for evaluating the effectiveness of the online marketing campaign
- ✓ the usage of data science in digital marketing

2. Be able to

- ✓ find the best ways to communicate with consumers
- ✓ use the site as a marketing tool
- ✓ navigate the site in search engines
- ✓ use modern digital tools for organizing advertising campaigns on social networks
- ✓ calculate the main performance criteria
- ✓ use an offline environment to promote digital marketing campaigns

3. Master

- ✓ skills to assess the organization's current advertising campaign methodology
- ✓ skills to optimize the advertising budget of the organization
- ✓ skills to use marketing tools that will increase the number of website visitors
- ✓ ability to increase customer loyalty and brand awareness
- ✓ ability to reduce the marketing costs of the organization
- ✓ skills of knowledge the normative acts of the laws of the RAa, regulating the field of ecommerce and information technologies

COURSE CONTENT

Total 120 hours, out of which lectures 24 hours, 6 seminars and 6 practical sessions, independent work: 88 hours

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived it in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

MARKETING MANAGEMENT

Module 1 Credit 4

Fall semester

for

Business Administration

Master's Degree Program

INTRODUCTION

1. **Course goal** is to provide Master students with systematic knowledge of the essence, significance, toolkit, marketing strategies, basic methods of marketing analysis, and the peculiarities of marketing control. The course gives students the opportunity to conduct marketing research based on theoretical and practical knowledge, to predict possible market developments, to make effective management decisions in the field of marketing management.

2. **Course objectives**

- To Introduce the essence and importance of marketing management, marketing areas and concepts,
- To discuss the main directions of marketing management, the peculiarities of marketing organization in organizations,
- To identify the main sources providing marketing information,
- To develop a clear understanding of the main types of marketing research methods and the specifics of their application,
- To develop a clear understanding of marketing management strategies, key features of toolkit usage,
- To get a clear idea of marketing cost calculation methods and features of marketing control

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

1. Know

- The essence and meaning of marketing management
- Functional responsibilities of marketing professionals
- The model of effective marketing organization

- Peculiarities of conducting marketing research
- Product, price, promotion and placement management.

2. Be able to

- Determine the directions of the company's marketing service with the account of market conditions
- Design the company's marketing management system
- Analyze the results of the company's marketing service
- Evaluate the effectiveness of the company's marketing management
- Develop ways to improve the existing marketing management system

3. Master

- Modern marketing development trends
- The main directions of marketing management
- Functions of the Marketing department and the professional requirements for the staff of the marketing department
- Principles of market segmentation and localization
- Marketing research process and methods
- Marketing decision-making skills.

COURSE CONTENT

Total 120 hours, out of which lectures 20 hours, 12 seminars, independent work: 88 hours

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,

• Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,

• Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

INNOVATION MANAGEMENT
Module _ credit 4
Fall semester

for

Business Administration

Master's Degree Program

INTRODUCTION

1. **Course goal** is to provide and develop the innovation management specifics, skills and systematic knowledge, practical skills in accordance with the international standards, which will contribute to the achievement of a new level of economic prosperity, effective management of innovative business activities. During the course the innovative activities of knowledge, IP policy, IP protection issues, IP evaluation principles, innovative potential, tools, functions and methods, and the related knowledge, practical skills, analytical skills, innovation project management features, innovation protection will be discussed and developed. The specifics of technology transfer, the features of strategic management in innovative enterprises: features of structure, rhythms of steps, risk of chaos and bureaucratic rigor, management improvisations, impacts of innovative activities on the economy and its effective management will be shaped through detailing and interactive discussions. While studying the course, the student should acquire theoretical knowledge, practical skills, independently demonstrate typical behavior of innovative manager.

2. Course objectives

1 . Present and describe: the basic concepts of Innovations, innovation activity and it's management; Intellectual Property Objects (IPO) and market; milestones of international protection of the Intellectual Property; principles of IPO evaluation; sources of innovation, the innovative potential of the unit.

2 . Explain: methods of innovation protection, standards; types of licensing and franchises during technology transfer; features of strategic management of innovative enterprises, features of structure, rhythms of steps, danger of chaos and bureaucratic rigor, improvisations of management; impact of innovative activities on the economy and its effective management

3 . Study and analyze: priorities and perspectives of scientific and technological development; analytical methods and strategies of the Innovative business process; periods, phases and markets of innovations; peculiarities and influencing factors of the innovation project management; peculiarities of organizing, coordinating, supervising, managing and promoting innovative activities; stages of management of innovation under the influence of external and internal factors

4 . Reveal: risks of innovative activities, expertise and effectiveness; special innovation infrastructures, centers and systems; regulation of innovative activities, its main types և forms; basic principles of innovative investments, effects of combining, phased analysis; technology transfer management,

commercialization, information chains and flows, market balance and breach issues; Commercial directions of innovative activity programs.

5 . Implement and apply: project development and protection; technological audit, technological tools and processes, sample multifunctionality and versatility; acquired knowledge and skills through experimental animations; perform animations and stimulations.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

- **Know**
  - Subject of the study, problems and main provisions;
  - What to do when implementing innovations and it's management;
  - System management criterias and their applications to create efficiency and added value.
- **Be able to**
  - Search, select innovation;
  - Recruit a team;
  - Apply innovation commercially and manage;
  - Create efficiency and added value in cases of balanced and breahced markets.
- **Master**
  - Innovation management methods and the specifics of that market;
  - How to be in a leading position and strive to it.

COURSE CONTENT

Total _32___hours, out of which lecures _28__hours, _4___seminars and practicals; Independent, individual and group (team) work 60 hours.

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived (in writen and oral form) , and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in written and oral presentations, individual and team works
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

BASICS OF INTERCULTURAL COMMUNICATION
Module _1_ credit _3_
Fall semester

for

Oriental Studies
Master's Degree Program

INTRODUCTION

1. Course goal

"Basics of Intercultural Communication" is an interdisciplinary course designed for the faculty of "Oriental Studies". This is a combination of theory and application course on intercultural communication. It is designed to help the students understand how to communicate with people who are different from them. This course is designed to lead the students through an examination of own cultural identities and interactions with others. In addition to a look at cultures around the globe, we will examine the interactions of values, beliefs, traditions, identities, contributions and food of non-dominant ethnic groups. Taking a communicative lens, we will address how these cultural indicators manifest through communication and how cultures use communication in different ways. Through this course, I hope to broaden the students' perspectives of life and build their capacity to adapt to a changing world by exploring perceptual differences.

2. Course objectives

This course will address topics ranging from the contested nature of culture and cultural definitions; privilege, power, and oppression in historical and contemporary societies; globalization, transnational conflict, and modern technological influences in intercultural practices; representation of cultures and identities in popular media; and the relationship between language, power, and culture. We will engage these topics through multiple and diverse readings, examples from television and films, research activities, in-class activities and discussions.

- Define major concepts and theories of intercultural communication
- To develop skills to engage in mindful, reflexive, and accountable dialogue through difference
- To identify and understand various benefits and challenges involved in competent and socially just intercultural communication

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

- **Know**

- Have basic understanding of what intercultural communication is, what its role is in a social and business-related context, and the different political and sociological implications thereof.
- Understand key concepts of intercultural communication and identify intercultural communication process

- **Be able to**

- Compare the role of historical, political, and religious factors in creating cultural stereotypes, perceptions, fears, desires, and misunderstandings between groups
- Use concepts and theories of intercultural communication to develop coherent communication strategies and plans, enhance human communication effectiveness
- Explain how culture shapes human perception, communication and conflict styles, behaviors, and ways of thinking
- Become increasingly more culturally aware, sensitive and intelligent.
- Demonstrate effective oral presentation skills
- Demonstrate effective and integrative team work

- **Master**

- Develop a healthy critical attitude towards the way inter and cross-cultural elements can be used to either reinforce social cohesion or create socio-political tensions
- Develop an attitude of open-mindedness and self-critical reflection with a view to self-improvement
- Develop a more open attitude towards inter-cultural team work

COURSE CONTENT

Total 32 hours, out of which lecures 26 hours, 2 interims and 2 practicals, independent work: 2 hours

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived in writing and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,

- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

VIROLOGY
Module _11_ credit _4_
Fall semester

for
MOLLECULAR AND CELLULAR BIOLOGY
Master's Degree Program

INTRODUCTION

1. Course goal

The goal of this course is to teach basics of virology representing contemporary issues of virology, to prepare students for the scientific research and to develop critical reasoning and reading of scientific papers in virology. It will give students theoretical and practical knowledge in the field of virology. In this course journal club meetings will be organized, where scientific papers will be discussed.

2. Course objectives

The lectures will illustrate classification of viruses, features of viral life cycle, antiviral response, antiviral drug discovery, vaccine technology, brief introduction to some DNA and RNA viruses. The objective of this course is to deliver theoretical and practical lectures on virology. Scientific papers will be discussed during journal clubs.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

1. Know
   - Challenges of contemporary virology, diversity of viruses, Molecular and cellular mechanisms of viral infection, methods of prevention and treatment of viral diseases, molecular mechanisms of action of antiviral drugs. Basics of work with viruses and cell cultures
2. Be able to
   - obtain skills of reading and analyzing scientific papers and scientific data. Students will be able to address scientific hypotheses and suggest ways of their solution. The introduction to antiviral research will be presented during laboratory classes.
3. Master
   - Basic methods of modern virology

COURSE CONTENT

Total __90__hours, out of which lecures _28_hourse, __4__seminars and _4__practicals

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived in written and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

BIOETHICS
Module 15 credit 4
Fall semester

for
MOLLECULAR AND CELLULAR BIOLOGY
Master's Degree Program

INTRODUCTION

1. Course goal: to familiarize students with the bases of bioethics; to teach students to apply the theoretical and practical knowledge gained as part of the course in order to identify and analyze the ethical and legal aspects of the impact introduction of modern achievements of biomedicine and biotechnology has had in various dimensions of human activity.

2. Course objectives :
➢ Mastering the principles, rules, and methods of bioethics, as well as their use in practice aimed at the analysis of specific situations.
➢ Learning about the ethical and legal aspects of the key bioethical problems, including, but not limited to: biomedical research that implies direct participation of humans or animals, gene technologies and cloning, new reproductive technologies and stem cells, organ transplantation, euthanasia, environmental safety, social justice in health care, and a few others.
➢ Studying the key state and international documents in the field of bioethics.
➢ Acquiring the skills of bioethical analysis which have been developed by solving specific situational tasks in practical classes and through homework.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

1. Know
- principles, rules and methods of bioethics;
- ethical and legal aspects of the major bioethical problems;
- essential national and international documents in the area of bioethics
- rights and obligations of a doctor in a new contractual model of doctor-patient relationship
- the basics of good clinical practice

2. Be able to
- apply the acquired knowledge in order to conduct bioethical analysis in specific situations;
- apply and exercise the provisions of good clinical practice, including drawing up the necessary documentation to acquire the approval of a scientific or clinical study from the relevant bioethics committee.

3. Master

- the skills for bioethical analysis, developed by solving specific situational problems based on knowledge of the basics of bioethics.

COURSE CONTENT

Total 120 hours, out of which lectures 42 hours, 6 seminars and 72 practicals

ASSESSMENT CRITERIA AT THE END OF COURSE

The Assessment has been based on the knowledge of the core content of the course, the ability to present what has been perceived in written or oral form, as well as the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: mid-term examination (in writing) and oral presentations,
- Assessment procedures: the aggregate of th two midterm examinations, final examination, and the attendance of and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First mid-term	0-4
2. Second mid-term	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

CELL AND TISSUE
BIOENGINEERING
Module _6_ credit _5_
Fall semester

for
Molecular and Cellular Biology
Master's Degree Program

INTRODUCTION

1. Course goal is to introduce theoretical basics, developmental methods and up-to-date strategies, and novel, low cost implicational approaches of Bioengineering, which may enhance the students' professional skills in Molecular and Cellular Biology and permit them to resolve social-economic issues related to ecology, agriculture and public health.

2. Course objectives are:

2.1. the provision of the knowledge on the composition of biological systems in the frame of the both molecular and cellular systems biology, and the level of organisms ;
2.2. the reinforcement and systematization of previously acquired knowledge on "Genetic Engineering" as an underpinning module of the Bioengineering landscape;
2.3. the introduction of theoretical basis, developmental methods and contemporary strategies, as well as practical applications of cell and tissue engineering ;
2.4. the provision of the risk factors, ethical, legal and social issues of the Bioengineering tools and applications;
2.5. the introduction to the strategic approaches for development of Bioengineering tools and technologies aiming to foster students' knowledge and ability to resolve social-economic issues related to ecology, agriculture and public health.

EXPECTED LEARNING OUTCOMES
As a result of learning course modules, the students will:

1. **Know :**
   - ❖ the theoretical basics, methods and applications of the gene, cell and tissue of Bioengineering;

- ❖ the methodology and strategies of the development and application of biotechnologies;
- ❖ contemporary molecular-genetic and nano-technological approaches applied in diagnosis and treatment of a number of diseases;
- ❖ the risk factors, ethical, social and legal issues and norms of the Bioengineering tools and applications.

2. Be able to:

- ❖ develop and apply novel and low-cost Bioengineering tools in exploration and elucidation of the biomedical tasks (in the laboratories with an appropriate infrastructure)

3. Master

- ❖ technologies and approaches to transform the genetic material ;
- ❖ tools to develop proteins, cells and organisms with beneficial new properties;
- ❖ applications for the growth of the cells and cell cultures, as well as assessment and transformation of their qualitative and quantitative properties;
- ❖ technologies for the production of monoclonal antibodies;
- ❖ technologies for the development of virus -vaccines and applications for virus-mediated gene-therapy;
- ❖ technologies for the development of bioactive compositions.

COURSE CONTENT

Total __150__hours, out of which lecures _56__hourse, __8__seminars and _86_ practicals

TOPIC 1: *Introduction (4 hours)*

TOPIC 2: *Cloning as an Important Tool in Bioengineering (4 hours)*

TOPIC 3: *Therapeutic Cloning (4 hours)*

TOPIC 4: *Transgenesis (4 hours)*

TOPIC 5: *Plant Tissue Cloning and Cell Cultures in Bioengineering, (4 hours)*

TOPIC 6: *Technologies for Generation of Genetically Modified Plants (4 hours)*

TOPIC 7: *Protoplasts (4 hours)*

TOPIC 8: *Animal Somatic Cell Hybridization and Cell Hybrids (4 hours)*

TOPIC 9: *Hybridomas, Production and Application of Monoclonal Antibodies (4 hours)*

TOPIC 10: *Insect Cell Culture Applications in Bioengineering (4 hours)*

TOPIC 11: *Transposon-mediated Genomic Manipulations (4 hours)*

TOPIC 12: *Animal Tissue Culture Applications in Bioengineered Reproduction of Viruses and Production of Vaccines (4hours)*

TOPIC 13: *Collection and Preservation of Biological Composites (4 hours)*

TOPIC 14: *Biomedical Applications of Composites (4 hours)*

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived in written and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

CELL BIOLOGY
Module 2 credit 6
Fall semester

for

MOLLECULAR AND CELLULAR BIOLOGY
Master's Degree Program

INTRODUCTION

1. Course goal - The basic goal of this course is for the student to gain an understanding of how cells operate, communicate, and control their activities, as well as to develop practical skills for conducting research in this field.
2. Course objectives - The objectives of this course is to impart the up-to-date knowledge on basic and applied cell biology to students from genetic, biochemical, physiological and pathophysiological perspectives. The program will introduce students to the dynamic interactions of cellular and non-cellular structural components that ensure cell growth, differentiation, viability, bioactivity and death.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

1. Know
   - molecular mechanisms and regulation of cell division, growth, differentiation, cell-cell interactions, cell migration and invasion, cellular and molecular mechanisms involved in the pathophysiology of diseases
2. Be able to
   - carry out various researches on cell models, creatively apply the knowledge to solve theoretical and practical problems.

3. Master
   - theoretical research work, as well as practical and professional skills in academic and clinical fields.

COURSE CONTENT

Total 180 hours, out of which lecures 32 hourse, 4 seminars and 28 practicals

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived it in written and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

CELL CULTURE TECHNOLOGIES
Module 8 credit
Fall semester

for
Molecular and Cellular Biology
Master's Degree Program

INTRODUCTION

1. Course goal - The basic goal of this course is to provide the student with knowledge and understanding of the principles of cell culture techniques and their application in scientific and industrial fields.
2. Course objectives - The objectives of this course is to introduce the main cell culture techniques, features of cell cultures, fields of application of cell cultures, as well as common methods used to investigate biological, genetic, physiological and pathological aspects of living organisms based on cell culture test-models. Special attention will be paid to the use of cell cultures in medicine, pharmacy, environmental monitoring and various fields of industry.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

1. **Know**
   - the sources of normal and cancer cells, cell culture conditions, state-of-the-art cell culture techniques and test-systems used in different scientific and industrial fields
2. **Be able to**
   - carry out various researches on cell culture models, creatively apply the knowledge to solve theoretical and practical problems.
3. **Master**
   - the theoretical and practical approaches and methods related to the given field.

COURSE CONTENT

Total 150 hours, out of which lecures 24 hourse, 4 seminars and 20 practicals

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived in written and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,

- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

MOLECULAR AND CELLULAR IMMUNOLOGY
Module _10_ credit _3_
Fall semester

for
Molecular and Cellular Biology
Master's Degree Program

INTRODUCTION

Course goal

The goal of the course is to educate students in fundamental and clinical immunology, preparing them to contribute to immunological research with a full awareness of the potential impact of immunology. The program combines an education in basic and molecular immunology, training in immunology, and exposure to the immunological and non-immunological problems of certain diseases.

Course objectives

- to provide an excellent knowledge base for graduate students in immunology and related fields.
- to describe how the immune system is able to discriminate self vs. non-self.
- to develop the skills necessary for the critical analysis of contemporary literature on topics related to immunology.
- to provide the knowledge in modern immunological methods and applications.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

1. **Know**
   - How the innate and adaptive immune responses coordinate to fight invading pathogens.
   - What are the cellular and molecular basis of immune responsiveness.
   - General functions of the immune system (immunological recognition, containment, immune regulation, immunological memory).
   - The roles of the immune system in both maintaining health and contributing to disease.

2. **Be able to**
   - Demonstrate advanced knowledge in the fields of molecular immunology.
   - Demonstrate independent critical and analytical thinking within immunology field.
   - Transfer knowledge of immunology into clinical decision-making through case studies presented in class.
   - Communicate with appropriate level of oral, written and visual that have been acquired during the course

3. Master

- Fundamental aspects of immunology

- Critical thinking on suggested topics in immunology and medicine

COURSE CONTENT

Total 90 hours, out of which lecures 28 hourse, 2 seminars and 2 practicals

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived in written and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

RESEARCH METHODS IN MOLECULAR BIOLOGY
Module 9 credit 5
Spring semester

for
Molecular and Cellular Biology
Master's Degree Program

INTRODUCTION

This course provides an introduction to the practical and theoretical basis of key experimental techniques that are used in molecular biology. Modern techniques such as bioinformatics, DNA microarrays and proteomics are covered. The lectures provide theoretical information, with accompanying tutorials. The practicals allow students to obtain diverse laboratory skills, and to observe in practice selected topics from the lectures. The students will be trained to, in part, independently design and plan molecular biology experiments. The students will be trained to find relevant articles from the primary literature and to critically evaluate published information. Seminars and reports will allow students to practice language and presentation skills.

1. Course goal is to train specialists who have a deep theoretical basis and know the basic modern experimental methods used in molecular biology research.

2. Course objectives are to acquaint students with the principles and approaches applied in various fields of molecular biology.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

1. **Know**
   - minimum vocabulary required for working with information in the field of oral-written professional communication և molecular biology;
   - the place and role of methods of molecular biology of the physical-chemical bases of living systems in modern research;
   - features of organization of biological substances, principles of reproduction and development of living systems;
   - modern concepts of the mechanisms of hereditary information storage, reproduction and transmission of different groups of pro- and eukaryotic organisms;
   - peculiarities of the organization of genes and genomes in different taxonomic groups (bacteria, yeasts, plants, animals);
   - prospects for the use of modern methods of molecular biology in biomedicine;
   - security issues in research in molecular biology.

2. **Be able to**
   - use effectively of theoretical and practical knowledge of molecular biology methods in scientific research;

- design and conduct experiments for genotyping in patients and healthy groups;
- analyze, coordinate and generalize research results using molecular biology methods and literature data.

3. Master

- in the selection of methods needed for research in molecular biology;
- in the planning, formulation and analysis of results of experiments using knowledge of molecular biology methods;
- using the scientific research and information sources (scientific literature, databases, software packages, etc.) required for research.

COURSE CONTENT

Total __150__ hours, out of which lecures __24__ hours, __8__ seminars and __16__ practicals.

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived in written and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,
- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

MOLECULAR MEDICINE
Module _3_ credit _3_
Spring semester

for
Molecular and Cellular Biology
Master's Degree Program

INTRODUCTION

Course goal is to introduce scientific basics of contemporary Molecular Medicine, up-to-date molecular-genetic and nano-technological approaches applied in diagnosis, therapeutics and prevention of a number of diseases.

Course objectives are:

- reinforcement and systematization of previously acquired knowledge on human genome, details of composition, structure and function of DNA, RNA, protein molecules and cell, and related functional processes;
- introduction and discussion of the role of genetic load in the molecular pathomechanisms of susceptibility of polygenic disorders in the frame of gene-environment interaction;
- elucidation of molecular and clinical aspects of infectious diseases, molecular mechanisms of human immune response against a number of microorganisms and current molecular-genetic approaches applied for diagnosis, treatment and prevention of infections;
- provision of the basics of molecular processes during human development and aging, as well as with aberrant molecular mechanisms in the pathophysiology of cancer and other diseases;
- introduction to the personalized medicine, contemporary molecular-genetic and nano-technological approaches applied in diagnosis and treatment of a number of diseases, as well as related ethical, legal and social issues.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

Know :

- basics of Molecular Medicine;
- molecular mechanisms of etiology and pathogenesis of a number of diseases;
- contemporary molecular-genetic and nano-technological approaches applied in diagnosis and treatment of a number of diseases;
- strategies of development, validation and utilization of novel molecular-genetic and nano-technological approaches for human health service;
- ethical, social and legal issues and norms in Molecular Medicine.

Be able to:

- ❖ use online resources and databases related to Molecular Medicine;
- ❖ investigate molecular mechanisms underlying the generation and development of diverse human diseases;
- ❖ develop new molecular approaches for a diagnosis and/or treatment of diseases.

Master

- ❖ theoretical basics of Molecular Medicine;
- ❖ a number of up-to-date molecular-genetic approaches on diagnosis, therapeutics and prevention of diseases.

COURSE CONTENT

Total __90__hours, out of which lecures _28__hourse, __4__seminars and _58_ practicals

TOPIC 1: *Introduction (2 hours)*

- *A synopsis of the course of Molecular Medicine*
- *Multi-disciplinary scientific trends underlying the up-to-date Molecular Medicine*
- *Molecular Medicine as a key scientific research field; Application areas of Molecular Medicine*
- *The progress and perspectives in Molecular Medicine*

TOPIC 2: *The Cell and a Role of Molecules in the Cellular Processes (2 hours)*

TOPIC 3: *Cell Signaling Pathways (2 hours)*

TOPIC 4: *Genetics and Molecular Pathways of the Development and the Aging (2 hours)*

TOPIC 5: *Molecular Oncology – Parts 1 and 2 (4 hours)*

TOPIC 6: *Human Genetics (2 hours)*

TOPIC 7: *Molecular and Cellular Immunology (2 hours)*

TOPIC 8: *Molecular and Clinical Aspects of Infections (2 hours)*

TOPIC 9: *Molecular Mechanisms of Human Diseases – Parts 1 and 2 (4 hours)*

TOPIC 10: *Current Molecular Approaches for Diagnosis and Treatment of Human Diseases (2 hours)*

TOPIC 11: *Nano-medicine and Medical Chemistry – Parts 1 and 2 (4 hours)*

TOPIC of Seminar #1: *The "Pathway Signal Flow" algorithm, its novelty and applications (2 hours)*

TOPIC of Seminar #2: *Action Molecular Mechanisms of COVID-19 Infection and Its Preventive Vaccines, Undergoing Stage III Clinical Trial (2 hours).*

ASSESSMENT CRITERIA AT THE END OF COURSE

Assessment is based on the knowledge of the core content of the course, the ability to present what has been perceived in written and oral form, and the demonstration of the ability to acquire additional knowledge independently.

- Assessment forms: midterm examination in writing and oral presentations,

- Assessment procedures: the aggregate of two midterm examinations, final examination and the component of attendance and active participation in classes,
- Assessment components: (assessment scale - 0.5)

Examination type	**Point**
1. First midterm	0-4
2. Second midterm	0-4
3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2

PROTEIN ENGINEERING
Module 7 credit 4
Fall semester

for

Molecular and Cellular Biology
Master's Degree Program

INTRODUCTION

1. Course goal

The main goal of this course is to introduce the modern methods of protein structure and function study, the basics of genetic material transformation mechanisms on molecular and cellular levels, the methods of genetic material modifications, the methods of introducing directed changes in the amino acid sequences of protein molecules and the methods of construction of transgenic organisms with the required properties to the future researchers. As a scientific discipline, Protein Engineering is a new direction in molecular enzymology and biotechnology, as it was founded in the end of 20th century. The establishment of Protein Engineering is directly related to the development of such science and technology spheres as genetic engineering, X-ray structural analysis, methods of organic synthesis, as well as abrupt progress of electronic computing. The course reviews the modern approaches of protein molecules biochemistry, such processes as protein folding, protein permeability through biological membranes, natural chemical modifications of proteins, etc. The program demonstrates the generality of many experimental and theoretical methods. The main objective of the program is to expand the scientific-methodological mindset of future researchers.

2. Course objectives

- to describe peptides and proteins according to their structure and properties as a separated group of biological compounds,
- to learn and study the types of protein-protein interaction and the factors effecting them,
- to learn the history of the establishment of protein engineering as a separate discipline,
- to learn the basic principles, methodological approaches of protein engineering and its applications in various fields,
- to introduce the peculiarities of the methods applied in protein engineering.

EXPECTED LEARNING OUTCOMES

As a result of learning course modules, the students will:

Know

- the basics of protein engineering – structure-functional features, types of protein-protein interaction;
- principles of protein engineering;
- methods of protein engineering;
- applications of protein engineering.

Be able to

- introduce the protein engineering methods and possibilities of their application;
- select which method of protein engineering to use to produce proteins with the required properties.

Master

- the basic concepts and knowledges of protein engineering;
- the methods applied in protein engineering.

COURSE CONTENT

Total 120 hours, out of which lecures 36 hours, 12 seminars and 72 practicals.

The program is largely interdisciplinary. As a fundamental discipline, protein engineering is crucial to the advancement of biotechnology. Protein engineering studies theoretical basics and methods of application of genetic material, which has a huge practical significance as it allows the construction of recombinant DNA molecules and genetically modified organisms improving strain-producers and creating new unique technologies of production of valuable products.

The program is based on the knowledge in the field of bioorganic chemistry, physical biochemistry, metabolic biochemistry, genetic engineering, microbiology, applied molecular biology, biotechnology, experimental methods of biophysics, which the students obtained in the previous stages of the educational process.

The program is planned to be implemented through lectures, but during the program it is also planned to conduct seminars, interactive auditing courses, independent works and independent creative works referred to special tasks, preparation of speeches from several literature sources, exams. During the program, students' knowledge will be tested through tests, interviews, essays, term papers, exams.

The program consists of separate sections including: Introduction; History of the establishment of protein engineering; The main functions of proteins; Structure and functions of protein molecules; *In vitro* construction of proteins; Rational design and redesign of protein molecules; Directed evolution of proteins; Biochemistry of protein molecules; *In vivo* construction of proteins; Advances in protein engineering; Application of protein engineering to search for polypeptides that meet modern biotechnology demands.

Topic 1

General description of protein engineering

Introduction to protein engineering. Basics of protein engineering. Basic definitions. History of origin and development. Dynamics of development of protein engineering. Development of protein engineering in the world market. The main groups of proteins.

Topic 2

Structure-functional properties of proteins, peptides

Amino acid composition of proteins, abbreviations. Structural levels of proteins – primary, secondary, tertiary and quaternary structures. Mechanisms of protein spatial structure formation. Self-organization of macromolecular complexes. Structure-functional properties of peptides. Peptide formation features. Types of peptides.

Topic 3

Types of protein-protein interaction

Types of protein-protein interaction *in vivo* and *in vitro*. Formation of homo- and heterologous oligomers. Two-hybrid analysis /screening/, versions of two-hybrid systems, advantages and disadvantages of the method.

Topic 4

Structure-functional properties of enzymes

Description of enzymes. Structure-functional properties of enzymes. Location of enzymes inside the cell. Catalytic properties of enzymes. Functional parts **of enzymes. Classification of enzymes. The main types of enzymes. Significance of enzymes in biological processes, economy and industry.**

Topic 5

Principles of protein engineering

Properties of the underlying proteins in protein engineering. Protein activity as a main problem in protein engineering. Increasing the thermostability of proteins as the most common direction in protein engineering. Achievements in solvent stability of proteins. The role of organic solvents in protein engineering. The role of substrate specificity in protein engineering.

Topic 6

Cycles of protein engineering

Peculiarities of the stages of protein engineering. The interconnectedness of the stages of protein engineering. Selection of the appropriate gene encoding the required enzyme. Selection of appropriate methods of protein engineering and mutagenesis. Selection of the best variant with the required properties from the received versions.

Topic 7

Methods of protein engineering. Rational design

The substance of rational design. Main description. Stages of rational design. Crystallizaion of proteins. Modeling of proteins. Mutagenesis of proteins. The cycle of rational design.

Topic 8

Methods of protein rational design

Selection of spatial structure of proteins. Combination of reverse design of proteins. Design of protein globule surface. Chemical modification of mutant proteins obtained by directed mutagenesis. Protein

surface engineering. Application of semi-synthetic polypeptides. Ligation of synthesized proteins. Ligation of proteins using proteolytic enzymes.

Topic 9

Methods of protein engineering. Directed evolution of proteins

The substance of protein directed evolution. Main description. Stages of protein directed evolution. Differences and similarities between natural and directed evolution. The cycle of directed evolution. Application of mutagenesis, selection and recombination in directed evolution.

Topic 10

Methods of protein directed evolution

Combined clonotes of nucleic acid sequences. Insertion of random mutations. Cassette mutagenesis. Alanine scan. Chemical mutagenesis. Error DNA synthesis. Gene screening and selection of genes with the required properties. Random screening. Simplified screening. Search and selection. Phage imaging.

Topic 11

Methods of protein engineering. Directed mutagenesis

The substance of directed or site-specific mutagenesis. Basic principles. Stages of directed mutagenesis. Application of mutant oligonucleotides.

Topic 12

Other methods of protein engineering

Peptidomimetics. *In-vitro* systems of protein evolution. MolCraft. DNA rearrangement. Fluorescent Activated Cell Sorting (FACS) cell surface libraries. Flow cytometry. Cell-free translation systems. Green fluorescent protein. Designed inadequate evolution. Peptide systems responsible for induction. Receptor-based QSAR methods. Mechanical engineering of elastomeric proteins. Protein and catalytic mixing. Engineering of extracellular matrix variants. Studdinger League. Computer methods. *De novo* engineering of enzymes.

Topic 13

Applications of protein engineering

Significance of protein engineering application. Necessity of protein engineering application in the 21st century. Fields of application of protein engineering. Application of protein engineering in food and detergent industry. Application of protein engineering in the environment. Application of protein engineering in medicine. Application of protein engineering in the production of biopolymers. Application of protein engineering in nanotechnology. Application of protein engineering with different redox proteins and enzymes. Other new applications of protein engineering.

ASSESSMENT CRITERIA AT THE END OF COURSE

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3. Final examination	0-10
Attendance	**Point**
Attendance and active participation in classes	0-2