Department “Georgaphy, Ecology and Environmental protection”

MASTER’S DEGREE PROGRAMME

„INFORMATION TECHNOLOGIES IN ECOLOGY”

FIELD OF HIGHER EDUCATION:	4. NATURAL SCIENCES, MATHEMATICS AND INFORMATICS
PROFESSIONAL AREA:	4.4 EARTH SCIENCES
EDUCATION AND QUALIFICATION DEGREE:	MASTER’S DEGREE
PROFESSIONAL QUALIFICATION:	MASTER IN INFORMATION TECHNOLOGIES IN ECOLOGY
PERIOD OF EDUCATION:	1 YEAR (2 SEMESTERS)
FORM OF EDUCATION:	FULL-TIME

GENERAL OVERVIEW OF THE MASTER'S PROGRAM

The qualification characteristics, curriculum and study programs of the Master's program "Information Technologies in Ecology" are in accordance with the Higher Education Act, the Regulation on the State Requirements for Acquiring Higher Education for the Educational and Qualification Degrees "Bachelor", "Master" and "Specialist", approved by Council of Ministers Decree 162 of 23.07.2002 (SG, No. 76/2002) and the University Regulations. The Master's program lasts one academic year with a total of 1800 hours (510 hours of classroom work and 1290 hours of extracurricular work), which corresponds to 60 ECTS credits in accordance with state requirements (Art. 44 a of the Law on Amendments and Supplements to the Higher Education Act - State Gazette, issue 48/04.06.2004 and Ordinance No. 21 of 30.09.2004 on the Implementation of a Credit Accumulation and Transfer System in Higher Education Institutions - State Gazette, issue 89 /12.10.2004). The compulsory academic courses are in the amount of 990 hours of total work (33 credits). They are related to the acquisition of specialized and general knowledge, skills and professional competencies in the field of databases, expert systems, applied statistics for processing the flow of information in the field of ecology, protection and management of natural biosystems and the environment, as well as the use of remote methods for environmental monitoring, neural networks, mathematical methods, etc. for modeling processes and phenomena, for research, forecasting and management of natural environmental components and systems. Elective courses are 360 hours (12 credits) and are related to specific areas of applied ecology, modeling, environmental standards for assessing the impact and management of natural resources and the functioning of ecosystems. They enrich and develop the students’ competencies for the practical application of their knowledge. Elective courses provide an opportunity to obtain additional knowledge in various scientific fields.

APPLICATION REQUIREMENTS

The Master's degree program Information Technologies in Ecology is designed for students who have completed the Bachelor's and/or Master's degree programs in majors from the professional field 4.4. Earth Sciences and professional field 4.3. Biological Sciences such as "Ecology", "Ecology and

Environmental Protection", "Biology", "Biology and Chemistry", "Geography and Biology", "Ecochemistry", etc.

MASTER'S PROGRAM OBJECTIVES

The main objective of the Master's program is to prepare specialists who can successfully apply information technologies in ecology and environmental protection, to deepen and expand already acquired fundamental knowledge and to build new specific knowledge and skills for ecological modeling and programming of natural and anthropogenic processes and forecasting of dynamics and risk for natural components and human society. Skills are acquired in the conservation, prognostication and management of natural resources for the development of various types of models and applications in the field of natural sciences and humanities and for the development and implementation of relevant projects financed under various EU programs.

ACQUIRED PROFESSIONAL KNOWLEDGE, SKILLS AND COMPETENCES

In accordance with Art. 9, paragraph 2 of the Regulation on the State Requirements for Acquiring Higher Education at the Higher Education Institutions - Bachelor, Master and Specialist /SG No. 76 of 6.08.2002/, training in the Master's program provides:

1. In-depth scientific-theoretical and specialized training;
2. Mastering the basics of scientific research and applied science;
3. Conditions for educational mobility of students, including international comparability of the knowledge obtained and the skills acquired;
4. Development of abilities for adaptation in the conditions of social, economic and technological changes.

The Master's program provides an opportunity to form knowledge and skills for:

1. Application of information technologies in ecology and environmental protection;
2. Remote methods for environmental monitoring;
3. Ecological modeling and programming of natural and anthropogenic processes and forecasting of dynamics and risk for environmental components and human society;
4. Conservation, prognostics and management of natural resources; development of various types of models and applications in the field of natural and human sciences and development and implementation of relevant projects financed under various EU programs.

The Master's program provides an opportunity to form personal and professional competencies:

1. Independence and responsibility - ability for administrative management; responsibility in making decisions in complex conditions; creativity and initiative in management activities;
2. For learning - self-assessment of one's own qualifications, through assessment of the knowledge and skills acquired to date and expansion and updating of one's professional qualifications;
3. Communicative and social - formulates and presents ideas, problems and solutions clearly and understandably; expresses attitude and understanding on issues, using methods based on qualitative and quantitative descriptions and assessments; demonstrates a broad personal worldview and shows understanding and solidarity with others;
4. Professional – collects, classifies, evaluates and interprets data from the field in order to solve specific tasks; applies acquired knowledge and skills in new or unfamiliar conditions; demonstrates the ability to analyze in a broader or interdisciplinary context; forms and expresses one's own opinion on problems of a social and ethical nature.

PROFESSIONAL REALIZATION

Graduates of the Master's program "Information Technologies in Ecology" will find their fulfillment as ecologists, experts, specialists, consultants, advisors, auditors, analysts, researchers in

ecology and environmental protection, associates in the management of European projects and programs, researchers, teachers, assistants in research institutes and higher education institutions in our country and abroad; in state and municipal government and administration - the Ministry of Environment and Water and its divisions, the Executive Agency for the Environment, the Directorates of National Parks, the Basin Directorates, the Ministry of Agriculture and Forestry, municipalities; in the non-governmental sector; in design organizations, as well as in all other departments and institutes that are related to environmental research and management.

CURRICULUM

MASTER'S DEGREE PROGRAMME

„INFORMATION TECHNOLOGIES IN ECOLOGY"

First year			
First semester	ECTS credits	Second semester	ECTS credits
Compulsory Courses		***Compulsory Courses***	
Neural Networks	5	Databases	6
Expert Systems	5	Web-ystems and Technologies	4
Mathematical Models in Ecology and Environmental Protection	4	Remote Sensing Methods for Environmental Monitoring	5
Applied Statistics	4		
Optional Course 1 (from group I)	4	Preparation and defense of a graduation thesis	15
Optional Course 2 (from group I)	4		
Optional Course 1 (from group II)	4		
Optional Courses group I		***Optional Courses group II***	
(students choose two courses)		(students choose one course)	
Contemporary Technologies and Environmental Protection		Ecotoxicology	
Introduction to Information Systems and Technologies		Environmental Management	
Environmental Requirements and Standards		Functional Biocoenology	
Computer Cartography and Geographic Information Systems			
Ecosystem Services			
	Total 30		Total 30

TOTAL FOR 1 ACADEMIC YEAR: 60 CREDITS

COURSE DESCRIPTION

NEURAL NETWORKS

ECTS credits: 5 **Hours per week:** 2l+2pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: I
Methodological guidance: Department of Geography, Ecology and Environmental Protection Faculty of Mathematics and Natural Sciences
Lecturer: Assoc. Prof. Radoslav Mavrevski, PhD, Department of Informatics

Annotation: The aim of the course is for students to acquire basic theoretical knowledge and practical skills for working with neural networks. The course will provide them with an understanding of the basic concepts, such as types of neural networks, activation functions, learning, and optimization algorithms. In addition to the theoretical part, students will have the opportunity to work with simulators for building, training, and evaluating various neural network models, which will allow them to apply these technologies to solve real problems in the field of machine learning and artificial intelligence. The main task is for students to learn to design and train a neural network. The expected results are that students, after becoming familiar with the basic theory of neural networks, will be able to implement, simulate, and use them in software.

Course content: The course will present the main types of networks, such as simple perceptrons, Hopfield networksa and and Kohonen networks. The main methods for training a neural network will be explained in detail. Examples will illustrate the application of neural networks in various fields such as ecology, natural resource management, etc. The course will use modern software packages for designing neural networks, such as Matlab.

Technology of education and grading: The lectures are richly illustrated with graphical materials, presented through presentations and a multimedia projector. The practical exercises are conducted in the department's laboratory, equipped with the necessary computers and specialized software. The assessment of students includes ongoing evaluation, which covers practical tasks from the exercises, written tests, and a course project, contributing 70% to the final grade. The semester exam, which consists of developing theoretical questions from the syllabus or a test, constitutes 30% of the final grade.

EXPERT SYSTEMS

ECTS credits: 5 **Hours per week:** 2l+1pe2
Form of assessment: on-going control and exam **Examination type:** written
Semester: I
Methodological guidance: Department of Geography, Ecology and Environmental Protection Faculty of Mathematics and Natural Sciences
Lecturer: Assoc. Prof. Irena Atanasova, PhD, Department of Informatics

Annotation: The course aims to provide new knowledge related to the methods of modeling and presenting knowledge and creating expert systems, with an emphasis on the preparation of a final finished product including all necessary applications to it.

The main task is for the student to acquire knowledge on the application of different approaches in the implementation of a finished product in the field of knowledge modeling and in particular the design and creation of expert systems.

The expected results of the course as a whole and of each practical topic separately are: mastery by students of modern general concepts in the preparation of a finished final application; good practical preparation in the design and implementation of expert systems.

The goals and objectives of each topic separately are evident from the content of the curriculum itself, with the expected results for each topic being the accumulation of important knowledge and skills directly related to the various methods for solving and implementing tasks related to the preparation and layout of the final finished software product.

Course content: The Expert Systems course aims to introduce students to the basic theoretical and practical knowledge of the structure, characteristics and tools for developing expert systems. For a better understanding of the presentation, preliminary preparation in the basics of computer science, mathematical logic and programming languages is necessary.

The content is structured in a way to clarify the basic concepts and characteristics of artificial intelligence systems; the main methods for representing and using knowledge; the architecture and classification of expert systems; examples of successfully working expert systems and tools and environments that can be used to create them; the technology for creating expert systems; methods for representing uncertainty, for plausible inference and machine learning in expert systems. The presentation is supported by numerous examples that can serve as models for solving practical problems.

Technology of education and grading: The teaching and technical means are a multimedia projector and a computer. The assessment process is as follows: The current control (CC) is formed by two control works (conducted during the laboratory exercises) and two current tests (during the lectures). TC is the arithmetic mean of these four grades. The exam grade (EG) is obtained during the exam (one question from the syllabus). The final grade (FG) is calculated according to the following formula:

FG=0,75.CC+0,25. EG.

MATHEMATICAL MODELS IN ECOLOGY AND ENVIRONMENTAL PROTECTION

ECTS credits: 4 **Hours per week:** 2l+1pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: I
Methodological guidance: Department of Geography, Ecology and Environmental Protection Faculty of Mathematics and Natural Sciences
Lecturer: Assoc. Prof. Mihail Kolev, PhD, Department of Mathematics, University of Architecture, Civil Engineering and Geodesy

Annotation: The educational process in this course includes teaching of ecology in order to apply the methods of mathematical modeling for investigation of ecological problems, ecosystems and problems of the environment, in particular the air and water pollution, climatic

changes etc. Basic mathematical models in ecology will be considered and analyzed with special attention to the application of the population theory.

Course content: Mathematical modeling. Systematic approach to the modeling of ecosystems. Models for assessment and management of exhaustible natural resources and renewable natural resourses. Climate model of the secretion of carbon dioxide. Modeling communities (plant associations). Modeling of forest ecosystems. Modeling of aquatic ecosystems. Modeling economic growth with exhaustible natural resources. Modeling of populations in protected areas. Control theory of dynamical systems. Solutions for open and closed loops. Stability and sustainability of ecosystems. Stability of equilibrium of open type fixed cycle.

Technology of education and grading: During the lectures the topics are developed in detail. Through the course students are introduced to the main theoretical material included in the discipline. During the exercises concrete problems are solved. Available software packages are used for performing programming and simulations.

Evaluation procedures applied in the process of the course are: monitoring and written exam.

APPLIED STATISTICS

ECTS credits: 4 **Hours per week:** 2l+1pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: I
Methodological guidance: Department of Geography, Ecology and Environmental Protection Faculty of Mathematics and Natural Sciences
Lecturer: Assoc. Prof. Elena Karashtranova, PhD, Department of Informatics

Annotation: The course Applied statistics should introduce to students how to apply the methods of statistics in practice with the tools of IT. The main objectives of the modeling the empirical data and application in the IT are presented in the course. Contemporary technologies used for their application (MS EXCEL, SPSS and STATISTICA) are also included in the course.

Course content: The structure and the contents of the course are in accordance with the students' knowledge in IT acquired in the respective academic year.

Methods of the scientific investigations; project work; specifics of empirical investigations in ecology; sample distribution and descriptive statistics; non-parametric criteria of investigation of types of distributions; investigation of co-relations; methods and technologies of statistical analysis of data.

Technology of education and grading: The lectures consist of basic theories concerning the different topics and their application in the scientific investigations as well as their realization in software for statistical analysis of data.

The seminars combine theory and practice. A specific experiment is argued, its model and the respective statistical procedures.

The extramural activities include a course project, work in libraries and with software.

In the course of the term the students participate in the argumentation of the procedures and solve problems in the respective system. The term examination consists of development and defense of a project and a test.

CONTEMPORARY TECHNOLOGIES AND ENVIRONMENTAL PROTECTION

ECTS credits: 4 **Hours per week:** 2l+1pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: I
Methodological guidance: Department of Geography, Ecology and Environmental Protection Faculty of Mathematics and Natural Sciences
Lecturer: Assoc. Prof. Dimitrina Kerina, PhD, Department of Communication and computer equipment and technologies, Faculty of Engineering

Annotation: The general loading of the course is 45 hours (it includes 30 lecture hours and 15 hours laboratory exercises) and 75 out auditorium hours. It is an elective course for subject Information Technologies in Ecology, M.S. Curriculum (2 educational semesters). The aim of the course is to introduce the students to the contemporary technologies for environmental protection from liquid and solid steady organic pollutions. Within out auditorium hours the students study the Best Available Techniques (BAT) for environmental protection.

Course content: In this course are considered the following main topics: components of the surroundings; a basic characterization of the steady organic pollutions; theoretical knowledge for obviating the steady organic pollutions; prevention methods for prevention of the steady organic pollutions.

Technology of education and grading: The lecture hours are organized according to the subject Information technologies in Ecology, M.S. Curriculum (2 educational semesters). Lectures are prepared on Power point. The contemporary technical equipment as multimedia, software, models, etc. is used for these lectures. The students' extra-curriculum activity represents the preparation and presentation of a scientific experimental research; conducting physical studies; testing.

The final grade is formed at the end of the course on the basis of the rating of a written test on all topics mentioned above, on the basis of the rating of the student's routine control and on the basis of the rating of the student's extra-curriculum activity in the following ratio.

Final grade calculation is done by using a 6-point rating scale: the rating 6 equals level A on ECTS; the rating 5 equals level B on ECTS; the rating 4 equals level C on ECTS; the rating 3 equals level D on ECTS; the rating 2 equals level E on ECTS.

ENVIRONMENTAL REQUIREMENTS AND STANDARDS

ECTS credits: 4 **Hours per week:** 2l+1pe
Form of knowledge evaluation: Examination **Examination type:** written
Semester: I
Methodological guidance: Department of Geography, Ecology and Environmental Protection Faculty of Mathematics and Natural Sciences
Lecturer: Assoc. Prof. Emilia Varadinova, PhD

Annotation: Environmental Law is a system of principles, requirements and standards aimed to regulate relations arising from the management of the main components of the environment, in order to maintain the balance between them, protect life and health and ensure

sustainable development. Essential for environmental management is the consistent application of the principle of 'integration policy' and the inclusion of environmental concerns in branch policies

Course "Environmental regulations and requirements" is studied by master students "Information technologies in ecology" in order to prepare staff to implement control activities and to participate in the development of information technology, expertise, plans and programs related to the protection of components of the environment, and reducing the adverse factors.

Emphasis in training is placed on sustainable development implies a deliberate policy of environmentally friendly technologies to reduce anthropogenic impact on the components of environment .At the learning process are examined directives, regulations and decisions of the European Union and harmonization of the Bulgarian legislation relating to the environmental management and implementation an environmentally friendly policy.

Course content: Course covers two groups of theoretical questions: General theoretical - National priorities and strategic documents; Environmental requirements and standards for the management of environmental components, widespread waste and noise.

The course "Environmental Regulations and Requirements" provides students - MSc necessary knowledge and skills to apply them in practice in compliance with the environmental requirements for permissible emissions or impacts of different production activities.

Teaching and assessment: In the process of teaching students lectures and practical classes are provided Lectures are conducted in a traditional way. They are illustrated with visual material, showing the limit concentrations of various pollutants in the environmental media and commenting good practice globally.

. The workshops are conducted in the laboratory. Students will get acquainted with structure of EU environmental policy, basic principles of the strategy "Environment 2020" and industries polluting the environment components. Tolerances and requirements as well as the best European practices will be commented.

Extramural training of students is mainly related to working in a library, individual and group consultation with the teacher.

During the course of study there is an ongoing control of the students' knowledge - preparing and defending of abstract analysis of certain legal documents, selected by students, solving test and a test paper that corresponds to the contents of the lectures.

COMPUTER CARTOGRAPHY AND GEOGRAPHIC INFORMATION SYSTEMS

ECTS credits: 4 **Hours per week:** 2l+1pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: I
Methodological guidance: Department of Geography, Ecology and Environmental Protection Faculty of Mathematics and Natural Sciences
Lecturer: Assist. Prof. Galina Bezinska, PhD

Annotation: Computer Cartography and Geographic Information Systems is an elective course for students majoring in Information Technology in Ecology. It introduces the fundamental principles, concepts, software applications and technologies required to produce effective maps, with an emphasis on the application of Geographic Information Systems (GIS) to

ecological research and practice. The course examines the role of cartography and GIS in biodiversity monitoring, natural resource management and the development of sustainable environmental solutions. The course is designed to equip students with the skills to produce maps that visualise ecological processes, support spatial data analysis and facilitate informed ecological decision-making. The practical element of the course involves the development of projects related to current environmental issues, thereby providing students with the knowledge and skills to produce a variety of cartographic products, regardless of the medium or software used.

Course content: The content is divided into the following sections:

Section I: Basic Concepts in Cartography and GIS. Focuses on the fundamental principles of cartography, coordinate systems, the mathematical foundation of maps, and the essential aspects of Geographic Information Systems (GIS).

Section II: Designing and Compiling Digital Maps. Covers data sources, classification methods, the creation of thematic maps, and specific techniques for mapping environmental phenomena and processes.

Section III focuses on data entry, management, and analysis, as well as the visualization of spatial information, geographic analysis, statistical modeling, and working with rasters.

Section IV discusses the stages of designing a geographic information system and its application to environmental monitoring, natural resource management, and the development of sustainable solutions.

All practical sessions will be conducted in a dedicated cartography and GIS teaching laboratory. The practical exercises are designed to develop students' skills in working with maps and geographic information systems. Students will become familiar with map elements, the use of scales, and distance calculations, and will gain hands-on experience in creating digital maps, including transforming, digitising, and structuring map layers. The exercises will entail data entry and manipulation, geographical analysis, and thematic mapping using specialised software. The exercises emphasise the visualisation of environmental processes and the development of projects related to contemporary environmental issues.

Technology of education and grading: During the semester, students are required to complete independent assignments in accordance with the course programme to facilitate ongoing assessment. They must develop three independent projects, each consisting of different but interrelated stages, which will be assessed individually. The assignments and requirements are outlined in the syllabus, and the final practical assessment will be based on the results from all stages, as well as regular attendance. The evaluation will consider the level of performance, competence, analytical ability, and understanding demonstrated by the students. To be eligible for the final examination, students must achieve a minimum current grade of 'Average (3)', calculated as the arithmetic mean of all grades earned during the semester. The final grade will be composed of 65% from the ongoing assessments and 35% from the end-of-semester examination, in accordance with the evaluation system for knowledge and skills adopted by the department.

ECOSYSTEM SERVICES

ECTS credits: 4 **Hours per week:** 2l+1pe
Form of assessment: on-going control and exam **Examination type:** written

Semester: I
Methodological guidance: Department of Geography, Ecology and Environmental Protection
Faculty of Mathematics and Natural Sciences
Lecturer: Assoc. Prof. Lidia Sakelarieva, PhD

Annotation: Prosperity of human society have always been closely linked with the natural environment, and the presence of natural resources such as minerals, oil, valuable timber and fertile land was crucial for the material wealth of each country. Over the past two decades, the notion of the value of natural resources has changed radically as the state of environment is deteriorating rapidly. Elements of nature such as clean air, abundant clean drinking water, greenery in cities and beautiful landscapes, until recently taken for granted, become more and more valued by people. The main objective of the course is to provide basic knowledge about the ecosystem services - the benefits, direct and indirect, that people derive from ecosystems functioning, and to develop skills for assessment of these services.

Course content: Global environmental problems. Essence of the concept of ecosystem services. Biodiversity and ecosystem services. Types of ecosystem services. Classifications. Provisioning, regulating, cultural, and supporting ecosystem services. Guiding principles for the assessment of ecosystem services. Assessment of ecosystem services. Basic concepts. Integrated approach to the assessment of ecosystem services. Types of assessments. Biophysical assessment of ecosystem services. Indicators for biophysical assessment of ecosystem services. Methods for monetary valuation of ecosystem services. Classification of methods. Types of methods. Existing assessments of global ecosystem services. Payment schemes for ecosystem services (PES) and benefits. Basic concepts. Types of PES schemes. Projects for PES schemes. Costs of implementing payment schemes for ecosystem services. Cost-effectiveness of payment schemes for ecosystem services. Essence of the concept of sustainable development. Economic, political and social problems for the implementation of the global strategy for sustainable development. Relationship with other global strategies.

Technology of education and grading: The course is included in the Blackboard e-learning platform. The lecture material is developed in the form of PowerPoint presentations. Practical classes are conducted in a laboratory or in field conditions. The semester (final) assessment is formed on the basis of ongoing control and a written exam. During the semester, the students prepare two PowerPoint presentations for different types of ecosystem services or methods for their valuation. Only students whose grade from the ongoing control is not lower than Average 3.00 are allowed to take the exam. The relative weight of the ongoing control in the final grade is 75%. The written exam is in the form of a final test in the Blackboard e-learning platform or on paper. The relative weight of the written exam in the final grade is 25%. The semester grade is formed on the condition that the grade from the written exam is at least Average 3.00.

ECOTOXICOLOGY

ECTS credits: 4 **Hours per week:** 2l+1pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: I
Methodological guidance: Department of Geography, Ecology and Environmental Protection
Faculty of Biology, Sofia University

Lecturer: Asisst. Prof. Alexander Pulev, PhD

Annotation: The Ecotoxicology course comprises studying of effects of the toxic components impact in the environment on biological systems of different ranks - organisms, individuals, populations, communities and ecosystems. For the expression of these effects knowledge about the properties and effects of the toxicant on biosystems are needed, as well as knowledge about the structure and function of all components of the environment. In this connection, ecotoxicology is the complex, upbuilding discipline for all professionals involved in the environmental protection. The course examines the use of various tests and biomarkers for toxic effects of various pollutants on bio systems which is related to the conducting of bio indication and biomonitoring studies priorred the identification of conservation actions. It is also considered the impact of the ecotope on the toxicant behavior. The knowledge of the course in ecotoxicology are part of the required basic and applied basis for the preparation of MA students in ecology, modeling possibly effective behavior of the affected ecosystems, menidzhamant and protection of the natural environment and all environmental sciences.

Course content: In the course in ecotoxicology are considered main parts of this interdisciplinary applied science, short history of the legislation related with ecotoxicology and ecotoxicological monitoring in Bulgaria. Students will study the basic types of biotoxins and toxicants and their existing classifications. They will be familiarized with “the black and gray lists" of toxicants and factors modifying their activities in different environments. Additionally students will study toxicants spatial and temporal scales of toxicity variation and the relationship between their quantity, structure and activity. There are considered also ecological principles underlying the ecotoxicological tests, the types of ecotoxicological parameters, and methods for their determination. Attention is given to the types of ecotoxicological tests - acute and chronic mono-and multi-species; the types of test - organisms and their requirements, also the types of expose systems - watercourse, static and are updated in the aquatic toxicology.

The ways of toxicological exposure to bio-systems and patterns of influence are considered in detail – bioaccumulation, biomagnification, bioconcentration as processes. Affected is also the essence of biotransformation and bio elimination. Students will study the toxicological effects on individuals, populations, communities and ecosystems: resource competition as a means of direct and indirect effects of contaminants; ecosystem effects, and the combined effects of exposure to more than one toxicant, etc. Special attention is paid to the ecosystem diagnosis; ecotoxicological risk assessment for human health and the environment, the use of early warning systems and risk assessment for new xenobiotics.

Technology of education and grading: Lectures are developed on Power point and will be presented with video - projector. Practical classes are conducted in subgroups in a laboratory where students consistently learn about the general characteristics of the test objects of the tested toxicant, methodologies, training and setting of ecotoxicological test. Attention is drawn to the way of construction of the dose-response curve, reporting the LD_{50} and LC_{50} and interpretation of results. At the end of each session the next topic is introduced students for their preparation. Extracurricular training of students is related to work in a library, Internet, individual consultations to prepare for the exercises, writing of essays and courseworks, preparation for ongoing control and final exam.

The examination procedure involves solving computer test or develop two questions from a pre-defined conspectus. The relative weight of the final assessment in the overall assessment is

25%. The relative weight of current control is 75%, and includes an assessment of test presentation and performance during exercises.

Environmental Management

ECTS credits: 4 **Hours per week:** 2l+1pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: I
Methodological guidance: Department of Geography, Ecology and Environmental Protection Faculty of Mathematics and Natural Sciences
Lecturer: Assoc. Prof. Michail Michailov, PhD

Annotation: The aim of the course "Environmental Management" is to give the students of "Information technologies in ecology" - "Master" degree, basic knowledge of the legal framework, the requirements and approaches in the management of various production activities in order to avoid negative impacts on the environment.

Students acquire skills to analyze and evaluate the various management activities in relation to the use and protection of the environment components including and as regards the clarification of the possible impacts on them.

The course "Environmental Management" provides students with the necessary knowledge to participate in teams in developing strategies, programs, systems and plans for the management of technological processes and management of environmental components.

Course content: Policy and legal framework of the EU and Bulgaria in the field of environmental management. Criteria for the significance of the impact on the environment components. Environmental requirements for control of technological processes. Company management. Environmental requirements and standards. Management of the business activities and requirements for air emissions; the formation of waste water; the formation of waste; load noise, radiation, fields and etc. Ecological risk and ecological responsibility. Strategies and policies. Control in the implementation of the environmental management.

Technology of education and grading: The training in the discipline "Environmental Management" is carried out by teaching 30 hours of lectures and conducting 15 hours of practical exercises. The lecture material covers the main issues of the content of the discipline, as well as various means of visualization - multimedia, educational videos, demonstration software, visual materials (boards and diagrams), some of which are developed as student coursework. During the practical exercises, ongoing control of the acquired knowledge and skills is carried out. Students form their works on individual topics as coursework, which are evaluated and if only they have a positive grade (at least an average of 3.00) are allowed to take the exam.

The training in the discipline ends with a written semester exam. The final grade is formed based on the results of the defense of the coursework and the semester exam in a ratio of 60/40%.

FUNCTIONAL BIOCOENOLOGY

ECTS credits: 4 **Hours per week:** 2l+1pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: I
Methodological guidance: Department of Geography, Ecology and Environmental Protection Faculty of Biology, Sofia University
Lecturer: Assoc. Prof. Lidia Sakelarieva, PhD

Annotation: The course "Functional Biocenology" examines the functioning of biocenoses and their role in the functional specificity of ecosystems, as well as the importance of the abiotic components of ecosystems for the biocenoses themselves. The relationships between them underlie the creation of empirical and formal models for simulating the "behavior" of these macrobiological systems when environmental factors change. The functional specificity of ecosystems manifests itself in various directions: energy flow, substance cycling, spatio-temporal structure, development, evolution and self-government. The role of biodiversity in the sustainability of ecosystems is also examined, as well as the various modern indicators and models for assessing ecosystem health and ecological risk, which are the basis of ecological resource management and sustainable development. Knowledge of the characteristics of biocenoses as supra-individual biosystems, an element of ecosystems, which are the main functional units of the biosphere, is an important prerequisite for the rational use of natural resources and the solution of emerging environmental problems on a regional and global scale.

Course content: Subject and tasks of Functional Biocoenology. Main problems. Significance. Biological productivity as an indicator of the intensity of functioning of biocenoses and ecosystems. Biomass as a geochemical and functional indicator. Energy flow and functioning of biocenoses. Biological diversity and functioning of ecosystems. Dynamics of biocenoses and stability of ecosystems. Basic approaches to ecosystem diagnostics and ecosystem management.

Technology of education and grading: Lectures are in the form of PowerPoint presentations. During the semester, periodic control of the acquired knowledge is carried out through the completion of an assignment and a test on part of the content of the study material. The share of the current control in the final grade is 65%, and in it the relative weight of the assignment and the test is 50%. Students are not exempted from the semester exam. In order to be admitted to such, the grade from the current control must be at least Average 3.00. The examination procedure includes the preparation and presentation of a PowerPoint presentation on topics that are not included in the assignments for current control. The final grade is formed only on condition that the student has received a grade from the semester exam of at least Average 3.00. The relative weight of the semester exam in the final grade is 35%.

DATABASES

ECTS credits: 5 **Hours per week:** 2l+2pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: I
Methodological guidance: Department of Geography, Ecology and Environmental Protection

Faculty of Mathematics and Natural Sciences
Lecturer: Assoc. Prof. Velin Kralev, PhD, Department of Informatics

Annotation: The course introduces students to the basic principles of databases, as well as to the related information systems. The main topics covered are data modeling and database design, with a more in-depth look at the relational model and relational database management systems. The aim of the course is to introduce students to the basic principles of database design and creation, as well as the use of real database management systems. The emphasis is also on the theoretical foundations of data modeling, the creation of database schemas and the constraints for preserving the referential integrity of data. Conceptual and semantic approaches to data modeling are presented. Various aspects related to data confidentiality and security are also discussed. The aim of the subject studied is for the student to acquire basic knowledge and skills in the design and creation of databases, as well as in the use of database management systems.

Course content: Introduction to databases. Applications. Automated database information systems. Basic approaches to creating information systems. Definitions of a database and a database management system. Modeling limitations. Data models. Network and hierarchical data model. Relational data model. Basic concepts. Properties of relational systems. Properties of tables. Operations on relational data. Semantic data models. Semantic modeling. Basic components of the E-R model. Transformation of the E-R model into a relational form. Selection of objects and attributes. Basic data characteristics. Data integrity. Referential constraints for preserving data integrity. Database design. Anomalies in relations. Functional dependencies. Armstrong's axioms. Normalization of relations. Normal forms. Physical organization of data. Access to data by primary key. Physical organization of data. Access to data by secondary key. Data processing languages. Languages for defining and manipulating data. Languages based on relational algebra. The SQL language. Basics of entering and modifying data in database systems. Restriction, nullification and cascade deletion. Data recovery. Use of transactions. Types of failures in database systems. Configuring database systems. Database management systems. Architecture of database management systems. Design of information systems for working with databases. Formalization of processes. Data confidentiality and security.

Technology of education and grading: The lecture material is developed in electronic form and uploaded to an e-learning system. Laboratory classes are held in subgroups, according to the curriculum. Classes are held in computer rooms with installed software necessary for the implementation of the relevant assignments. At the end of each practical exercise, homework assignments are given, which are preparatory for the students for the next class.

The students' extracurricular work includes work in the library, work on individual assignments - homework, essays, reports, as well as work on an individual project. During the semester, a periodic analysis of the acquired knowledge by the students is carried out, through conducting independent work (control), as well as additional tests related to the educational content of the course.

The examination procedure includes a written exam on two questions from the syllabus or a test on the entire material. The relative weight of the exam from the total grade is 25%, and the current control - 75%.

WEB-SYSTEMS AND TECHNOLOGIES

ECTS credits: 4 **Hours per week:** 1l+2pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: II
Methodological guidance: Department of Geography, Ecology and Environmental Protection Faculty of Mathematics and Natural Sciences
Lecturer: Assoc. Prof. Radoslava Kraleva, PhD, Department of Informatics

Annotation: The proposed curriculum, issues and techniques in the field of modern web systems and technologies. Presented are techniques related to the construction of static and dynamic web pages, and their integration into comprehensive sites. Consider the following topics: Introduction to Web technology; Introduction to the language HTML. HTML document structure; Types of symbols and their formatting. Structuring and shaping of texts. Lists; Use of multimedia objects and formatting in HTML with CSS. Designing a logo; Creating and layout of tables with HTML and CSS; Working with containers. Positioning objects. Align Objects; Selection of colors. Color schemes. Fonts and Typography. Textures; Creating web forms; Hyperlinks. Maps of images. Anchors. Menus; JavaScript and JQuery. XML; Creating web graphics in a browser; Adaptive web design. Design Principles of the Web interface; Web services, blogs and social networks. Databases on the web; Semantic web and metadata. The course aims to provide students with a comprehensive idea about the structure and capabilities of modern web technologies. Free to use the terminology and have practical experience in the development of static websites. After completion of the course students should be able to: Use language HTML, DHTML, CSS, and through them to create Web sites; Knowledge of current development environments for the Web.

Course content: Introduction to web technologies. Introduction to the HTML language. Structuring an HTML document. Working with cascading style sheets CSS. Ways of using CSS in HTML documents. Types of symbols and their formatting. Structuring and shaping texts. Lists. Using multimedia objects in HTML and formatting with CSS. Logo design. Software products for editing and creating images, and various collages. Creating and layout tables with HTML and CSS. Working with containers. Positioning objects. Aligning objects. Selecting colors. Color schemes. Fonts and typography. Textures. Creating web forms. Hyperlinks. Image maps. Anchors. Menus. JavaScript and JQuery. XML. Creating web graphics in a browser. Adaptive web design. Principles of web interface design. Web services, blogs and social networks. Web databases. Semantic web and metadata.

Technology of education and grading: The lecture material is developed in electronic form and uploaded to an e-learning system. Laboratory classes are held in subgroups, according to the curriculum. Classes are held in computer rooms with installed software necessary for the implementation of the relevant assignments. At the end of each practical exercise, homework assignments are given, which are preparatory for the students for the next class.

The students' extracurricular work includes work in the library, work on individual assignments - homework, essays, reports, as well as work on an individual project. During the semester, a periodic analysis of the acquired knowledge by the students is carried out, through conducting independent work (control), as well as additional tests related to the educational content of the course.

The examination procedure includes a written exam on two questions from the syllabus or a test on the entire material. The relative weight of the exam from the total grade is 25%, and the current control - 75%.

REMOTE METHODS FOR ENVIRONMENTAL MONITORING

ECTS credits: 5 **Hours per week:** 2l+2pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: II
Methodological guidance: Department of Geography, Ecology and Environmental Protection Faculty of Mathematics and Natural Sciences
Lecturer: Assist. Prof. Miroslav Ivanov, PhD

Annotation: The course aims to introduce the students with the technical possibilities and applications of the aerospace methods and technologies as a tool that can be used to resolve one of the most significant problems of contemporary humanity — research in the field of ecology and the environment. The course examines aerospace research, with an emphasis on remote sensing of the Earth. The various methods and tools for remote sensing are discussed, as well as the various techniques and processes for processing the captured images to achieve optimal environmental monitoring.

Course content: is divided into two parts. The first part provides a synthesized overview of the remotesensing methods, the main properties of the electromagnetic spectrum, different types of scanning, and describes various satellites with their technical capabilities. The second part focuses on the primary tools for analyzing the atmosphere and Earth's surface, as well as the main image processing techniques and their application in the environmental reserches. The Practical exercises include activities that enhance the understanding of atmospheric processes and phenomena and also the application of the remote sensing methods as tools for environmental analysis. A crucial part of the practical exercises is the processing of satellite images and extracting, and analyzing information using Geographic Information Systems (GIS).

Technology of education and grading: The Lactures are delivered through pre-planned sessions, which include an introduction, a topic, connections between the previous and current lectures, links to other disciplines, presentation, discussion, and summary. The lectures are prepared in PowerPoint and are presented via video projector. The process of teaching is supported by the use of technical tools and software applications. The Practical sessions are conducted in specialized laboratories where theoretical facts, processes, and phenomena are discussed, followed by practical tasks performed individually or by team work. Some exercises take place in the field, demonstrating the use of unmanned aerial vehicles. The discussion sessions during the practical courses includes various aspects of the remote sensing methods as tools for environmental protection and during the session’s innovative student ideas and provocative thinking are encouraged.

During the course, the students as a form of on-going control have to develop a project related to the application of the remote sensing methods as tools for environmental protection.

Students’ extracurricular preparation primarily involves fieldwork, assignments in different administrative structures or organizations on a given topic, library researches, internet use, and individual or group consultations. These activities aim to prepare the students for the practical

exercises and help them to develop knowledge, and ensure readiness for ongoing assessment and the final exam.

The Periodic assessments are conducted throughout the semester by development of a indiviudal project, wich is evaluated after that by the teacher. The Ongoing assessment contributes to 75% of the final grade. Exceptional student performance (100% completion of all ongoing tasks) may lead to exemption from the semester exam, at the teachers's discretion.

The final exam includes a test covering both parts of the course content. The exam accounts for 25% of the overall grade.