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

The Master Programme has been designed for graduates with Bachelor or Master degree in Ecology, Ecology and Environmental Protection, Biology, Biology and Chemistry, Geography and Biology and Eco-chemistry.

The Master Programme allows students to upgrade the acquired knowledge and building skills for the information technologies implementation in ecology and environmental protection; to acquire knowledge and skills in the field of modern ecology, environmental modeling; and programming of natural and anthropogenic processes; to predict the dynamics and the risk for the natural components and human society, as well as for development and implementation of relevant projects, funded by various EU programs.

Basic prerequisite for achieving the educational goals is the structure and content of the curriculum. It has been developed in two semesters and includes mandatory and optional courses, which provide additional knowledge in various scientific fields. The curriculum provides an opportunity to achieve additional, more closely specialized expertise through a combination of electives and writing a Master thesis on a specific topic in the second semester. All this guarantees a successful adaptation of the future masters to the conditions of dynamic labor market in Bulgaria.

Important conditions for the achieving of the Master program objectives are the rich educational, research and practical experience of the training lectors. The availability of lecture and computer rooms, modern licensed, and specialized educational software library, ensure the high level of training in the program. Various cognitive methods - talk and discussion, development of tasks and multimedia presentations, e-learning methods and others, will be used in the teaching process.

Graduates of the Master's program can realize themselves as experts and officials in various fields of applied ecology - science, legislative and executive activities, in institutes, universities, ministries, agencies, NGOs and others.

CURRICULUM

MASTER'S DEGREE PROGRAMME

„INFORMATION TECHNOLOGIES IN ECOLOGY"

First year			
First semester	ECTS credits	Second semester	ECTS credits
Compulsory Courses		***Compulsory Courses***	
Databases	5	Neural Networks	5
Web-technologies and Programming	5	Mathematical Models in Ecology and Environmental Protection	6
Object-Oriented Programming	4	Optional Course	4
Applied Statistics	4		
Aerospace Information Technologies in Environmental Protection	4	Preparation and defense of a graduation thesis	15
Optional Course 1	4		
Optional Course 2	4		
Optional Courses (students choose two courses)		***Optional Courses*** (students choose two courses)	
Contemporary Technologies and Environmental Protection		Ecotoxicology Environmental Management Computer Cartography and Geographic Information Systems	
Ontologies and Applications in Ecology			
Chronoecology with Dendrochronology Analysis			
Environmental Standards and Requirements			
Functional Biocoenology			
Ecosystem Services			
	Total 30		Total 30

TOTAL FOR 1 ACADEMIC YEAR: 60 CREDITS

COURSE DESCRIPTION

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 Informatics
Faculty of Mathematics and Natural Sciences
Lecturer: Prof. Peter Milanov, PhD

Annotation: Databases are incredibly prevalent -- they underlie technology used by most people every day if not every hour. Databases reside behind a huge fraction of websites; they're a crucial component of telecommunications systems, banking systems, video games, and just about any other software system or electronic device that maintains some amount of persistent information. In addition to persistence, database systems provide a number of other properties that make them exceptionally useful and convenient: reliability, efficiency, scalability, concurrency control, data abstractions, and high-level query languages. Databases are so ubiquitous and important that computer science graduates frequently cite their database class as the one most useful to them in their industry or graduate-school careers.

Course content: This course covers database design and the use of database management systems for applications. It includes extensive coverage of the relational model, relational algebra, and SQL. It also covers XML data including DTDs and XML Schema for validation, and the query and transformation languages XPath, XQuery, and XSLT. The course includes database design in UML, and relational design principles based on dependencies and normal forms**.**

Technology of education and grading: Written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

WEB-TECHNOLOGIES AND PROGRAMMING

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 Informatics
Faculty of Mathematics and Natural Sciences
Lecturer: Assist. Prof. Ivo Damyanov, PhD

Annotation: The course is designed as an introduction to Web technology and programming, such as prejudice widely used and proven effective technologies underlying the World Wide Web. Issues related to the design and implementation of effective Internet / Intranet applications are observed. Students learn the syntax and semantics of languages HTML, JavaScript, CSS, and ASP.NET (C #) and the opportunities they offer an integrated development environments for web projects.

Course Aims: The course aim is to give theoretical and practical background to students to use different web technologies and develop web based software.

Methods of teaching: lectures, tutorials, group seminars or workshop, projects, other methods.

Pre-requirements: Basic computer skills and basic knowledge in Mathematics.

Exam: Written examination and discussion at the end of the semester, individual tasks and the general student's work during the semester.

OBJECT-ORIENTED PROGRAMMING

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 Informatics
Faculty of Mathematics and Natural Sciences
Lecturer: Assist. Prof. Ivo Damyanov, PhD

Annotation: In the course students are introduced with methods and means of programming and the one of the most used paradigm i.e. Object-oriented programming. The principles and strategies of the object-oriented programming are introduced with C++ programming language.
The course is fundamental and together with the course of Web technologies and programming cover the basic aspects of the modern programming languages, concepts and development environments. The knowledge will be used in the general theoretical, technical and some special courses.

Objectives:
Basic objectives and tasks:

- the students give knowledge for algorithum thinking;
- to give knowledge for methods and skils in Object-oriented programming in integrated development environment;
- to give knowledge for Data structures, that can process with computer;
- to give knowledge for methods and skills in programming.
- to give knowledge for good style in programming;
- to give knowledge for basic principles when develop applications.

Methods of teaching: lectures, tutorials, group seminars or workshop, projects, other methods

Pre-requirements: Basic computer skills and basic knowledge in Mathematics.

Exam: Written examination and discussion at the end of the semester, individual tasks and the general student's work during the semester.

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 Informatics
Faculty of Mathematics and Natural Sciences
Lecturer: Assoc. Prof. Elena Karashtranova, PhD

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.

Assessment and Evaluation
Project- 30%
Final Test- 30%
Individual students works-40%
The course is successfully completed with at least 50% of all scores.

AEROSPACE INFORMATION TECHNOLOGIES IN ENVIRONMENTAL PROTECTION

ECTS credits: 4 **Hours per week:** 2l+1pe
Form of assessment: on-going control and exam
Examination type: written and oral
Semester: I
Methodological guidance: Bulgarian Academy of Science
Lecturer: Prof**.** Roumen Nedkov, PhD

Annotation: Aerospace Information Technologies in Environmental Protection is a comparatively new discipline with a focus on the theoretical and practical aspects of the cotemporary high technologies in investigation and protection of the environment. It discusses theoretical and practical problems of the application of the geo-information technologies and of the remote sensing in the protection of environment.

Students become familiar with the contemporary aerospace information technologies, the integrated geo-information model systems, and the systems of global positioning (GPS) which are widely applied both in monitoring and protecting the ecosystems.

As a result, in the end of the course students have gained not only theoretical knowledge about the remote sensing but also some practical skills in its applying in an integrated geo-information model system.

Course content: The course discusses the problems of the contemporary integrated geo-information model systems and the general principles of the remote sensing for the Earth observation and the environmental protection. It treats the electromagnetic specter and the atmosphere impact as well as the spectral reflection characteristics of the Earth surface in the process of remote sensing. Another important subject of the syllabus is the GIS and IGMOS application in environmental protection. Different aerospace platforms are described and their functions explained. Special attention is paid to the processing of the received data and the interpretation and analysis of the images of the investigated ecosystems.

Technology of education and grading: Lectures are developed on Power Point and will be presented to the students through a video-projector.

Practical exercises are connected with getting knowledge on GPS measuring and solving of individual problems. In the end of the course students prepare a paper on the basis of their own measuring of an object.

Extracurricular training of students consists in reading books and articles in the library or in the Internet and individual consultations.

The examination procedure involves a written and an oral exam. The final grade takes into consideration both the paper and the student participation in the exercises.

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 Communication and computer equipment and technologies
Faculty of Engineering
Lecturer: Assoc. Prof. Dimitrina Kerina, PhD

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 граде 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.

ONTOLOGIES AND APPLICATIONS IN ECOLOGY

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 Informatics
Faculty of Mathematics and Natural Sciences
Lecturer: Assoc. Prof. Irena Atanasova, PhD

Annotation: The main goal of course "Ontologies and applications in ecology" is to introduce the current state of research and practical developments in the field of Semantic Web technologies and their applications in the area of Ecology to the students. The course program includes issues relating to methods for the creation, integration and usage of the ontologies. The course is a theoretical and a practical introduction in methodologies for ontological engineering. Students should study the principles for modeling and design of ontological systems for representing and working with knowledge. The typical problems, tasks and their applications in the area of ecology are discussed as well. The course is an extension of the courses, related to ecology, giving students a real opportunity to represent and model knowledge in a given area.

The extramural activities in this course involve working in the library and developing the course project. The ratio between the auditorium activities and the additional activities is 1:2.

Course content: Semantic annotation. Ontologies and ontology systems. Systems and tools for representation of ontology knowledge. Methodology for design and development of ontologies. Features of the ontology Cyc. Features of inference in Cyc. Tools for describing of information resources in RDF/RDFS. General characteristics of the language OWL. Basic structures for describing ontologies in OWL. Tools and environments for developing of ontologies. Protégé. Ontologies for knowledge management. Usage of the ontologies in ecology domain.

Technology of education and grading:

А. Lectures: Lectures with the whole group, which chooses the course.

Б. Lab exercises: Exercises in the small groups.

В. Current control and final evaluation of the knowledge: The current control (К) is carried through during the lab exercises. The final assessment (Оок) is calculated using the

current control during the term and the assessment for class project (П) according the formula: Оок = (К + П)/2

CHRONOECOLOGY WITH DENDROCHRONOLOGY ANALYSIS

ECTS credits: 4 **Hours per week:** 2l+1pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: I
Methodological guidance: Depatrment of Ecology and environmental protection
Faculty of biology, Sofia University
Lecturer: Prof. Mariyana Lyubenova, PhD

Annotation: The dynamics of biological systems of different rank / individuals, populations, communities, ecosystems and biosphere/ in connection with various continuous changes and dynamics of environmental factors are considered in the course "Chronoecology with Dendrochronology Analyze". Particular attention is paid to the biological rhythm as synthesized adaptation with exo-endogenous nature in various biological systems and its modification – the expression of ecological plasticity and also the basis for the systems evolution. The impact of anthropogenic factors on the natural history of biological phenomena at different levels is also considerred. Students are introduced to the modeling capabilities of the change and the dynamics of biological phenomena and with the development of the dynamic global models.

The lecture course gives an information on the nature and possibilities of dendrochronology as one of the most advanced and perspective methods for chronoecological analysis.

Knowledge and understanding of the natural history of natural phenomena and biological rhythms is important for the environmental assessment and to assess the extent of its modification, also for forecasting and environmental management of natural resources.

Course content: Periodicity and time lack of regularity of the environmental factors. Time measurement and determination of periodicals through mathematical - physical methods. Cronology and periodicals of biological time – its endo-and exogenous nature and as a result of self-regulation systems and adaptation to environmental factors. Types of biorhythms of biological systems: daily rhythms, monthly and “tidal” / lunar / rhythms, annual rhythms, multi-annual and ancient rhythms and changes in environmental factors. Characteristics of biological rhythms and their endo - exogenous conditioning. Importance of cosmic factors, geophysical factors and environmental regimes. Phylogeny and ontogeny of changes in biological rhythms. Ecological significance. Modeling capabilities and assessment of changes and rhythms in the environmental factors. Influence of human factors on perennial and ancient changes. Evolution of the systems. Link between ancient and perennial changes in populations and communities and states, functioning and evolution of ecosystems and the biosphere. Ecological and biological bases of dendrochronology. Periodicity in the growth of the stems of woody plants. Factors influencing the characteristics of the annual rings. Dendrochronology and global monitoring and rhythmic changes in the environment. Basic models.

Technology of education and grading: Lectures are developed on Power point and presented with video - Projector. Practical classes are conducted in subgroups in a laboratory

where students are introduced to measurement, stages of statistical data processing and modeling of stem growths, depending on environmental factors. At the end of each students are familiarized with topics of the next exercise.

Extracurricular training of students is related to work in a library, Internet, individual consultations to prepare for the exercises, preparation of essays coursework, and exam preparation.

During the semester students carry out periodical checks of knowledge by presenting a PowerPoint presentation on given topic and its discussion in front of the group. They also will solve tests, which correspond to parts of lectures content. The students will be assessed according to their performance in class and prepared course work. The relative weight of the current control is 40% of the total score.

The examination procedure involves solving computer test or detailed answer two questions from a pre-defined conspectus. The relative weight of the final assessment in the overall assessment is 60%.

ENVIRONMENTAL STANDARDS AND REQUIREMENTS

ECTS credits: 4 **Hours per week:** 2l+0se+0le+1pe+p
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.

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: Depatrment of Ecology and environmental protection
Faculty of Biology, Sofia University
Lecturer: Prof. Mariyana Lyubenova, PhD

Annotation: The course "Functional Biocoenology" to master course "Information Technology in ecology" is a thorough review of functioning of the biocoenosis and their role in the functional specificity of ecosystems. In considers also the importance of other ecosystem components for plant associations themselves, which links underlie the creation of empirical and formal models for simulating "behavior" of these macro biological systems under climate environmental factors.

Functional specificity of ecosystems occurs in different directions: energy flow, circulation of substances space-time structure, development, evolution and self-organization. Attention is paid to the role of biodiversity for ecosystem resilience and the various contemporary indicators and models for assessing ecosystem health and environmental risks that underlie environmental resource management and sustainable being recognized. Students are introduced to various ecosystem models with their advantages and drawbacksp and the priorities in the modeling of ecosystems. All these aspects are considered consecutively in lectures and practical sessions.

Course content: Geochemical background environment. Clark and migration of chemical elements. Major biogeochemical factors. Zonal particularities in the chemical composition of the biomass. Biological cycle - and capacity characteristics in different groups depending on the ecosystem structure and functioning of biocoenosis. "Bottlenecks" in the cycle of nutrients. The biological productivity as an indicator of the intensity of functioning of biocoenosis and ecosystems. Features in the quantity, structure and dynamics of primary production in various types of terrestrial and aquatic ecosystems. Use of primary production and operation of the biocoenosis. Modeling. Biomass as a geochemical and functional indicator.

Biological activity of the biomass. Particularities of the distribution of biomass in different types of ecosystems - an indicator of the functioning of the biocoenosis. Balance of productive and destructive processes in nature. Biocoenotical importance and role in shaping the environment. Relevance. Energy characteristics of the environment. Energy flow and functioning of the biocoenosis. Trophic structure and ecological pyramids reflecting the functional characteristics of the biocenosis and ecosystems. Models. Main conclusions for energy flow in ecosystems on earth - practical significance. Energy field of anthropology sphere. Biodiversity and ecosystem functioning. Importance of ecosystem modeling. Classification of ecosystem types. Problems and concepts. Application of PFTs and ETs classification of ecosystem type. Dynamics of biocoenosis and stability of ecosystems. Basic models self-organization. Practical problems of ecosystem modeling. Plant and ecosystem functional types (PFTs and ETs) and ecosystem modeling - definitions and concepts. Characteristics and shortcomings of the current Dynamic Global Vegetation Models (DGVMs). Application of PFTs and ETs development models. Ecosystem approach for the development of DGVMs. Basic approaches to ecosystem diagnosis (ED) and ecosystem management. Role of bioindications and biomonitoring of biocoenotical and ecosystem level for ED. Ecological and adaptive management of ecosystem functions. Importance of different types of models. Concept of sustainable development and ecosystem management as an attempt to regulate the human impact on the biosphere. Socio-political and economic problems of its implementation.

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 study the general characteristics of the indicators, their importance for the functioning of the ecosystem and biocenosis, opportunities for their empirical and formal models. Attention is drawn to the values of the parameters on which you can evaluate the steady state of ecosystems and those who speak for destabilization and onset of degradation. 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 and group consultations to prepare for the exercises, writing of essays and courseworks, preparations for ongoing control and final exam.

During the semester students carry out periodical checks of knowledge by solving test, which corresponds to part of the contents of the lectures. Evaluated the preparation and performance of the students during the activity through the development of coursework.

Examination procedure includes a written examination on two questions or computer test. The relative weight of the total test score is 60%, and the current rating - 40%.

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. Anthropogenic impact on the environment at regional level. Concept and strategy for sustainable development and link with other global strategies. The concept of ecosystem services. Classification of ecosystem services. Guiding principles and methods for assessing ecosystem services. Classification of methods and assessments of ecosystem services. Modern problems of realizing the concept of sustainable development.

Technology of education and grading: The lectures are presented by using PowerPoint. The practical classes are conducted in a laboratory. Some of the classes are held in the field, where some of the methods for assessing ecosystem services are tested. During the semester the students prepare PowerPoint presentation for different types of ecosystem services or methods for assessing ecosystems and their services.

The final grade is formed on the basis of on-going control and written exam. The relative weight of the written examination from the final grade is 50%. Credits are awarded only if the final grade is equal to or higher than 3.00.

Neural networks

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 Informatics
Faculty of Mathematics and Natural Sciences
Lecturer: Prof. Peter Milanov, PhD

Annotation: Neural networks use learning algorithms that are inspired by our understanding of how the brain learns, but they are evaluated by how well they work for practical applications such as speech recognition, object recognition, image retrieval and the ability to recommend products that a user will like. As computers become more powerful, Neural Networks are gradually taking over from simpler Machine Learning methods. They are already at the heart of a new generation of speech recognition devices and they are beginning to outperform earlier systems for recognizing objects in images.

Course content: The course will explain the new learning procedures that are responsible for these advances, including effective new proceduresr for learning multiple layers of non-linear features, and give you the skills and understanding required to apply these procedures in many other domains.

Technology of education and grading: Written final exam on two theoretical topics (grade weight is 60 %); two projects (grade weight is 40 %).

MATHEMATICAL MODELS IN ECOLOGY AND ENVIRONMENTAL PROTECTION

ECTS credits: 6 **Hours per week:** 2l+3pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: II
Methodological guidance: Department of Mathematics
Faculty of Mathematics and Natural Sciences
Lecturer: Assoc. Prof. Mihail Kolev, PhD

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.

ECOTOXICOLOGY

ECTS credits: 4 **Hours per week:** 2l+1pe
Form of assessment: on-going control and exam **Examination type:** written
Semester: 2
Methodological guidance: Depatrment of Ecology and environmental protection
Faculty of Biology, Sofia University
Lecturer: Prof. Mariyana Lyubenova, 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 60%. The relative weight of current control is 40%, 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: II

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" - degree "Master" 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 process control. Management company. Environmental requirements and standards. Management of the business activities and requirements for air emissions; in the formation of waste water; in the formation of waste; at load noise, radiation, fields and etc. Ecological risk and responsibility. Strategies and policies. Control in the implementation of environmental management.

Technology of education and grading: The course "Environmental Management" is done by teaching 30 hours of lectures and 15 hours conducting seminars. The lectures cover the basic questions on the content of the discipline, and various visualizations - multimedia, educational videos, demo software, visual aids (posters and schemes), some of which were developed as term papers for students.

During the practical exercises exercise ongoing control of the acquired knowledge and skills. Students shape their work on individual topics such as assignments that are evaluated and only a positive assessment (at least average 3.25) are examine.

The course ends with a written exam. The final grade is based on the results of the course assignments and the semester examination (50/50%).

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: II
Methodological guidance: Department of Geography, Ecology and Environmental Protection Faculty of Mathematics and Natural Sciences
Lecturer: Assoc Prof. Penka Kastreva, PhD

Annotation: The subject "Cartography and GIS" is optional and designed for students who have not studied in bachelor's degree the basic subjects "Cartography" and “Geographic Information Systems."

The lecture course aims to familiarize students with the basic principles for the creation and use of maps. With the practical exercises the students receive undersanding for the mapping,

a system of cartographic concepts, knowledge and skills to work with different cartographic products.

Course content: The lecture course is divided in two parts. The first part is entirely devoted to cartography and aims to familiarize the students with the basic theoretical topics regardless of the medium in which are designed and are created the maps, they remain constant - as datum, local and global reference systems, coordinate systems, map projections, cartographic symbols and methods for mapping geographic objects and phenomena. More attention is paid to the processes taking place in the digital environment. Some issues about the nature of topographic and thematic maps and establish them in the digital environment are included.

The second part introduces the students to the general concepts for the development and implementation of GIS. The topics are grouped into modules covering fundamental theoretical directions which aim to provide practical knowledge about key aspects of GIS - hardware, custom software, types and data structures, database and modern methods of storage and data management, spatial and network analysis.

Technology of education and grading: The lectures and exercises are conducted solely on the equipment basis of the Department „Geography Ecology and Environmental Protection". To illustrate the lecture material are used: computer with video – projector, study videos, specialized software (ArcGIS), additional materials (tables, diagrams and maps), some of which have been developed as students' course and diploma works. For the practical exercises is used a multimedia computer lab. For the normal conduct of the exercises the students are divided into groups and each student has a separate computer.

During the semester periodically the students are assigned individual tasks.or testing. The tasks are fully related to digital work environment with specialized software for mapping and using of maps. The students are admitted to the exam with a minimal note of 3, which is formed as the average of all notes received during the semester. The final note is 40% of the periodic evaluation and 60% of the semester exam.