FACULTY OF MATHEMATICS AND NATURAL SCIENCES

Department of Georgaphy, Ecology and Environmental protection

PhD PROGRAMME

ECOLOGY AND ENVIRONMENTAL PROTECTION
(ENGLISH LANGUAGE TRAINING)

SCIENTIFIC FIELD:	4. NATURAL SCIENCES, MATHEMATICS AND INFORMATICS
PROFESSIONAL FIELD:	4.4 EARTH SCIENCES
NATIONAL QUALIFICATIONS FRAMEWORK LEVEL:	8
PROFESSIONAL QUALIFICATION:	RESEARCHER
PERIOD OF STUDY:	3 /three / or 4 /four/ YEARS
FORM OF EDUCATION:	FULL-TIME/ INDEPENDENT/PART-TIME / DISTANCE

THE CURRICULUM HAS BEEN APPROVED SINCE 2024 г.

QUALIFICATION CHARACTERISTICS

1. GENERAL INTRODUCTION TO THE PhD PROGRAMME

The PhD programme "Ecology and environmental protection" is administered by the Department of geography, ecology and environmental protection, at the Faculty of mathematics and natural sciences, SWU "Neofit Rilski" Blagoevgrad. The qualification characteristics, the curriculum and the programme courses correspond to the requirements of the Higher Education Act in Bulgaria and the University regulations.

Students from all regions of the Republic of Bulgaria and from other countries can be trained in the PhD programme. The period of study lasts three academic years for the full-time and independent form of education, and four academic years for the part-time and distance form of education. The curriculum includes compulsory and elective courses.

The education finishes after successful completion of all activities included in the individual PhD student's plan. After the successful defence of the dissertation, the PhD students receive the educational and scientific degree "Doctor" in "Ecology and Environmental Protection".

2. AIMS OF THE PhD PROGRAMME

1. To train highly qualified scientific staff, researchers and specialists with wide-ranged competences in the field of ecology and environmental protection.

2. To create opportunities for the acquisition of modern theoretical knowledge, formation of methodological experience and skills for planning and conducting scientific research activity.

3. To create competencies for carrying out professional work (individually and in a team), for application of innovative scientific achievements in the field of conservation, sustainable use and management of natural resources.

4. To develop skills for performing critical analysis of scientific results, making justify decisions and taking adequate actions related to the competent implementation of the environmental legislation and conducting an environmentally friendly policy.

3. GENERAL QUALIFICATION AND SPECIALISATION

- ✓ Deepening the knowledge related to application of modern theoretical and methodological principles of research in the field of ecology and environmental protection.
- ✓ Mastering the scientific style of explanation, free handling of specialised environmental terminology.
- ✓ Building capacities for analysis and prioritization of normative, institutional and practical problems in the field of ecology and environmental protection.
- ✓ Acquiring competencies and skills for organisation of planned scientific research and realisation of independent experimental activity in the thematic scientific field.
- ✓ Knowledge and correct application of the environmental legislation and formation of professional skills for finding optimal approaches in the implementation of environmentally friendly activities.
- ✓ Periodic review of scientific achievements in the field of ecology and environmental protection, motivation, readiness and ambition to participate in the process of development and implementation of national and international projects.
- ✓ Developing of professional skills for analysis of causal relationships, interpretation of the results and their popularization at national and international scientific forums.

4. KNOWLEDGE, SKILLS AND COMPETENCIES ACQUIRED ACCORDING TO THE NATIONAL QUALIFICATION FRAMEWORK

4.1 Knowledge (theoretical and/or factological)

The students who complete their doctoral degree will:

- ✓ Have systematic knowledge to critically analyse ecological data and to generate and implement new ideas in the field of environmental protection.
- ✓ Demonstrate knowledge of scientific research methods and their application in the analysis of environmental issues on a local, regional and planetary scale.
- ✓ Possess knowledge to perform innovative research, to apply analytical approach, to interpret research results correctly, to create summaries and to draw conclusions.
- ✓ Possess knowledge with the highest degree of complexity and demonstrate ability to expand them in the specific thematic field, have competencies in related scientific fields and in applying an interdisciplinary approach.

4.2. Skills (cognitive and/or practical)

The students who complete their doctoral degree will:

- ✓ Organize and plan scientific activity, analytically and critically evaluate experimental results, create and lead research groups or teams, manage human and financial resources.

- ✓ Argumentatively, with evidence analyse and defend theses related to the scientific field and the topic of the dissertation, seek innovative solutions by combining different strategies and models, improve, adapt and test new methods and approaches.
- ✓ Have skills such as creative thinking, analytical and intellectual flexibility, be able to find, summarize and evaluate relevant information from different sources in a certain sequence and logic.
- ✓ Professionally prepare and present scientific and technical documents and communicate through various media to different audiences.

4.3. Independence and responsibility

By the end of their training the PhD students will:

- ✓ Possess self-criticism and ability to self-assess their scientific research achievements
- ✓ Demonstrate capacity to systematically acquire and understand a significant amount of knowledge of the latest scientific achievements in the field of ecology and environmental protection
- ✓ Demonstrate interpretation competency of both own and other research, indicate that they have acquired skills in expanding the scope of the studied scientific field and in selection of up-to-date publications
- ✓ Use scientific language and style, characterised by accuracy in handling scientific terminology, and by clarity and logical consistency in presenting facts and results.

4.4. Learning competence

- ✓ Demonstrate capacity for systematic acquisition, understanding and upgrading of a significant amount of knowledge dedicated to modern scientific achievements in the field of ecology theory and practice.

4.5. Communicative and social competencies

The students who complete their doctoral degree will be able to:

- ✓ Show high personal responsibility, independent initiative and scientific style of communication (in conversations, in consultations and debates, in the defence of scientific positions, etc.)
- ✓ Demonstrate general skills to conceptualize, design and implement projects, to understand and apply the latest achievements, as well as to adapt design solutions to unforeseen circumstances
- ✓ Communicate fluently in Bulgarian, English and / or another language.

4.6. Professional competencies

By the end of their training the PhD students will:

- ✓ Apply specialised research techniques and independent professional approach to conducting research experimental and practical activities
- ✓ Analyse, interpret and identify the main patterns and trends in environmental pollution, climate change, sustainable use and opportunities for management of natural resources in accordance with human needs and aimed at improving the quality of life
- ✓ Apply fundamental principles, formulate ideas and find environmentally friendly approaches to solving global, regional and local problems in the protection of biodiversity, air, water, soil and waste management
- ✓ Apply new achievements, demonstrate competencies for generating new knowledge, be able to transfer their own results in solving other interdisciplinary problems
- ✓ Identify resources and opportunities for research and project activities in the field of component analysis and environmental monitoring; make informed decisions and

adapt project ideas, contribute to the development of new techniques, ideas or approaches

- ✓ Participate in strategic planning and management in the spirit of implementation of European and national standards for the implementation of thematic conventions, directives, regulations, strategies, plans and programs in the field of ecology and environmental protection.
- ✓ Participate in strategic planning and management through the implementation of European and national standards set out in various conventions, directives, regulations, strategies, plans and programmes in the field of ecology and environmental protection.

5. FIELDS OF PROFESSIONAL REALISATION

The PhD degree holders can be successfully realised as scientists in research institutions, experts in specialised laboratories, experts in the system of the Ministry of Environment and Water, in other ministries and agencies, in the state, regional and municipal administration, as ecologists in enterprises and companies in the production sphere, environmental protection experts and administrative managers, in consulting, design companies and non-governmental organisations, developing ecological projects, performing monitoring and ecological expertise, etc.

PhD STUDENTS EDUCATION

The PhD students are trained according to a Curriculum, which contains three main types of activities - educational activity, research activity and pedagogical activity. The individual work plan of the PhD student is accepted by the Council of the department of Geography, ecology and environmental protection and approved by the Council of the Faculty of Mathematics and Natural Science.

PhD students are supervised by the following qualified university professors:

1. Assoc. Prof. Lidia Sakelarieva, PhD;
2. Assoc. Prof. Konstantin Tyufekchiev, PhD;
3. Prof. Emilia Varadinova, PhD;
4. Assoc. Prof. Krasimir Stoyanov, PhD
5. Assoc. Prof. Hadejhda Nikolova, PhD

PhD students take exams in four compulsory courses during the educational process. Two of the compulsory courses are common to all PhD students in the SWU “N. Rilski”. These are "Project Preparation and Management" and "Methodological guidelines for writing a scientific article". The proposed list of elective courses is indicative. The compulsory courses 1 and 2, as well as the elective course, are offered in accordance with the topic of the dissertation. The courses are listed in the Individual work plan of the doctoral student.

CONDITIONS FOR ADMISSION TO THE PHD THESIS DEFENSE

The educational and scientific degree “Doctor of Philosophy” is acquired after fulfilling the obligations under Article 46, paragraph 2 of the Higher Education Act, Article 9, paragraph 2 of the Act for the Development of the Academic Staff in the Republic of Bulgaria, section II of the Regulations for the Application of the Act for the Development of the Academic Staff in the Republic of Bulgaria and according to the Terms and conditions for

acquiring the educational and scientific degree PhD of the Internal Rules for Academic Staff Development of the South-West University "Neofit Rilski".

CURRICULUM CONTENT

№	ACTIVITIES	Preparation and realization			Types of acknowledgement
		CREDITS	WORKLOAD	lectures, seminars, laboratory exercises, self-study, consultations, participation, other	written examination, ongoing assessment, certificate, report,
I.	**EDUCATIONAL ACTIVITY**				
1.	Compulsory course 1 from the thematic field of the PhD thesis	9.0	270	30 consult. / 240 self-study	examination
2.	Compulsory course 2 from the thematic field of the PhD thesis	9.0	270	30 consult. / 240 self-study	examination
3.	Preparation and management of projects	3.0	90	30 lec.,sem / 60 self-study	examination
4.	Methodological guidelines for writing a scientific article	4.0	120	60 lec.,sem. / 60 self-study	examination
5.	Elective course	5.0	150	30 consult. / 150 self-study	examination
	TOTAL:	**30**	**900**		
II.	**RESEARCH ACTIVITY**				
1.	Elaboration and presentation of a concept for the structure and content of the PhD thesis, determining the purpose, tasks and methods of research.	3.0	90	self-study, consultations	signed report
2.	Finding and studying literature sources on the topic of the PhD thesis.	10.0	300	self-study, consultations	signed report
3.	Analysis of selected literature sources and writing the chapter "Literature Review" of the dissertation.	8.0	240	self-study, consultations	signed report

4.	Field and/or laboratory studies and/or searching and collecting data on the topic of the PhD dissertation.	15.0	450	self-study, consultations	signed report
5.	Preparation and writing parts of the dissertation: "Materials and methods"and „Description of the model object of the study".	10.0	300	self-study, consultations	signed report
6.	Systematization, processing and analysis of the research data.	14.0	420	self-study, consultations	signed report
7.	Preparation and writing parts of the dissertation: „Results and discussion".	20.0	600	self-study, consultations	signed report
8.	Preparation of a report and participation in a scientific forum on ecology and/or environmental protection.	12.0	360	self-study, consultations, participation	certificate (minimum 2)
9.	Preparation and publication of an article in a scientific journal on the topic of the PhD thesis..	12.0	360	self-study, consultations	publication (minimum 3)
10.	General processing of the dissertation.	15.0	450	self-study, consultations	signed report
11.	Preparation and presentation of the thesis work at a meeting of the department council.	5.0	150	self-study, consultations	signed report
12.	Editing of the PhD manuscript.	6.0	180	self-study, consultations	signed report
	TOTAL:	**130**	**3900**		
III.	**PEDAGOGICAL ACTIVITY**				
1.	Conducting field training and / or exercises / practicum in courses from the curriculum of the Bachelors programme in Ecology and Environmental Protection".	4.0	120	lectures, seminars, laboratory work, self-study, consultations	minutes, report
2.	Consulting/Advising students in courses from the curriculum of the Bachelor programme in Ecology and Environmental Protection".	3.0	90	self-study	signed report
3.	Reviewing tests, presentations, written works etc., prepared by students in Bachelor programme "Ecology and Environmental Protection".	6.0	180	self-study	signed report

4.	Writing reviews of diploma works of students in Bachelor or Master programme “Ecology and Environmental Protection”.	2.0	60	self-study	minutes, report
	TOTAL:	**15**	**450**		
IV.	**OTHER**				
1.	Participation in meetings of the department “Geography, ecology and environmental protection”..	1.0	30	participation	minutes
2.	Participation in university commissions.	1.0	30	participation	minutes
3.	Participation in the work of department commissions, workshops or other administrative activities.	3.0	90	participation	minutes
	TOTAL:	**5**	**150**		
	TOTAL (for the entire period of study)**:**	**180**	**5400**		
	ELECTIVE COURSES				
1.	Application of GIS in ecological and geographical research	5.0	150	30 consult. / 150 self-study	examination
2.	Applied statistics	5.0	150	30 consult. / 150 self-study	examination
3.	Mathematical models in ecology and environmental protection	5.0	150	30 consult. / 150 self-study	examination
4.	Remote sensing for assessment and analysis of spatial information	5.0	150	30 consult. / 150 self-study	examination
5.	Modern technologies and environmental protection	5.0	150	30 consult. / 150 self-study	examination

COMPULSORY COURSE DESCRIPTION

PROJECT PREPARATION AND MANAGEMENT

ECTS credits: 3.0
Form of assessment: exam
Semester: I

Workload: 30 classes / 60 self study
Course type: compulsory
Examination type: written / interview

Annotation:

The aim of the course "Project Preparation and Management" is to prepare highly qualified specialists in project preparation and management at national and trans-European level, providing knowledge and skills for different types of projects and programs.

The specific objectives of the course are the following:

To provide basic knowledge and skills in project management by considering national and international instruments for support of projects and programs with different orientation;

To enrich the knowledge about the nature and main characteristics of project management and project team management;

To provide good practices for making strategic and tactical management decisions related to project management.

Doctoral students who study in this course will acquire after its completion the necessary competence to develop a project, project design is different areas, to participate in the management of a project and to bring it to fruition. The acquired knowledge is important because the development of different types of economic areas will be carried out on a project-program basis.

The course is in accordance with the mission and the concept of the university for providing modern and up-to-date knowledge; The volume of the course is in accordance with the provided credits, as well as the qualification characteristics of the PhD programme. The achievement of the objectives of the course will be controlled by conducting two tests - entrance and final.

METHODOLOGICAL GUIDELINES FOR WRITING A SCIENTIFIC ARTICLE

ECTS credits: 4.0
Form of assessment: exam
Semester: I
Workload: 60 classes / 60 self study
Course type: compulsory
Examination type: written / interview

Annotation:

The main objective of the course is to give the PhD students knowledge on the basic principles and practical techniques in the preparation of scientific publications. The first module of the course deals with the basic principles in the process of scientific publishing activity: the need for publication, the types of scientific articles, the features of each of them, the principle of operation of scientific journals, the review process. The second module examines the structure and elements of a scientific article. The third module presents the stages through which the development of a scientific article goes with practical guidelines for working on each of them. During the course, participants will acquire practical skills in writing a scientific article by developing their own publication.

The two remaining compulsory courses are specialized and are in line with the dissertation topic. Compulsory specialized courses could be „General Ecology“; „Protected territories and protected zones in Bulgaria“, „Diversity of the vertebrate fauna in Bulgaria“, “Monitoring of soils”, “Methods of ecological studies of invertebrates”, “Diversity of the herpetofauna in Bulgaria”, “Methods of ecological studies of vertebrates”,”Hydrobiology”, “Water pollution and impact on ecosystems”, “Limnology” “Methods for analysis and

assessment of surface water bodies status", "Anthropogenic impact on freshwater ecosystems", "Air pollution and impact on ecosystems", "Air monitoring".

Electives courses are also determined by the dissertation topic and could be "Application of GIS in the ecological and geographical research", "Mathematical models in ecology and environmental protection", "Contemporary technologies and environmental protection", "Methodological guidelines for writing a scientific article", "Applied statistics" and "Remote methods for spatial information analysis".

The research activity, which is laid down in the Curriculum of the PhD students, is aimed at conducting field research, laboratory analyses, review of thematic literary sources and preparation of scientific publications on the topic of the dissertation.

The pedagogical activity of the PhD students is mainly related to the conduct of laboratory exercises, teaching practices and preparation of reviews of diploma theses of students majoring "Bachelor" and "Master" programmes "Ecology and environmental protection".

ELECTIVE COURSE DESCRIPTION

APPLICATION OF GIS IN THE ECOLOGICAL AND GEOGRAPHICAL RESEARCH

ECTS credits: 5
Form of assessment: exam
Semester: III - IV

Workload: 30 consult. / 150 self study
Course type: optional
Examination type: written / interview

Annotation:

The course "Application of geographic information systems in the environnemental and geographical research" for the PhD program "Ecology and Environmental Protection" presents the general concepts of development and implementation of GIS. The lecture course complements the fundamental theoretical knowledge of the basic GIS course from the bachelor and master degree.

Aim of the course: The lecture course aims to provide specific knowledge on the application and the increasing role of GIS in solving issues related to the study of the distribution of animals, plants and important environmental factors, opportunities for the functioning of populations and components of ecosystems, as well as anthropogenic disturbances of ecosystems.

With the help of GIS, the ecologist builds not just a thematic map, but a model of processes. The aim is to analyze and organize various information about the territorial distribution of the studied phenomenon, to identify the relationships between the components of nature, to derive functional dependencies and generalized indicators or models to describe a particular process or phenomenon.

Tasks: In this course, the practical application of map projections in GIS, the transformations from one projection to another, interpolation methods for visualization of ecological models, generalizing cartographic procedures, classification methods of data in digital environment, vector and raster analyzes, the ways of presentation of three-dimensional objects and surfaces are discussed in more detail. It is extremely important for PhD students to use GIS to study the model of data collected from their own field research and to perform analysis in assessing and monitoring the condition of key components and environmental factors.

Expected results: At the end of the semester students should know how to apply their knowledge of GIS for mapping and analyzing data from the field of their research.

The end result of the theoretical and practical knowledge is students to be able to structure their own geobase with which can effectively present their environmental research.

APPLIED STATISTICS

ECTS credits: 5
Form of assessment: exam
Semester: III - IV
Workload: 30 consult. / 150 self study
Course type: optional
Examination type: written / interview

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.

MATHEMATICAL MODELS IN ECOLOGY AND ENVIRONMENTAL PROTECTION

ECTS credits: 5
Form of assessment: exam
Semester: III - IV
Workload: 30 consult. / 150 self study
Course type: optional
Examination type: written / interview

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 modelling of ecosystems. Models for assessment and management of exhaustible natural resources and renewable natural resources. 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. Modelling 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.

REMOTE SENSING METHODS FOR ASSESSMENT AND ANALYSIS OF SPATIAL INFORMATION

ECTS credits: 5
Form of assessment: exam
Semester: III - IV
Workload: 30 consult. / 150 self study
Course type: optional
Examination type: written / interview

Annotation:

The course aims to introduce the technical possibilities and applications of the aerospace methods and technologies as a tool that can be used in the assessment and analysis of spatial information. The emphasis is on remote sensing of the Earth. The various methods and tools for remote aerospace research are discussed, as well as the various techniques and processes for processing and analyzing the captured images.

The 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 studies. 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).

CONTEMPORARY TECHNOLOGIES AND ENVIRONMENTAL PROTECTION

ECTS credits: 5
Form of assessment: exam
Semester: III - IV
Workload: 30 consult. / 150 self study
Course type: optional
Examination type: written / interview

Annotation:

The aim of the course is to introduce the contemporary technologies for environmental protection from liquid and solid steady organic pollutions, and the Best Available Techniques (BAT) for environmental protection.

Course content: In this course the following main topics are considered: components of the environment; 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 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.