BIOLOGICAL MONITORING

Autumn semester, 2019-2020

Coordinator	**Nina Pakharkova**
Credits	3 ECTS (required course), 54 in-class hours
Lecturers	**Nina Pakharkova** (Siberian Federal University, Russia), **Tatiana Shashkova** (Siberian Federal University, Russia)
Level	MSc
Host institution	**Siberian Federal University**, School of Ecology and Geography
Course duration	September 1 – December 28, 2019

Summary

Assessment of soil, water and air quality is getting more and more actual therefore it is necessary to assess current and potential future impact on environment. Two fundamentally different approaches are used for this purpose: physically- chemical and biological. Biological approach is developed within the framework of biomonitoring of the environment.

The course will give students an advanced understanding of problems associated with environmental changes resulted from human activities, overcoming the environmental crisis caused by the environment pollution and it will also contribute to development of students' environmental awareness.

Target student audiences

Final-year MSc students in ecology and environmental management

Prerequisites

The content of the discipline is based on previous biologically and ecologically based BSc courses such as "Biology", "Chemistry", "Botany", "Zoology", "Mycology", "General Ecology", "Environmental monitoring", "Ecology of plants, animals and micro-organisms" and MSc courses such as "Contemporary Problems of Ecology and Nature", "The theoretical basis of estimation of environmental quality in the parameters of cell and organism" and reveals the methodology of the biological diagnosis of the environment.

Goals and objectives

The purpose of the course is to give students an advanced understanding of possibilities of biological monitoring of the environment, bio-indication and bioassay methods.

Academic aims, goals of the discipline:

• to introduce theoretical tools and standard methodological approaches of biological monitoring of the environment to the students;

• to develop practical skills and experience by means of modern methods of bio-indication and bioassays;

• to foster students' skills to the level of bachelor's and proficiency for R&D and industrial activities.

General learning outcomes:

By the end of the course students should be able to obtain professional competencies:

1. thorough understanding and creative use of knowledge from the basic and applied MSc subjects in research and industrial activities;

2. awareness of documents regulating organization management in the field of environmental monitoring;

3. expertise and determination to organize and manage research-based and expert-analytical work with in-depth knowledge in the field of environmental management and monitoring.

Overview of sessions and teaching methods

The course includes three modules dedicated to monitoring of different environmental objects. The course will combine three forms of training: lectures, practical and laboratory classes. Each module will start with theoretical course mastering during the lectures' period. Lectures will be interactive with maximum students' involvement into related topic. Laboratory activities comprise planning and conducting experiments with modern biomonitoring equipment. It will enable students not only to gain skills in applying analytical equipment and instruments but also teach them to plan work independently and analyze research results. Processing, discussing the experiments results, summarizing the workload accomplished during the seminars will provide students with the expertise to use the theoretical basis for the scientific analysis of research results. Students' independent work is of particular importance in the structure of the course. It is necessary to consolidate the acquired knowledge, skills and capabilities as well as additional discussion of uncertain issues. To organize control, guidelines placement for independent work and interaction between students and teachers, the electronic course platform shall be used. The elements such as "lecture", "assignment", "forum", "seminar" and "test" shall be applied in the e-learning course.

Course workload
The table below summarizes course workload distribution:

Activities	Learning outcomes	Assessment	Estimated workload (hours)
In-class activities			
Lectures	Understanding theories, concepts, methodology and tools	Class participation	18
Laboratory work	Ability to carry out research independently and in a team	Class participation	18
Workshop	Ability to interpret data, analyze results, and use the concepts, tools, and methods for communicating information to workshop participants.	Class participation, preparedness for assignments and preparedness for discussions	18
Independent work			
Course assignments		Quality of individual assignments	18
Interactive work in e-course seminars	The ability to competently and effectively present the material to the	The quality of topical issues	24

	audience and enter into a discussion on topical issues of environmental biomonitoring	analysis of biomonitoring, and the quality of reviews of works	
Tests	Knowledge of theoretical issues in the discipline	Accuracy of answers	2
Reading and discussion of assigned papers for seminars and preparation for lectures	Familiarity with and ability to critically and creatively discuss key concepts, tools and methods as presented in the literature	Class participation, creative and active contribution to discussion	28
Total			*108*

Grading

The students' performance will be based on the following:

- Level of preparedness for participation in class discussions and seminars (30 %): ranging from 100 % for active participation and to 0 % for complete ignorance of in-class discussions and lack of demonstrated awareness of the course readings;
- Contribution to laboratory group work (30 %): ranging from 100% for clearly demonstrated input to 0 % for non-participation;
- Quality of the answers to control tests (10%);
- Quality of knowledge of the lectures material (15%);
- Quality of preparation of e-course assignments (15%).

Course schedule

Week №	Time	Topic	Lecturer
1		**Lecture**: The principles of organization of biological monitoring	Nina Pakharkova
		Lecture: Basic requirements and approaches to the development of methods of biomonitoring	
		Seminar: General characteristics of biological methods for assessing the state of the environment at different levels of the organization	
2		**Laboratory work**: Assessment of the state of plants by determining the parameters of photosynthetic energy conversion (PAM-fluorimeter)	Nina Pakharkova
		Laboratory work: Evaluation of the activity of the photosynthetic apparatus of plants by the parameters of delayed fluorescence (Fluorimeter "Foton-10")	
		Seminar: Advantages and disadvantages of biological methods of control of environment	
3		**Lecture**: Methods of assessment of air environment quality	Nina Pakharkova

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		Seminar: Lichenoindication and phytoindication of air quality	
		Laboratory work: Determination of the influence of atmospheric pollution on the life cycles of plants using the method of registration of thermally induced changes in the zero level of chlorophyll fluorescence (Fluorimeter "Foton-11")	
4		**Lecture**: Bioindication of aquatic ecosystems	Tatiana Shashkova
		Seminar: Saprobity index for assessment of water quality	
		Lecture: Bioassay methods of water, soil and waste	
5		**Laboratory work**: Determination of toxicity of waste water samples by the intensity of luminescent bacteria luminescence	Tatiana Shashkova
		Laboratory work: Determination of the toxicity of water samples by the change in the relative index of delayed fluorescence of the *Chlorella* algae culture	
		Laboratory work: Determination of toxicity of water samples by changes in feeding rate of *Daphnia magna* Straus	
6		**Seminar**: Discussion, statistical processing and presentation of laboratory results	Tatiana Shashkova
		Lecture: Modern trends in the development of biomonitoring of the aquatic environment	
		Seminar: Modern methods of bioassay the quality of water, soil and waste	

Literature

Biomonitoring: General and Applied Aspects on Regional and Global Scales / C. A. Burga, A. Kratochwil ISBN: 978-90-481-5621-4 (Print) 978-94-015-9686-2 (Online) http://link.springer.com/book/10.1007/978-94-015-9686-2

Protocols in Lichenology. Culturing, Biochemistry, Ecophysiology and Use in Biomonitoring / Ilse C. Kranner, Richard P. Beckett, Ajit K. Varma ISBN:978-3-642-56359-1(Online) http://link.springer.com/book/10.1007/978-3-642-56359-1

Biomonitoring of Water and Waste Water / Anju Agrawal, Krishna Gopal ISBN: 978-81-322-0864-8 (Online) http://link.springer.com/book/10.1007/978-81-322-0864-8

Bioassays. Advanced Methods and Applications. / Donat-P. Häder and Gilmar S. Erzinger ISBN 978-0-12-811861-0 (Online) https://www.sciencedirect.com/book/9780128118610/bioassays