MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SUMY NATIONAL AGRARIAN UNIVERSITY
Faculty of Agrotechnologies and Natural Resource Management
Department of Ecology and Botany

MODULE SYLLABUS
OC 2. **BIOINDICATION AND BIOTESTING**

(optional)

Implemented in the "Ecology" Academic Program

Area of specialization: 101 "Ecology"

at the third (educational and scientific) level of higher education

Sumy – 2021

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                                                Sciences, Professor, Head of Ecology and
                                                Botany Department

| Module syllabus viewed and agreed at the Ecology and Botany Department meeting | Minutes № 19 dated June 07, 2021 |
| | Head of Department   _____   **V. G. Skliar**
 (signature)   (surname, initials) |

Approved by:

Guarantor of the Academic program   I. M. Kovalenko

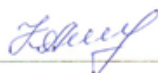Dean of the Faculty   I. M. Kovalenko

Syllabus review (attached) is provided by : _____   V. G. Skliar

                                                           G.O. Klymenko

Syllabus review data:

The academic year in which changes are made	The Academic program attachment number with changes description	Changes revised and approved		
		Minutes No and date of the department meeting	Head of Department	Guarantor of the Academic program

1. MODULE OVERVIEW

1.	Title	Bioindication and biotesting
2.	Faculty/Department	Faculty of Agrotechnologies and Natural Resource Management Department of Ecology and Botany
3.	Type (compulsory or optional)	Optional
4.	Program(s) to which module is attached	
5.	Module can be suggested for (to be filled in for optional types)	Academic program " Ecology " Area of specialization 101 " Ecology "
6.	Level of the National Qualifications Framework	8 level
7.	Semester and duration of module	III semester
8.	ECTS credits number	5 (150 hours)

9.	Total workload and time allotment	Directed study			Self-directed study	
		Lectures	Practicals	Labs		
		20	30		100	

10.	Language of instruction	Ukrainian, English
11.	Module leader	Sklyar Victoria Grigorivna
11.1	Module leader contact information	PhD in Biology, Professor of Ecology and Botany Department, room 25a, skvig@ukr.net
12.	Module description	The theoretical bases of bioindication and biotesting, the basic concepts connected with these directions of biological and ecological researches, prospects of development and bioindication and biotesting are studied.
13.	Module aim	Formation of knowledge among applicants about bioindication methods for studying natural and artificial ecosystems in order to understand the features of their functioning using biological test objects.
14.	Module Dependencies (prerequisites, co-requisites, incompatible modules)	The educational component is based on the study of such disciplines as: "A Plant in the experiment", "Research methodology"
15.	The policy of academic integrity	PhD student must follow the rules of academic integrity doing the practical tasks, writing modular, attestation, test and examination tasks. If the facts of copying or academic dishonesty are identified, the work done by the PhD student is not credited.
16.	Link in Moodle	https://cdn.snau.edu.ua/moodle/course/view.php?id=4787

2. CORRELATION BETWEEN MODULE LEARNING OUTCOMES (MLOs) AND PROGRAM LEARNING OUTCOMES (PLOs)
(101 "Ecology")

MLOs: On successful completion of the module the PhD student will be able to:	PLOs (indicate the number according to the numbering given in the AP)					How assessed
	PLOs1 Demonstrate a deep knowledge of the advanced conceptual and methodological foundations of the natural sciences, which makes it possible to rethink and deepen the science of the environment.	**PLOs2** Demonstrate mastery of general scientific concepts of modern natural science.	**PLOs7** Independently use modern equipment for research in the field of ecology, environmental protection and sustainable use of nature.	**PLOs13** Be able to carry out a comprehensive analysis of the state of populations and develop measures to ensure their protection and rational, inexhaustible use.	**PLOs14** Be able to assess the degree, nature of the negative impact of agricultural production and other types of anthropopression on humans, biodiversity, the environment, assess risks and propose measures for the greening of the agrosphere.	
MLOs 1. Possess the basics of bioindication and biotesting as components of biological monitoring of the environment.	X	X				Report, discussion, survey, test control.
MLOs 2. Operate the basic concepts related to the implementation of bioindication and biotesting.			**X**			Report, discussion, survey, test control. Preparation of a report with a multimedia presentation. Checking and analysis of completed tasks.
MLOs 3. Possess the principles of modern environmental regulation of technogenic impacts on the environment based on biological criteria.	X	X			X	Report, discussion, survey, test control. Preparation of a report with a multimedia presentation. Checking and analysis of completed tasks.
MLOs 4. Understand the prospects for the development and use of bioindication and biotesting as components of biological monitoring.	X	X				Report, discussion, survey, test control. Preparation of a report with a multimedia presentation. Checking and analysis of completed tasks. Mastering skills and abilities in observation.
MLOs 5. Be able to use microorganisms in the system of measures for bioindication and			**X**		X	Report, discussion, survey, group work, test control. Preparation of a report with a multimedia presentation. Checking and analysis of

biotesting.						completed tasks. Observation of PhD students in the process of performing tasks.
MLOs 6. Possess the theoretical and practical principles of lichenoindication.		X	X		X	Report, discussion, survey, group work, test control. Preparation of a report with a multimedia presentation. Checking and analysis of completed tasks. Observation of PhD students in the process of performing tasks.
MLOs 7. Identify insects as indicators and know their practical significance			**X**		X	Report, discussion, survey, group work, test control. Preparation of a report with a multimedia presentation. Checking and analysis of completed tasks. Observation of PhD students in the process of performing tasks.
MLOs 8. Possess the theoretical and practical foundations for determining the signs of the state of the environment based on eco-scales and the results of a comprehensive population analysis.			**X**	X	X	Report, discussion, survey, group work, test control. Preparation of a report with a multimedia presentation. Checking and analysis of completed tasks. Observation of PhD students in the process of performing tasks.

3. MODULE INDICATIVE CONTENT

Topics. (List of issues to be addressed within the topic)	Distribution of hours				Learning resources
	Directed study			Self-directed study	
	Lectures	Practicals	Labs		
Topic 1. Objects and subject of bioindication.	2	3		10	1,2,3,4
Topic 2. Ecological principles of bioindication. Requirements for bioindicators.	2	3		10	1,2,3,4,9
Topic 3. Methods of bioindication research.	2	3		10	1,2,3,4,8
Topic 4. Bioindication and environmental monitoring.	2	3		10	1,2,3,4,11
Topic 5. Microorganisms as test objects of bioindication.	2	3		10	1,2,3,4,7
Topic 6. Multicellular invertebrates as indicator objects in bioindication.	2	3		10	3,4,6,9
Topic 7. Vertebrates in bioindication**.**	2	3		10	5,7,9,11
Topic 8. The use of algae for water quality analysis.	2	3		10	1,2,3,10
Topic 9. Lichenoindication of biosystems.	2	3		10	1,2,3,4,7
Topic 10. Phytoindicator characteristics of plant communities.	2	3		10	8,9,11
Total hours	20	30		100	

4. TEACHING AND LEARNING METHODS

MLOs	Teaching methods (directed study)	Hours	Learning methods (self-directed study)	Hours
MLOs 1. Possess the basics of bioindication and biotesting as components of biological monitoring of the environment.	conducting lectures using multimedia presentations and calculated practical work	10	- studying of unknown (new) terms, - studying of additional material on relevant topics.	20
MLOs 2. Operate the basic concepts related to the implementation of bioindication and biotesting.	conducting lectures using multimedia presentations and calculated practical work	10	- studying of additional material on relevant topics, - analysis of the work done in carrying out the tasks and preparation for the defense of papers, - writing essays and / or abstracts.	20
MLOs 3. Possess the principles of modern environmental regulation of technogenic impacts on the environment based on biological criteria.	conducting lectures using multimedia presentations and calculated practical work	10	- studying of additional material on relevant topics, - analysis of the work done in carrying out the tasks and preparation for the defense of papers, - writing essays and / or abstracts.	20
MLOs 4. Understand the prospects for the development and use of bioindication and biotesting as components of biological monitoring.	conducting lectures using multimedia presentations and calculated practical work	10	- studying of additional material on relevant topics, - analysis of the work done in carrying out the tasks and preparation for the defense of papers, - writing essays and / or abstracts.	20
MLOs 5. Be able to use microorganisms in the system of measures for bioindication and biotesting.	conducting lectures using multimedia presentations and calculated practical work	10	- studying of additional material on relevant topics, - analysis of the work done in carrying out the tasks and preparation for the defense of papers, - writing essays and / or abstracts.	20
MLOs 6. Possess the theoretical and practical principles of lichenoindication.	conducting lectures using multimedia presentations and calculated practical work		- studying of additional material on relevant topics, - analysis of the work done in carrying out the tasks and preparation for the defense of papers,	

				- writing essays and / or abstracts.	
MLOs 7. Identify insects as indicators and know their practical significance	conducting lectures using multimedia presentations and calculated practical work			- studying of additional material on relevant topics, - analysis of the work done in carrying out the tasks, - writing essays and / or abstracts.	
MLOs 8. Possess the theoretical and practical foundations for determining the signs of the state of the environment based on eco-scales and the results of a comprehensive population analysis.	conducting lectures using multimedia presentations and calculated practical work			- studying of additional material on relevant topics, - analysis of the work done in carrying out the tasks and preparation for the defense of papers, - writing essays and / or abstracts.	
Total hours		50			100

5. ASSESSMENT

5.1. Summative assessment

5.1.1. To assess the expected learning outcomes provided

№	Summative assessment methods	Grades	Deadline
Module 1			
1.	Practical work 1.1. Bioindication of water quality using invertebrates on the example of daphnia.	3 grades /3%	Up to 3 week
2.	Practical work 1.2. Bioindication of the aquatic environment state according to the anomalies of amphibian development.	3 grades /3%	Up to 4 week
3.	Practical work 1.3. Determination of the saprobity index by Pantle and Buk. Determination of the Mayer biotic index.	3 grades /3%	Up to 5 week
4.	Practical work 1.4. Determination of free oxygen in water by the Winkler method.	3 grades /3%	Up to 6 week
5.	Practical work 1.5. Microbiological methods of water quality research.	3 grades /3%	Up to 7 week
6.	Modular control	5 grades /5%	Up to 8 week
7.	Attestation (multiple choice test)	15 grades /15%	Up to 8 week
Module 2			
8.	Practical work 2.1. Compilation of water bodies regulatory documentation.	4 grades /4%	Up to 10 week
9.	Practical work 2.2. Accounting for bacteria in the air of educational premises.	4 grades /4%	Up to 11 week
10.	Practical work 2.3. Assessment of biotope air pollution by lichen condition.	4 grades /4%	Up to 12 week
11.	Practical work 2.4. Bioindication of air and soil pollution by the quality of dandelion pollen.	4 grades /4%	Up to 13 week
12.	Practical work 2.5. Determination of the environment state signs on the basis of ecoscales and the results of complex population analysis.	4 grades /4%	Up to 14 week
13.	Modular control	15 grades / 15%	Up to 15 week

14.	Exam		30 grades /30%	Examination period

5.1.1. ASSESSMENT CRITERIA

Component	**Unsatisfactory**	**Satisfactory**	**Good**	**Excellent**
Module 1				
Practical work 1.1. Bioindication of water quality using invertebrates on the example of daphnia.	*0 grades* Practical work is not done or done improperly	*1 grade* Not all tasks are calculated	*2 grades* All requirements and tasks are fulfilled, but the PhD student is not sufficiently versed in the theoretical material	*3 grades* All requirements and tasks are fulfilled, the obtained results are clearly interpreted, the opinion and the vision of a certain problem are formed.
Practical work 1.2. Bioindication of the aquatic environment state according to the anomalies of amphibian development.	*0 grades* Practical work is not done or done improperly	*1 grade* Not all tasks are calculated	*2 grades* All requirements and tasks are fulfilled, but the PhD student is not sufficiently versed in the theoretical material	*3 grades* All requirements and tasks are fulfilled, the obtained results are clearly interpreted, the opinion and the vision of a certain problem are formed.
Practical work 1.3. Determination of the saprobity index by Pantle and Buk. Determination of the Mayer biotic index.	*0 grades* Practical work is not done or done improperly	*1 grade* Not all tasks are calculated	*2 grades* All requirements and tasks are fulfilled, but the PhD student is not sufficiently versed in the theoretical material	*3 grades* All requirements and tasks are fulfilled, the obtained results are clearly interpreted, the opinion and the vision of a certain problem are formed.
Practical work 1.4. Determination of free oxygen in water by the Winkler method.	*0 grades* Practical work is not done or done improperly	*1 grade* Not all tasks are calculated	*2 grades* All requirements and tasks are fulfilled, but the PhD student is not sufficiently versed in the theoretical material	*3 grades* All requirements and tasks are fulfilled, the obtained results are clearly interpreted, the opinion and the vision of a certain problem are formed.
Practical work 1.5. Microbiological methods of water quality research.	*0 grades* Practical work is not done or done improperly	*1 grade* Not all tasks are calculated	*2 grades* All requirements and tasks are fulfilled, but the PhD student is not sufficiently versed in the theoretical material	*3 grades* All requirements and tasks are fulfilled, the obtained results are clearly interpreted, the opinion and the vision of a certain problem are formed.
Modular control : test, oral questioning, written test (at the discretion of the module leader)	*0-5 points* Assessed based on the number of correct answers			
Attestation (multiple	0-3 grades	*3-7 grades*	*7-13 grades*	*13-15 grades*

choice test)	Depends on the number of correct answers to the test	Depends on the number of correct answers to the test	Depends on the number of correct answers to the test	Depends on the number of correct answers to the test
Module 2				
Practical work 2.1. Compilation of water bodies regulatory documentation.	*0-1 grades*	*2 grades*	*3 grades*	*4 grades*
	Practical work is not done or done improperly	Not all tasks are calculated	All requirements and tasks are fulfilled, but the PhD student is not sufficiently versed in the theoretical material	All requirements and tasks are fulfilled, the obtained results are clearly interpreted, the opinion and the vision of a certain problem are formed.
Practical work 2.2. Accounting for bacteria in the air of educational premises.	*0-1 grades*	*2 grades*	*3 grades*	*4 grades*
	Practical work is not done or done improperly	Not all tasks are calculated	All requirements and tasks are fulfilled, but the PhD student is not sufficiently versed in the theoretical material	All requirements and tasks are fulfilled, the obtained results are clearly interpreted, the opinion and the vision of a certain problem are formed.
Practical work 2.3. Assessment of biotope air pollution by lichen condition.	*0-1 grades*	*2 grades*	*3 grades*	*4 grades*
	Practical work is not done or done improperly	Not all tasks are calculated	All requirements and tasks are fulfilled, but the PhD student is not sufficiently versed in the theoretical material	All requirements and tasks are fulfilled, the obtained results are clearly interpreted, the opinion and the vision of a certain problem are formed.
Practical work 2.4. Bioindication of air and soil pollution by the quality of dandelion pollen.	*0-1 grades*	*2 grades*	*3 grades*	*4 grades*
	Practical work is not done or done improperly	Not all tasks are calculated	All requirements and tasks are fulfilled, but the PhD student is not sufficiently versed in the theoretical material	All requirements and tasks are fulfilled, the obtained results are clearly interpreted, the opinion and the vision of a certain problem are formed.
Practical work 2.5. Determination of the environment state signs on the basis of ecoscales and the results of complex population analysis.	*0-1 grades*	*2 grades*	*3 grades*	*4 grades*
	Practical work is not done or done improperly	Not all tasks are calculated	All requirements and tasks are fulfilled, but the PhD student is not sufficiently versed in the theoretical material	All requirements and tasks are fulfilled, the obtained results are clearly interpreted, the opinion and the vision of a certain problem are formed.
Modular control: test, oral questioning, written test (at the discretion of the module leader)	*0-15 grades*			
	Assessed based on the number of correct answers.			
Exam	*0-5 grades*	*5-15 grades*	*15-27 grades*	*30 grades*
	The PhD student is not sufficiently versed in the theoretical material, the tasks are not	The PhD student is not sufficiently versed in the theoretical material, the tasks are done	The PhD student is sufficiently versed in the theoretical material, the tasks are completed	The PhD student is well versed in the theoretical material, all tasks are completed

	completed	with mistakes		

5.2.   Formative Assessment

№	Formative Assessment elements	Date
1	Oral questioning after studying each topic	After completing the study of the topic
2	Oral answers to individual questions during lectures and practicals	Throughout the semester
3	Analysis of texts on the topics of the course worked out by the PhD student individually	Throughout the semester
4	Defence of practical work	After completing of work
5	Oral feedback from the tutor when working on practicals.	Throughout the semester

6. LEARNING RESOURCES
Key resources

1. Шалімов М.О. Біоіндикація: конспект лекцій / М.О. Шалімов. – О.: Наука і техніка, 2011. – 124 с.

2. Чухрій Ю.П. Біоіндикація. Біотестування. Біомоніторинг./ Ю.П. Чухрій. - Одеса: ОНАХТ, 2014. – 41 с.

3. Дідух Я.П., Плюта П.Г. Фітоіндикація екологічних факторів. К.: Наук. думка, 1994 – 280 с.

4. Злобин Ю.А., Скляр В.Г., Клименко А.А. Популяции редких видов растений: теоретические основы и методика изучения. Сумы: Унив. книга, 2013 - 439 с.

5. Didukh Ya. P. The ecological scales for the species of Ukrainian flora and their use in synphytoindication. – Kyiv: Phytosoziocentr, 2011. – 176 p.

6. Дідух Я.П. Основи біоіндикації / Я.П. Дідух. – Київ: Наукова думка, 2012. – 312 с.

7. Біоіндикація. Методичні рекомендації до виконання лабораторних робіт студентами напряму підготовки 6.040106 «Екологія, охорона навколишнього середовища та збалансоване природокористування» / А.І. Горова, А.В. Павличенко, О.О. Борисовська, В.Ю. Ґрунтова, О.В. Деменко; − Д.: Національний гірничий університет, 2014. – 76 с.

8. Карпова Г., Зуб Л., Мельничук В., Проців Г. Оцінка екологічного стану водойм методами біоіндикації. Перші кроки до оцінки якості води. – Бережани, 2010. – 32 с.

9. Посудін Ю.І. Методи вимірювання параметрів навколишнього середовища. - К.: Світ, 2003.- 288 с.

Other sources
10. Гідроекологічна токсикометрія та біоіндикація забруднень: теорія, методи, практика використання / За ред. Олексієва І.Т., Брагінського Л.П. – Львів: Світ, 1995. – 440 с.: іл.
11. Шапиро И. А. Загадки растения-сфинкса. Лишайники и экологический мониторинг. - Л.: Гидрометиздат. - 2001, с. 80.

Information resources

1.https://books.google.de/books?id=2RjsmXBBegIC&pg=PA1&hl=ru&source=gbs_selected_pages&cad=2#v=onepage&q&f=false-Біоіндикація: конспект лекцій

2. http://www.twirpx.com/file/1462632/ - підручник з біоіндикації

3. http://www.twirpx.com/file/1355881/ -Дідух Я.П. Основи біоіндикації

4. http://any-book.org/download/31517.html - агроекологічний моніторинг

5. https://www.slideshare.net/VovaLozik/ss-57214077-біоіндикація- навчальний посібник

Academic Program (Syllabus) Review
BIOINDICATION and BIOTESTING

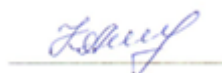| Parameter by which the educational program (syllabus) of the educational component is assessed by the guarantor or a member of the project team	Yes	No	Comment
Learning outcomes according the educational component (MLOs) correspond to the NQF	+		
Learning outcomes according the educational component (MLOs) correspond to the stipulated PLOs (for compulsory EC)	+		
The results of training in the educational component provide an opportunity to measure and assess the level of their achievement	+		

Member of the project group Ecology Academic Program   *Beus-*   V.G. Skliar

Parameter by which the educational program (syllabus) of the educational component is assessed by the teacher of the relevant department	Yes	No	Comment
General information about the educational component is sufficient	+		
Learning outcomes for the educational component (MLOs) correspond to the NQF The list of training resources contains the necessary software products to achieve DRN	+		
Learning outcomes for the educational component (MLOs) provide an opportunity to measure and assess the level of their achievement	+		
Learning outcomes (MLOs) relate to the students competencies, not the content of the discipline (contain knowledge, skills, abilities, not topics of the curriculum of the discipline)	+		
The content of the EC is formed in accordance with the structural and logical scheme	+		
Learning activity (teaching and learning methods) allows students to achieve expected learning outcomes (MLOs)	+		
The educational component involves learning through research that is appropriate and sufficient for the corresponding level of higher education	+		
The assessment strategy within the educational component is in line with the policy of the University / faculty	+		
The provided assessment methods allow to assess the degree of achievement of learning outcomes in the educational component	+		
The workload of students is adequate to the volume of the educational component	+		
Recommended learning resources are sufficient to achieve learning outcomes (MLOs)	+		
The literature is relevant	+		
The list of training resources contains the necessary software products to achieve MLOs	+		

Reviewer   *Lauy*   G.O. Klymenko