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

MODULE SYLLABUS
EC 6. *Modelling and Planning of the Scientific Experiment*
(compulsory)

Implemented in the "Ecology" Academic Program

Area of specialization 101 *"Ecology"*

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

Sumy – 2021

Author: Doctor of Agr.Sciences, Professor, Head of the Department of Biotechnology and Phytopharmacology Podgaetsky A.A.

Module syllabus viewed and agreed at the Biotechnology and Phytopharmacology Department meeting	Minutes № 42 dated July 5, 2021
	Head of Biotechnology and Phytopharmacology Department **Prof.PodgaetskyA.A.** (surname, initials)

Approved by:

Guarantor of the Academic program Kovalenko I.M.

Dean of the Faculty Kovalenko I.M.

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

<table>
<tr><td>1.</td><td>Title</td><td colspan="4">Modelling and Planning of the Scientific Experiment</td></tr>
<tr><td>2.</td><td>Faculty/Department</td><td colspan="4">Faculty of Agrotechnologies and Natural Resource Management
Department of Biotechnology and Phytopharmacology</td></tr>
<tr><td>3.</td><td>Type (compulsory or optional)</td><td colspan="4">compulsory</td></tr>
<tr><td>4.</td><td>Program(s) to which module is attached</td><td colspan="4">Academic program “ Ecology ”
Area of specialization 101 “ Ecology ”</td></tr>
<tr><td>5.</td><td>Module can be suggested for (to be filled in for optional types)</td><td colspan="4">-</td></tr>
<tr><td>6.</td><td>Level of the National Qualifications Framework</td><td colspan="4">8 level</td></tr>
<tr><td>7.</td><td>Semester and duration of module</td><td colspan="4">3 semester, 5 weeks</td></tr>
<tr><td>8.</td><td>ECTS credits number</td><td colspan="4">3,0 credits (90 hours)</td></tr>
<tr><td rowspan="3">9.</td><td rowspan="3">Total workload and time allotment</td><td colspan="3">Directed study</td><td rowspan="2">Self-directed study</td></tr>
<tr><td>Lectures</td><td>Practicals</td><td>Labs</td></tr>
<tr><td>16</td><td>-</td><td>14</td><td>60</td></tr>
<tr><td>10.</td><td>Language of instruction</td><td colspan="4">Ukrainian, English</td></tr>
<tr><td>11.</td><td>Module leader</td><td colspan="4">Doctor of Agr.Sciences, Professor, Podgaetsky A. A.</td></tr>
<tr><td>11.1.</td><td>Module leader contact information</td><td colspan="4">Podgaetsky A. A., podgaje@ukr.net, room C 22</td></tr>
<tr><td>12</td><td>Module description</td><td colspan="4">Use the latest scientific developments to understand the deep environmental processes that occur with plants during research. A systematic approach to modeling and planning of the environmental research. Development of conditions for the successful environment functioning.</td></tr>
<tr><td>13.</td><td>Module aim</td><td colspan="4">Not a simple study of the phenomena of simulated processes, but the improvement of the obtained data for their control, the creation of optimal conditions for the implementation of plant organisms characteristics in various environmental situations.</td></tr>
<tr><td>14</td><td>Module Dependencies (prerequisites, co-requisites, incompatible modules)</td><td colspan="4">The basis for studying the reaction of plants during the performance of ecological research should be a good knowledge of general biological conditions, as well as related sciences of chemistry, physics, mathematics, and so on. After mastering the course, the PhDe student will be able to explain much more deeply the processes that occur with plants, in the experiment, including from the standpoint of the relationship between plants and their environment</td></tr>
<tr><td>15.</td><td>The policy of academic integrity</td><td colspan="4">A priori, the tasks set for PhD students must be performed by them independently. In case of rewriting detection, the papers submitted for verification returned for revision or canceled. The results of works of different levels: scientific articles, dissertation are checked for plagiarism.</td></tr>
<tr><td>16.</td><td>Link in Moodle</td><td colspan="4">https://cdn.snau.edu.ua/moodle/course/view.php?id=4812</td></tr>
</table>

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 advanced concepts and methodological foundations of the natural sciences, which provides an opportunity to rethink and deepen the science of the environment	**PLOs2** Demonstrate mastery of general scientific concepts of modern natural science	**PLOs6** Apply methods of mathematical and geoinformation analysis and modelling of the current state and forecasting changes in ecosystems and their components	**PLOs7** Independently use modern equipment for research in the field of ecology, environmental protection and sustainable use of nature	
MLOs 1. On the basis of the deep knowledge to determine the direction of own research in the field of ecology, environmental protection and sustainable use of nature, which will be relevant and in demand.	X	X			Report, discussion, survey, test con-trol.
MLOs 2. Understand, successfully choose and use scientific methods of knowledge of current issues and issues in the field of ecology, environmental protection and sustainable use of nature.	X	X			Report, discussion, survey, test con-trol. Preparation of a report with a multimedia presentation. Checking and analysis of completed tasks.
MLOs 3. Effectively use various methods of mathematical modeling, planning, analysis of the state of the environment, geoinformation analysis in order to organize and conduct a scientific experiment.		X	X		Report, discus-sion, survey, test con-trol. Prepa-ration of a re-port with a mul-timedia presen-tation. Checking and analysis of completed tasks.
MLOs 4. To be able to optimally select and use modern scientific equipment to obtain experimental data in the field of ecology, environmental protection and sustainable use of nature.				X	Report,discussio n, survey, test control. Preparation of a report with a multimedia presentation. Checking and analysis of completed tasks. Mastering skills and abilities in observation.

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		
Theme 1. Role of modelling in understanding objective reality in the field of ecology, environmental protection and balanced natural resource management	2	-		8	1,2,3,7,17
Theme 2. The role of mathematical modelling in the knowledge of ecological laws	2	2		6	1,3,4,6,11,16
Theme 3. Functions of ecological forecasting	2	2		8	8,9, 12, 14, 19
Theme 4. Strategy and tactics of planning an experiment in ecology.	2	2		8	5,8, 10, 13, 20
Theme 5. Purpose and objectives of environmental projects.	2	2		8	10, 12, 15, 17, 19
Theme 6. Environmental factor and its role in maintaining a balanced nature management	2	2		8	8, 13, 15, 21
Theme 7. Ecological and evolutionary optimum	2	2		6	1, 13, 14, 18, 20
Theme 8. Types and significance of statistical data processing on ecology	2	2		8	5, 8, 19,20
Total hours	16	14		60	

4. TEACHING AND LEARNING METHODS

MLOs	**Teaching methods** (directed study)	**Hours**	**Learning methods** (self-directed study)	**Hours**
MLOs 1. On the basis of the deep knowledge to determine the direction of own research in the field of ecology, environmental protection and sustainable use of nature, which will be relevant and in demand.	conducting lectures with the use of multimedia presentations and calculated practical work	6	- elaboration of unfamiliar (new) terms, - elaboration of additional material on relevant themes	12
MLOs 2. Understand, successfully choose and use scientific methods of knowledge of current issues and issues in the field of ecology, environmental protection and sustainable use of	conducting lectures with the use of multimedia presentations and calculated practical work	8	- elaboration of additional material on relevant themes, - analysis of the work performed during the tasks and preparation for the defense of works, - writing essays and / or abstracts	12

nature.				
MLOs 3. Effectively use various methods of mathematical modeling, planning, analysis of the state of the environment, geoinformation analysis in order to organize and conduct a scientific experiment.	conducting lectures with the use of multimedia presentations and calculated practical work	8	- elaboration of additional material on relevant themes, - analysis of the work performed during the tasks and preparation for the defense of works, - writing essays and / or abstracts	18
MLOs 4. To be able to optimally select and use modern scientific equipment to obtain experimental data in the field of ecology, environmental protection and sustainable use of nature.	conducting lectures with the use of multimedia presentations and calculated practical work	8	- elaboration of additional material on relevant themes, - analysis of the work performed during the tasks and preparation for the defense of works, - writing essays and / or abstracts	18
Total hours		30		60

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. The role of modelling in environmental research	3 grades /3%	Up to 3 week
2.	Practical work 1.2. Environmental planning functions	3 grades /3%	Up to 4 week
3.	Practical work 1.3. Scientific basis for environmental planning	3 grades /3%	Up to 5 week
4.	Practical work 1.4. The specifics of taking into account environmental factors when planning an experiment	3 grades /3%	Up to 6 week
5.	Module control	5 grades /5%	Up to 8 week
6.	Attestation (multiple choice test)	15 grades /15%	Up to 8 week
	Module 2		
7.	Practical work 2.1. The role of environmental forecasting in environmental protection	4 grades /4%	Up to 10 week
8.	Practical work 2.2. Research of ecological populations	4 grades /4%	Up to 11 week
9.	Practical work 2.3. The role of plants in maintaining of ecological balance	4 grades /4%	Up to 12 week
10.	Module control	15 grades / 15%	Up to 15 week
11.	Exam	30 grades /30%	Examination period

5.1.2. ASSESSMENT CRITERIA

Component	**Unsatisfactory**	**Satisfactory**	**Good**	**Excellent**
Module 1				
Practical work 1.1. The role of modelling in environmental research	*0 grades*	*1 grade*	*2 grades*	*3 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 1.2. Environmental planning functions	*0 grades*	*1 grade*	*2 grades*	*3 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 1.3. Scientific basis for environmental planning	*0 grades*	*1 grade*	*2 grades*	*3 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 1.4. The specifics of taking into account environmental factors when planning an experiment	*0 grades*	*1 grade*	*2 grades*	*3 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.
Module control : test, oral questioning, written test (at the discretion of the module leader)	*0-5 grades*			
	Assessed based on the number of correct answers			
Attestation (mul-	0-3 grades	*3-7 grades*	*7-13 grades*	*13-15 grades*

tiple 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. The role of environmental forecasting in environmental protection	*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. Research of ecological populations	*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. The role of plants in maintaining of ecological balance	*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.
Module 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 completed	The PhD student is not sufficiently versed in the theoretical material, the tasks are done with mistakes	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

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	Texts analysis of on the topics of the course worked out by the PhD student individually	Throughout the semester
4	Defence of practical work	After completing of the work
5	Oral feedback from the tutor when working on practicals.	Throughout the semester

6. LEARNING RESOURCES

Key resources

1.Podhaietskyi A. Ad., Kravchenko N. V., Kriuchko L. V., Gorbas S.M., Podhaietskyi A.An. Simulation of nature of Solanum L. sect.PetotaDumort. species towards late bligt resistance. Ukrainian Journal of Ecology, 2018, 8(1), 324–334. Doi: 10.15421/2018_218. (Web of Science).

2.Подгаєцький А. А., Кабанець В. М., Кравченко Н. В., Подгаєцький А. Ан., Мацкевич В. В. Бордун Р. М. Розмноження та оздоровлення насіннєвого матеріалу картоплі. Суми. 2019. 161 с.

3.Вергунова І. М. Основи математичного моделювання для аналізу та прогнозу агрономічних процесів / І. В. Моргунова.– К.: Нора-принт, 2000.– 145 с.

4.Стеценко І. В. Моделювання систем / І. В. Стеценко.– Черкаси, 2010.– 482 с.

5.Дідора В. Г. Методика наукових досліджень в агрономії / В. Г. Дідора, О. Ф. Смаглій, Е. Р. Ермантраут та ін. К.: Центр учбової літератури, 2013.– 206 с.

6.Буртняк І. В. Імітаційне моделювання.– Івано-Франківськ, 2011.– 126 с.

7.Томашевський В. М. Моделювання систем / В. М. Томашевський.– К.: Видавнича група ВНУ, 2005.– 367 с.

8.Грищук Ю. С. Основи наукових досліджень / Ю. С. Грищук.– Харків НТУ: ХПІ, 2008.– 232 с.

9.Чумак В. Л. Основи наукових досліджень / В. Л. Чумак, С. В. Іванов, М. Р.Максимюк.– К.: «НАУ-друк», 2009.– 355 с.

10. Хамханов К. М. Основы планирования эксперимента / К. М. Хамханов.– Улан-Удэ, 2001г.– 53 с.

11. Ризниченко, Г. Ю. Математическое моделирование биологических процессов. Модели в биофизике и экологии : учеб. пособие для бакалавриата и магистратуры / Г. Ю. Ризниченко. — 2-е изд., перераб. и доп. — М. : Издательство Юрайт, 2019. — 181 с.

12. Ризниченко, Г. Ю. Математические методы в биологии и экологии. Биофизическая динамика продукционных процессов в 2 ч. Часть 2 : учебник для бакалавриата и магистратуры / Г. Ю. Ризниченко, А. Б. Рубин. — 3-е изд., перераб. и доп. — М. : Издательство Юрайт, 2018. — 185 с.

13. Актуальные проблемы экологии / коллект. автор, гл. ред. В.Н Бурдь. - Гродно : ГрГУ им. Я. Купалы. – 2014.- Ч.2. - 211 с.

14. Основы экологии [Электронный ресурс] : учебно-методический комплекс для студентов всех специальностей / Белорусский национальный технический университет, Кафедра "Экология" ; сост.: В. А. Левданская, Г. В. Бельская, Е. В. Карпинская. – Минск : БНТУ, 2013.

15. Христофорова Н. К. Основы экологии : учебник : для студентов высших учебных заведений. М.: Магистр : ИНФРА-М. 2014. – 638с.

Other sources

16. Anslow R.C. Edge effects in plots of wheat experiments. J. Nat. Inst. Agr. Bot. 1987. 17. 3. P.385-386.

17. Khalifa M.A., Al-Saheal Y.A. Inheritance of harvest index in wheat. Cer. Res. Com. 1984. 12. 3 - 4. P. 159-166.

18. Leopold C., Kriedemann P. Plant growth and development. New Jork. 1975. 545 p.

19. Царенко О. М., Злобін Ю. А., Скляр В. Г. Панченко С. М. Комип'ютерні методи в сільському господарстві та біології. Суми. 2000. 204 с.

20. Агаев М. Г. Экспериментальная эволюция (на примере модельних популяцій автогамных растений). Л.: Наука. 1978. 272 с.

21. Альтергот В. Ф. Действие повышенной температуры на растение в эксперименте и природе. Тимирязевские чтения. XL. М.: Наука. 1981. 56 с.

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

23. Злобин Ю.А. Популяционная экология растений: современное состояние, точки роста. - Сумы: Унив. книга, 2009 - 263 с.

Information resources

ЗУ «Про охорону навколишнього середовища» - https://zakon.rada.gov.ua/laws/show/1264-12#Text

- ✓ ЗУ «Про екологічну експертизу» - https://zakon.rada.gov.ua/laws/show/45/95-%D0%B2%D1%80#Text

Academic Program (Syllabus) Review

Modelling and Planning of the Scientific Experiment

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 AP "Ecology" project group  V. G. Skliar

(full name)

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 (Ecology and Botany Department member)  G.O. Klymenko

(full name)