MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SUMY NATIONAL AGRARIAN UNIVERSITY
Department of plant protection named after Associate Professor A.K.Mishnov

"Approved"
Head of the Department of plant protection
named after Associate Professor A.K.Mishnov

"_____"_____2019

_____(V.A. Vlasenko)

CURRICULUM

CURRENT METHODS FOR IDENTIFICATION OF PHYTOPATHOGENS

Field of study: 202 Plant Protection and Quarantine
Faculty of Agricultural Technologies and Environmental Use

2019 - 2020

Educational program for the course “Population biology of phytopathogenic fungi”

Developed by: **Rozhkova T.O.,** Associate Professor of the Department of plant protection named after Associate Professor A.K.Mishnov, Candidate of Biological Sciences _____

Tatarynova V.I., Associate Professor of the Department of plant protection named after Associate Professor A.K.Mishnov, Candidate of Agricultural Sciences _____

The educational program was approved at the meeting of the Department of plant protection named after Associate Professor A.K.Mishnov,

Minutes No. 23 dated 2nd May 2019

Head of the Department _____(V.A. Vlasenko)
(*signature)*

Agreed:
Head of the Department of Postgraduate
and Doctoral Studies _____ I.V. Lozynska
Methodist of the Educational Department _____ H.O. Baboshina
Registered in the electronic data base. Date: _____ 2019

1. Description of the Course

<table>
<tr><td rowspan="2">Indicators</td><td rowspan="2">Field of study, program subject area, level of higher education</td><td colspan="2">Characteristics of the course</td></tr>
<tr><td>Full-time study</td><td>Part-time study</td></tr>
<tr><td rowspan="2">Number of credits
- 4</td><td>Field of study: 20 Agrarian Sciences and Foodstuffs</td><td colspan="2" rowspan="2">Selective</td></tr>
<tr><td></td></tr>
<tr><td>Number of modules: – 2</td><td rowspan="8">Program subject area: 202 Plant Protection and Quarantine</td><td colspan="2">Academic year:</td></tr>
<tr><td>Content modules: 2</td><td>2019-2020</td><td></td></tr>
<tr><td></td><td colspan="2" rowspan="2">Year of study</td></tr>
<tr><td rowspan="2">Загальна кількість годин
Hours of total workload - 120</td></tr>
<tr><td>1</td><td></td></tr>
<tr><td colspan="2">Semester</td></tr>
<tr><td>2</td><td></td></tr>
<tr><td colspan="2">Lectures</td></tr>
<tr><td rowspan="9">Weekly hours for full-time study:
in-class learning - 2</td><td rowspan="9">Level of higher education:
Third (educational and research/ educational and creative)
Higher education degree:
Doctor of Philosophy (PhD)</td><td>12 hours</td><td></td></tr>
<tr><td colspan="2">Practical classes, seminars</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Practical classes</td></tr>
<tr><td>24 год.</td><td></td></tr>
<tr><td colspan="2">Individual work</td></tr>
<tr><td></td><td></td></tr>
<tr><td colspan="2">Individual work:
84</td></tr>
<tr><td colspan="2">Final control:
credit</td></tr>
</table>

2. The purpose and objectives of the course

Purpose: provision for students the professional knowledge of modern methods of diagnostics of plant diseases of different etiology, determination their pathogens.

Objectives: understanding of different methods of identification of plant pathogens

Program training outcomes:

The student must know:

- *methods of fungi diagnostics;*
- *methods of diagnostics of phytobacteria;*
- *methods of diagnosis of phytoviruses;*
- *methods of diagnostics of flower parasites;*
- *methods of phytoplasma diagnostics.*

***The student must be able to*:**

- *separate pathogens from the affected plants;*
- *work with clean cultures;*
- *apply different methods of diagnosis of plant diseases.*
- *conduct expert research.*

General competencies to be acquired by the graduate

Code	General competencies
GC 1	Ability to learn, master modern knowledge, self-improve and form a systematic scientific outlook.
GC 2	Ability to critically analyze and evaluate modern scientific achievements, to synthesize the acquired knowledge, to solve complex problem.
GC 3	Ability to use abstract thinking, identify, receive, systematize, synthesize and analyze information from various sources using modern information technologies in scientific activities.
GC 5	Ability to generate new ideas and take grounded decisions to achieve goals.
GC 8	Ability to take initiative, take responsibility, motivate people and move towards a common goal.
GC 11	Ability to prepare scientific abstracts, presentations, discussions; to debate scientific results in national and foreign languages to an extent sufficient for full understanding; to demonstrate high standards of scientific language (both in oral and writing forms).

Professional competencies to be acquired by the graduate

Code	Professional competencies
PC 1	Ability to apply methods for determination and identification of harmful organisms, to carry out scientifically grounded phytosanitary diagnostics in agrobiocenoses and to control and manage the density of harmful organisms.

PC 2	Ability to develop the effective scientific models and technological schemes for identifying the objects to be regulated in order to ensure compliance with phytosanitary measures in the import-export products and the latest crop management systems.
PC 3	Ability to identify the regularities in the development and spread of harmful organisms and to develop scientifically grounded protective measures.
PC 5	Ability to develop technological schemes of effective control of harmful organisms on the basis of extensive knowledge and skills in the field of entomology, phytopathology and herbology.

Expected learning outcomes
Program training outcomes

Code	Program training outcomes
ПРН 3	To have up-to-date advanced conceptual and methodological knowledge when performing scientific and / or professional activities and on the border of subject knowledge areas, guided by the principles of academic integrity and scientific ethics.
ПРН 7	To be able to work with various literary sources, carry out, process, analyze and organize the received information; to understand scientific articles in the field of the chosen specialty; to be able to work with up-to-date bibliographic and abstract databases, as well as scientometric platforms such as Web of Science, Scopus, etc.
ПРН 8	To be able to critically analyze, evaluate and synthesize new scientific provisions, various information sources, scientific literature, research of domestic and foreign authors on plant protection and quarantine; to keep up with the latest developments in the industry and to find scientific sources relevant to the field of scientific interest of the applicant; to analyze information sources, identify contradictions and previously unsolved problems or parts of them, to formulate working hypotheses.
ПРН 9	To understand the peculiarities of structure and to be able to prepare scientific papers (monographs, scientific articles, etc.), following the principles of academic integrity; to skilfully reflect the results of scientific research in scientific articles published both in the professional domestic editions and in the editions that are included in the international scientometric databases.
ПРН 14	To initiate, organize and conduct complex plant protection and quarantine studies that lead to obtaining new knowledge.
ПРН 21	To combine different technological methods of scientific research, including laboratory ones, to solve the typical professional problems, taking into account national and world standards for plant protection and quarantine; to perform research according to the methodologies.

Module 1.

Content module 1. The essence of the basic diagnostic methods of plant diseases

Topic 1. Visual diagnostics of plant diseases. The essence. Types of symptoms. Peculiarities of macroanalysis of diseases of different etiology.

Topic 2. Biological analysis. The essence of the method. Its modifications. Peculiarities of work with clean crops.

Topic 3. Luminescent method for determination of plant diseases. The essence of the method. Peculiarities of diagnostics of diseases of different etiology.

Topic 4. Diagnostic methods based on the interaction of antibodies with antigens of phytopathogens. The essence of the method. Immune-enzyme analysis ELISA. Immunofluorescence.

Topic 5. Diagnostic methods based on the analysis of phytopathogen nucleic acids. Methods of nucleic acid hybridization. Methods with PCR application.

Topic 6. Use of pathogen metabolites for diagnostics. Determination of marker metabolites of fungi in tissues of infected plants. Analysis of fatty acid composition in the identification of phytopathogenic bacteria.

Topic 7. Physical and chemical methods of plant diagnostics. The essence of the physical method. The essence of the chemical method, peculiarities of application.

Module 2.

Content module 2. Identification of pathogens of different etiology.

Topic 8. Diagnosis of non-infectious plant diseases. Method of visual diagnostics. Plant-indicator method. Method of leaf (tissue) diagnostics. Methods of injection and spraying.

Topic 9. Diagnosis of flower parasites. Peculiarities of diagnostics of flower half-parasites. Determination of flower parasites.

Topic 10. Diagnosis of plant diseases of fungal etiology. Macroscopic method. Centrifugation method. Biological method. Luminescent method. Serological method. Types of ELISA tests. Immunofluorescence. PCR diagnosis of phytopathogenic fungi.

Topic 11. Diagnosis of bacterial diseases of plants. Anatomical method. Method of macroscopic (external) examination. Biological method. Luminescent method of phytobacteria. Serological method. Types of ELISA tests for bacteria. PCR diagnosis of phytopathogenic bacteria.

Topic 12. Diagnosis of viral diseases of plants. Indexing method. Electronic microscopy method. Serological method. Types of ELISA tests for virus detection. Immunoblotting. Immunological analysis in plant tissues. Use of plants-indicators. Mechanical contamination of plants by rubbing. Infection of a plant by vaccinationwith a tissue of a diseased plant. Dodder virus transmission. Transmission of viruses by insects. Inclusion method. PCR diagnosis of phytopathogenic viruses.

4. Course Structure

Content modules and Topics	**Hours of workload**											
	Full-time study						**Part-time study**					
	total	**including**					**total**	**including**				
		l	**p**	**lab**	**ind**	**Ind.wo**		**l**	**p**	**lab**	**ind**	**Ind. wor**

						rk						k
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Module 1												
Content module 1. The essence of the basic diagnostic methods of plant diseases												
Topic 1. Visual diagnostics of plants.	10	2	8									
Topic 2. Biological analysis.	2	2			10							
Topic 3. Luminescent method.	2	2										
Topic 4. Diagnostic methods based on the interaction of antibodies with antigens of phytopathogens.	2	2										
Topic 5. Diagnostic methods based on the analysis of phytopathogen nucleic acids.	6	2	4									
Topic 6. Use of pathogen metabolites for diagnostics.	5				**5**							
Topic 7. Physical and chemical methods of plant diagnostics.	5				**5**							
Hours of total workload		**10**	**12**		**20**							
Module 2												
Content module 2. Identification of pathogens of different etiology												
Topic 8. Diagnosis of non-infectious plant diseases.	4	2	2									
Topic 9. Diagnosis of flower parasites.	10				10							
Topic 10. Diagnosis of plant diseases of fungal etiology.	36		6		30							
Topic 11. Diagnosis of bacterial diseases of plants.	16		2		14							
Topic 12. Diagnosis of viral diseases of plants.	12		2		10							
Hours of total workload		**2**	**12**		**64**							
Hours of total workload	**120**	**12**	**24**		**84**							

5. Topics and plan of in-class learning

No.	Topic and plan	Hours of workload
1	**Topic 1. Visual diagnostics of plant diseases.** Plan 1. The essence of the method. 2. Types of symptoms. 3. Peculiarities of macroanalysis of diseases of different etiology.	2
2	**Topic 2. Biological analysis in determination of plant pathogens.** Plan 1. The essence of the method. 2. Its modifications. 3. Peculiarities of work with clean crops.	2
3	**Topic 3. Luminescent method for determination of plant diseases.** The essence of the method. Peculiarities of diagnostics of diseases of different etiology.	
4	**Topic 4. Diagnostic methods based on the interaction of antibodies with antigens of phytopathogens.** Plan 1. The essence of the method. 2. Immune-enzyme analysis ELISA. 3. Immunofluorescence.	2
5	**Topic 5. Diagnostic methods based on the analysis of phytopathogen nucleic acids.** Plan Methods of nucleic acid hybridization. Methods with PCR application.	2
6	**Topic 6. Diagnosis of non-infectious plant diseases.** Plan. 1. Method of visual diagnostics 2. Plant-indicator method. 3. Method of leaf (tissue) diagnostics. 4. Methods of injection and spraying.	2
	Total	**12**

6. Topics of practical classes

No.	Topic	Hours of workload
1	Study of typical symptoms of non-infectious diseases.	2
2	Examination of the types of mycosis symptoms.	2
3	Study of typical symptoms of bacteriosis.	2
4	Examination of typical symptoms of virosis.	2
5	The essence of PCR diagnosis of *Alternaria* fungi.	2

6	Study of molecular methods of diagnosis of *Fusarium* fungi.	2
7	Study of visual diagnostics of non-infectious maize diseases.	2
8	Examination of the diagnosis of flour-mongers fungi.	2
9	Study of peculiarities of diagnostics of smut cereal diseases.	2
10	Study of peculiarities of diagnostics of rusty cereal diseases.	2
11	Study of peculiarities of diagnostics of *Pseudomonas* phytobacteria.	2
12	Study of peculiarities of diagnostics of BYDV (barley yellow dwarf virus**)** of cereal crops.	2
	Total	**24**

8. Individual work

No.	Topic and a list of tasks	Hours of workload
1	**Topic 1. Biological analysis.** Carry out biological analysis of seed contamination (according to the variant). Identify pathogens of seeds. Prepare a presentation based on the results of the analysis.	10
2	**Topic** 2. Use of pathogen metabolites for diagnostics.	5
3	**Topic** 3. Physical and chemical methods of plant diagnostics.	5
4	**Topic 4. Diagnosis of fungal plant diseases.** Collect herbarium. Identify pathogens of mycosis.	10
5	**Тема 5.** Diagnosis of flower parasites.	10
6	**Write summary on the topic**: Peculiarities of diagnostics of wheat diseases.	44
	Total	**84**

9. Methods of Training

1. Methods of training by source of knowledge:

1.1. ***Verbal****: story, explanation, conversation, lecture.*

1.2. ***Visual****: demonstration, illustration, observation.*

1.3. ***Practical****: laboratory method, practical work.*

2. Methods of training by the logic of perception.

2***.1. Analytical***

2.2. Synthesis

2.3. Inductive method

3. Methods of training by the level of independent mental activity of students.

3.1. ***Problem-solving***

3.2. ***Heuristic method***

3.3. ***Research method***

3.4. ***Reproductive***

3.5. ***Explanatory - demonstrative***

4. Active training methods - use of teaching aids, self-assessment and training tests, reference lecture notes.

5. Interactive training technologies - use of multimedia technologies, cooperation of students.

In case of small groups the following training methods are used:

Personalized Learning
Differentiated Instruction
Inquiry-based Learning

10. Methods of control

1. Rating control according to the 100-point ECTS grading scale.
2. Intermediate control during the semester (intermediate assessment)
3. Multicriteria assessment of students' current work:
– the level of knowledge demonstrated during practical, laboratory classes and seminars;
– activities during the problem discussion;
- results of laboratory work fulfillment and defence;
- self-study of the topics on general or specific issues;
- assessment results;
–tasks in writing during the tests;
– writing an essay.

The assessment of the graduate is carried out by the board of examiners (includes members of the department)

Direct consideration in the final assessment of the student's fulfillment of a specific individual task:

essay

11. Points of the Total Score got by a student

Поточне тестування		Individual work	**Assessment**	Total
Content module 1	Content module 2	15		
35 **points**	35 **points**		15	100

National and ECTS grading scale

Total points for all educational activities (Grading interval)	**ECTS grade**	**National grade**	
		for exam, course project (work), internship	**for credit**

90 – 100	**A**	excellent	passed
82-89	**B**	good	
75-81	**C**		
69-74	**D**	satisfactory	
60-68	**E**		
35-59	**FX**	fail (some more work required before the credit can be awarded)	fail (some more work required before the credit can be awarded)
1-34	**F**	fail (considerable further work is required)	fail (considerable further work is required)

12. Recommended literature

1. Diakov, Yu.T. (2012). Fundamental Phytopathology. - Moscow: KRASAND. 512 p.

2. Marutin, F.M., Panteleev, V.K., & Bilyk M O. (2008). Phytopathology: Textbook. - Kharkiv: Espada. 552 p.

3. Markov, I.L. (2015). Phytopathology: textbook. - Kiev: Phoenix. 455.

4. Diakov, Yu.T. (2001). General and molecular phytopathology: Textbook. - M .: Publishing House of the Society of Phytopathologists. 302 p.

4. Popkova, K.V , Shkalikov, V.A., & Stroykov, Yu.M. (2005). General phytopathology: a textbook for universities. - M .: Drofa. 445 p.

Additional

1. Leontiev, D.V., Akulov, A.Y. (2007). General Mycology: A Textbook for Higher Educational Institutions. - Kharkiv: Osnova. 228 p.

2. Diakov, Yu.T. (2013). Entertaining Mycology. - M.: Book House "LIBROCOM". 240 p.

3. Sytnyk, I.O., Klimnyuk, S.I. (2009). Microbiology, Virology, Immunology: Textbook. - Ternopil: TDMU. 392 p.

13. Information resources

1. Methods for detection and identification of potato T virus. https://vniikr.ru/files/Doc/TK42/ProeGOST_1Red-VirusT.pdf
2. 2. Development of highly sensitive test systems for the simultaneous rapid diagnosis of a wide range of potato diseases based on qPCR matrices of long-term storage. http://mbio.bas-net.by/wp-content/uploads/2017/06/26_Statsyuk_2017.pdf
3. Monitoring of bacterial and viral diseases of crops. https://cyberleninka.ru/article/n/monitoring-bakterialnyh-i-virusnyh-bolezney-selskohozyaystvennyh-kultur