National University of Life and Environmental Sciences of Ukraine

Department of Molecular Biology, Microbiology and Biosafety

"APPROVED"
Dean of the Faculty of Plant Protection,
Biotechnology and Ecology

_____ Kolomiets Yu. V.

"____" _____ 2020.

CONSIDERED AND APPROVED

Department of Molecular Biology, Microbiology and Biosafety

Protocol No.10 from 1 "02" June 2020

Head of Department

_____ Starodub MF

STRUCTURE OF ACADEMIC DISCIPLINE

BIOSAFETY (USE OF BIOTECHNOLOGIES)

Specialty 162 "Biotechnologies and bioengenery"_____
educational program__ "Biotechnology and Bioengineering"_____
Faculty (NIS) Plant protection, Biotechnology and Ecology_____
Developers: Starodub M. F., Professor, Doctor of Biological Sciences_____

Kyiv - 2020

1. **1. Description of the academic discipline**

"Biosafety (Use of biotechnology)"

Field of knowledge, specialty, educational program, educational degree		
Educational degree	Bachelor	
Specialty	Ecological biotechnology	
Educational program	"Biotechnology and Bioengineering"	
Characteristics of the academic discipline		
Type	Compulsory subject	
The total number of academic hours	90 h.	
No. of credits ECTS	3	
Number of content modules	2	
Course project (work) (if available)	-	
Form of control	exam	
Indicators of academic discipline for full-time and part-time forms of education		
	Full-time education	External form of
Year of preparation (course)	3	
Semester	6	
Lectures	15 years	
Practical, seminar classes	30 hours	
Laboratory sessions:	-	
Individual work	45 years	
Individual tasks	-	
Number of weekly classroom hours for full-time study	3 h.	

2. **Purpose, tasks and competencies of the discipline**

The purpose The study of the discipline is a theoretical and practical training of students to create safe conditions.

Task study of the discipline "Biosafety (use of biotechnology)" are the formation of specialists capable of:

know:

- modern ideas about heredity and variability, their nature and molecular essence;
- understand the effects of scientific and technological progress on the gene pool of the planet, crystallizing the positive and negative aspects of the interaction of living organisms with changes in the environment as a result of climate, technological and information changes;

- basic methodological approaches to control the genetic status of organisms;
- modern analytical means of quality control of human food and animal feed;
- ethical aspects and problems of biosafety;
- basic legal documents and agreements in the field of biosafety adopted in Ukraine and a number of advanced countries of the world;
- principles and mechanisms of genome manipulation, advances in genetic engineering and therapy, as well as a number of modern biotechnologies, their benefits and risks to the planet's bioworld.

be able:

- use scientific, educational and methodological literature related to biosafety issues;
- to analyze the state and possible consequences of active and wide involvement of genetically modified organisms and a number of modern biotechnologies on the environment;
- to be guided in the use of certain achievements of scientific and technological progress, which are the least destructive for living systems, and in the appropriate degree of intensity of their use to avoid the maximum impact on the gene pool of organisms;
- assess the benefits and risks to humans, animals and plants of the realities of genetic engineering and modern biotechnology.

Acquisition of competencies:

general competencies (GQ): ability to apply knowledge in practical situations; Ability to learn and master modern knowledge; the ability to exercise their rights and responsibilities as a member of society, to realize the values of civil (free democratic) society and the need for its sustainable development, the rule of law, human and civil rights and freedoms in Ukraine; ability to preserve and multiply moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technology, use different types and forms of physical activity active recreation and a healthy lifestyle.

professional (special) competencies (FC): ability to carry out experimental research on the improvement of biological agents, including to cause changes in the structure of the hereditary apparatus and functional activity of biological agents; ability to analyze raw materials, intermediate products, target products of biotechnological production; ability to comply with the requirements of biosafety, biosecurity and bioethics.

Program and structure of the discipline for:

- full-time full-time (part-time) form of study;

Content module 1. <u>«Basic provisions of biosafety»</u>

Topic of the lecture 1. Biosafety, its essence and tasks. General characteristics of certain areas of scientific and technological progress and possible options for its impact on the genome of living organisms..

Basic concepts of biosafety. Purpose and tasks. Positive influence of STP on the genome of living organisms. Possible negative impact of STP on the genome of living organisms.

Topic of the lecture 2. Heredity and variability - the main properties of living things. Horizontal and vertical gene transfer.

The unit of heredity is the gene. Gene localization. Molecular structure of genes. Genome of the organism. Genomes of pro- and eukaryotes. Natural mobile genetic elements, retrotransposons. Problems of using hereditary and non-hereditary transgenic traits. Changing heredity by genetic engineering methods. Problems of protection of heredity of organisms. Traditional intraspecific and interspecific hybridization of movement of plants, animals, microorganisms as a basis of evolutionary process. Changing heredity in the process of natural and industrial hybridization.

Topic of the lecture 3. Practical achievements of modern biotechnology and genetic engineering. Modern methods of biosafety.

Getting new pharmaceuticals. Expression of human somatotropic (growth hormone). Genetically modified plants (transgenic varieties of rice, potatoes, corn, cotton, tomatoes, etc.)Objectives of achievement and problems of genetic engineering. Compensation of congenital genetic defects of development and treatment of the diseases which have arisen in ontogenesis. Restriction enzymes. Vectors for molecular cloning. Plasmid, phage, cosmid, shuttle vectors, artificial chromosomes of yeast. Creation of genomic libraries. Construction of restriction maps.

Topic of the lecture 4. Characteristics of the mutation process. Biotechnology of gene manipulation.

Mutations associated with a violation of the genetic code. Methods and principles for assessing mutagenic effects. Measures to prevent the introduction of environmental mutagens. Genetic engineering strategy. Isolation of DNA of the desired gene from the genome. Gene transfer into the cells of other organisms: microinjections, electroporation, transfection, packaging in liposomes, microparticle bombardment.

Content module 2. «Traditional and modern immunoassay»**.**

Topic of the lecture 1. Genetically modified organisms: essence, directions of use. Problems of possible ecological consequences of the use of genetically modified organisms.

Addressing food shortages in third world countries, improving the quality of existing plant varieties and animal breeds. Purification of the environment from toxicants of various chemical nature, the use of plants as factories for the directed chemical synthesis of certain

compounds, obtaining pharmacological drugs. Possibilities of influence of genetically modified organisms on the environment. Benefits and risks. The principle of prudence and the principles of sufficient equivalence. Labeling of genetically modified food, fodder crops, seeds, medicines.

Topic of lecture 2. Basic legal documents and agreements in the field of biosafety. Ecological and genetic models.

The essence of the Cartagena Protocol and the Aarhus Convention; Alimentarius Code; Bilbao and Inuyama Declaration. UNESCO Universal Declaration on the Human Genome and Human Rights**.** Natural food chains. Genetic colonization (interaction of agrobacteria with plant roots). Interaction of insects and higher plants.

Topic of the lecture 3. The principle of prudence and the principle of sufficient equivalence. Genetic toxicology.

Possibilities of influence of genetically modified organisms on the environment. Benefits and risks. The principle of prudence and the principle of sufficient equivalence. Classification of genetically active factors. Test systems for the initial detection of genetically active substances.

Topic of the lecture 4. Genetics of resistance to environmental factors.

Genetic heterogeneity in terms of sensitivity to environmental factors under conditions of harmful production. Hereditary anomalies of DNA replication and repair (molecular diseases).

Names of content modules and topics	Hours											
	Full-time						External form					
	Total	including					Total	including				
		l	p	lab	Ind.	s.r.		l	p	lab	Ind.	s.r.
1	2	3	4	5	6	7	8	9	10	11	12	13
Content module 1. General provisions of biosafety												
Topic 1. Biosafety, its essence and tasks. General characteristics of certain areas of scientific and technological progress and possible options for its impact on the genome of living organisms.	4	1	3				2	1	1			
Topic 2. Heredity and variability - the main properties of living things.	6	2	4				2	1	1			
Topic 3. Practical achievements of modern biotechnology	6	2	4				1.5	0.5	1			

and genetic engineering. Modern methods of biosafety.												
Topic 4. Characteristics of the mutation process. Biotechnology of gene manipulation.	6	2	4				2.5	0.5	2			
Total on the content module 1	22	7	15				8	3	5			
Topic 1. Genetically modified organisms: essence, directions of use. Problems of possible ecological consequences of the use of genetically modified organisms.	6	2	4				2	1	1			
Topic 2. Basic legal documents and agreements in the field of biosafety. Ecological and genetic models.	6	2	4				2	1	1			
Topic 3. The principle of prudence and the principle of sufficient equivalence. Genetic toxicology.	6	2	4				1.5	0.5	1			
Topic 4. Genetics of resistance to environmental factors.	5	2	3				2.5	0.5	2			
Total on the content module 1	23	8	15				8	3	5			
Total hours	45	15	30				22	6	10			
Coursework (project)												
Total hours	45	15	30				16	6	10			

3. **Topics of seminars**

№ number	Topic Title	Number of hours
1	Not provided for in the working curriculum	

4. **Themes of practical classes**

№ number	Name of the theme	Number of hours
1	Introduction to the Ames test	2

2	Setting up instrumental analysis for the detection of individual substances in water samples and some products in the registration of biospecific interactions using an optical biosensor based on surface plasmon resonance	4
3	DNA electrophoresis	4
4	DNA and RNA structure, replication, transcription, translation	4
5	Organoleptic methods for assessing biosafety and product quality	4
6	Classical immune analysis and its use to determine the quality and origin of food and animal feed	4
7	Introduction to the Allium test. Biological wastewater treatment with activated sludge	4
8	Legal documents in the field of biosafety, regulating the use of genetically modified organisms in various areas of life	4

5. **Topics of laboratory classes**

No.	Name of the topic	Hours
1	Not provided for in the working curriculum	

1. **Control questions, sets of tests to determine the level of knowledge acquisition by students.**

Examination paper 1

No. 1	**Biosafety is:**
1	Safety against radiation damage
2	Safety from genetically modified products
3	Safety from a complex of negative environmental factors
4	Safety from pesticide exposure

№2 Antibodies are _____

№3 Antigens are: _____

No. 4	**Haptens are able to:**
1	Induce an immune response
2	To interact with antibodies
3	Before conjugation with proteins
4	To spontaneous interaction with carbohydrates

№5 Classical immune analysis is based on: _____

_____

No.6	The immunodiffusion reaction is:
1	Quantitative
2	Semi-quantitative
3	Qualitative
4	None

No.7	Which of the following methods of solid-phase enzyme-linked immunosorbent assay is performed:
1	On dice
2	Dot
3	Blot
4	In solution

No.8	Which of the following labels is not used in modern immunochemical analysis:
1	Radioactive
2	Enzymatic
3	Lipid
4	Carbohydrate

№9 Which method of classical immunoassay is quantitative? _____

No.10	What are the types of ELISA:
1	Heterophase
2	Solid phase
3	Homogeneous
4	Heterocyclic

№11 Name the year of opening of the modern IHA:
_____

No.12	IHA method "dot" is not performed:
1	By transferring the electrophoregram material to the substrate
2	Analysis of a drop of material sorbed on the solid phase
3	Analysis in a drop of solution
4	Analysis of the material in the gel

No.13	IHA by "blot" is performed:
1	By transferring the electrophoregram material to the substrate
2	Analysis of a drop of material sorbed on the solid phase
3	Analysis in a drop of solution
4	Analysis of the material in the gel

No.14	Which of the following abbreviated names reflect modern immunochemical analysis
1	RID
2	ELISA
3	FIA
4	LIA

15	Stacking of bases, quantitative set of connections between GC-pairs:
1	1
2	2
3	3

4	4

№ 16 What is the basic dogma of molecular genetics: _____

17	Division of living organisms in genetic kinship:
1	Prokaryotic
2	Eukaryotes
3	Micro- and macroorganisms
4	Viruses and microorganisms

№18 What are the names of antibodies obtained by immunization of animals: _____

19	The biosafety system from GMOs is not:
1	Complete ban on GMOs
2	Prevent or reduce the effects of GMOs
3	Some areas of GMO use
4	Use of GMOs in completely closed conditions

20	DNA code:
1	Meaningful
2	Two-digit
3	Unambiguous
4	Degenerate

No. 21	Hybridomas for monoclonal antibodies are a combination of:
1	Two lymphocytes
2	Two myeloma
3	Lymphocyte and myoma cell
4	Lymphocyte and any somatic cell

No. 22	Nucleosides include:
1	Nitrogen base
2	Deoxyribose
3	Nitrogen base + deoxyribose + phosphate residue
4	Deoxyribose + phosphate residue

№23 What abbreviation of the abbreviated name of antigens is common: _____

24	Stacking of bases, quantitative set of connections between GC-pairs:
1	2
2	1
3	3
4	4

No. 25	Who first created hybridomas:
1	Steinitz and Klein
2	Baltimore
3	Keller
4	Milstein

26	How do you feel about the following abbreviations: GMOs and GMOs:
1	It's the same
2	These are different concepts

3	These are concepts that complement each other
4	These are opposite concepts

No. 27.	Is the use of GMOs fully permitted in the United States:
1	Yes
2	No
3	Under certain conditions
4	Each state is different

28	Which laboratories have the right to issue opinions on the content of GMOs in products?
1	State
2	Private
3	Certified
4	All of the above

No. 29	When hybridomas were first obtained:
1	1975
2	1985
3	1990
4	1965

No. 30.	Transcription - is the formation of:
1	mRNA
2	DNA
3	Protein
4	RNA

2. Methods of study.

The success of learning in general depends on the internal activity of students, on the nature of their activities, that is, the nature of activities, the degree of independence and creativity should be important criteria in choosing a method.

Explanatory-illustrative method. Students gain knowledge by listening to a story, lecture, educational or methodical literature, through an on-screen textbook in "ready" form. Perceiving and comprehending facts, assessments, conclusions, they remain within the framework of reproductive (reproductive) thinking. This method is most widely used to transmit a large array of information. It can be used to present and assimilate facts, approaches, assessments, conclusions.

Reproductive method. It is a question of application of the studied on the basis of a sample or rule. The activity of those who are taught is algorithmic, ie corresponds to instructions, orders, rules - in situations similar to the presented sample.

Method of problem statement. Using any sources and tools, the teacher, before teaching the material, poses a problem, formulates a cognitive task, and then, revealing a system of evidence, comparing views, different approaches, shows how to solve the problem. Students become like witnesses and accomplices of scientific research.

Partial search, or heuristic method. Its essence is in the organization of active search for the solution of the cognitive tasks put forward by the teacher (or independently

formulated) or under the guidance of the teacher, or on the basis of heuristic programs and instructions. The process of thinking becomes productive, but it is gradually directed and controlled by the teacher or the students themselves on the basis of work on programs (including computer) and with textbooks. This method, one of the varieties of which is a heuristic conversation, is a proven way to activate thinking, to encourage cognition.

Research method. After analyzing the material, posing problems and tasks, and briefing orally or in writing, those who are taught study the literature, sources, conduct observations and measurements, and perform other research activities on their own. Initiative, independence, creative search are most fully manifested in research activities. The methods of educational work directly turn into methods that mimic and sometimes implement scientific research.

3. Forms of control:

Control of knowledge and skills of students (current and final) in the discipline of Immunogenetics is carried out in accordance with the credit-module system of organization of the educational process. The student's rating for mastering the discipline is determined by a 100-point scale. It consists of a rating of academic work, for the assessment of which is assigned 70 points, and a rating of certification (exam) - 30 points. Criteria for assessing the level of knowledge in laboratory, seminar and practical classes. In laboratory classes, each student on each topic performs individual tasks. The level of knowledge is assessed: "excellent" - the student gives comprehensive, reasonable, theoretically and practically correct answers to at least 90% of questions, problem solving and laboratory exercises are correct, demonstrates knowledge of textbooks, manuals, instructions, instructions, conducts , was present at lectures, has a synopsis of lectures or abstracts on the main topics of the course; "Good" - when the student has knowledge of the material, but makes minor mistakes in the formation of terms, categories and calculations, but with the help of the teacher quickly navigates and finds the correct answers, was present at lectures, has a syllabus of lectures or abstracts; "Satisfactory" - when the student gives the correct answer to at least 60% of the questions, or gives insufficiently substantiated, inexhaustible answers to all questions, makes gross mistakes, which he corrects with the help of the teacher. This takes into account the presence of a synopsis on the topic of tasks and independence; "Unsatisfactory with the possibility of re-assembly" - when the student gives the correct answer to at least 35% of questions, or gives all the questions unfounded, inexhaustible answers, makes gross mistakes. Has an incomplete syllabus of lectures.

Final (general assessment) of the course of the discipline. Is the sum of rating assessments (points) obtained for certain assessed forms of educational activity: current and final testing of the level of assimilation of theoretical material during classroom classes and independent work (modular control); assessment (points) for laboratory tests. The final grade is set after a complete study of the discipline, which is displayed as the sum of intermediate grades for content modules. It consists of a rating of academic work, for the assessment of which is assigned 70 points, and a rating of certification (exam) - 30 points.

4. **Distribution of points received by students** Assessment of student knowledge is on a 100-point scale and is translated into national assessments according to table. 1 "Regulations on examinations and tests in NULES of Ukraine" (order of entry

into force of 27.12.2019 № 1371)

Student rating, points	National assessment based on the results of the compilation	
	exams	tests
90 – 100	Perfect	Passed
74-89	Good	
60-73	Satisfactory	
0-59	Fail	Not passed

To determine the rating of the student (listener) for mastering the discipline B_{dis}(up to 100 points) the received rating on attestation (up to 30 points) is added to the rating of the student (listener) on educational work K_{HP}(up to 70 points): **R dis = R** $_{N}$p + **R** $_{AND}$t-

5. Methodical support

Scientific and methodological support of the educational process includes: state standards of education, curricula, curricula in all normative and elective disciplines; programs of educational, industrial and other types of practices; textbooks and manuals; instructional and methodical materials for seminars, practical and laboratory classes; individual educational and research tasks; control works; text and electronic versions of tests for current and final control, methodical materials for the organization of independent work of students.

6. References and Recommended Resources

Main

1. Zhimulev I, F. General and molecular genetics: A textbook. - Novosibirsk, 2003. - 479p.
2. Totsky VM Genetics. - Odessa: Astroprint, 2002. - 710p.
3. Sanger M., Berg P. Genes and genomes. Mir: M., 1999, 2nd volume, 391p.
4. Sorochinsky BV, Danilchenko OO, Kripka GV Biotechnological (genetically modified) plants. - Kyiv: KVITs Publishing House, 2007. - 219p.
5. Freemel H., Brock J. Fundamentals of immunology. M., Mir, 1986, 253p.
6. National report of Ukraine on the harmonization of society in the natural environment. K .: New Print, 2003.- 128 p.
7. Itogi Nauki i Tekhniki, Biotechnology: Nonisotopic Methods of Immunoanolysis, vol. 3, 1987.
8. Ponomarev PH, Sirohman AB, Food safety and food raw materials: Textbook. way. - K: Лібра, 1999.- 272 p:

Assisted

1. Nikolaychuk VI, Gorbatenko IY Genetic engineering. - Uzhhorod, 1999. - 189p.
2. Borshchevsky IP, Deineko LV Food security of Ukraine: state, tendencies // State building. - 2000, 1- 6.S.- 66-73.
3. Starodub MF, Starodub VM. Immunosensors: origins, achievements and prospects. Ukrainian Biochemical Journal 2000, **72**, № 4-5, C. 147-163.
4. Starodub NF, Starodub VN // Biosensors and control of pesticides in water and food. Chemistry and technology of water, 2001. v.23. No. 6. P.612-638.
5. Nadtochiy RM, Sinat-Radchenko DS Food quality and safety control. K:, UDUHT, 1998. - 44p.

Informational Resources

1.http://www.cbio.ru/modules/news/article.php?storyid=404
2.http://www.molbiol.ru/forums/index.php?act=ST&f=1&t=105003