



PROBLEM ISSUES OF ECOBIOTECHNOLOGY AND BIOENERGY

Syllabus

Details of the discipline

Level of higher education	<i>Third (educational and scientific)</i>
Branch of knowledge	<i>16 Chemical and bioengineering</i>
Specialty	<i>162 Biotechnology and Bioengineering</i>
Educational program	<i>Biotechnology</i>
Discipline status	<i>Normative</i>
Form of study	<i>Extramural studies</i>
Year of preparation, semester	<i>2nd year, autumn semester</i>
The scope of discipline	<i>4 credits</i>
Semester control / control measures	<i>Exam / modular test</i>
Lessons schedule	<i>Lectures: 6 hour / practical classes: 2 hour / according to the schedule</i>
Language of instruction	<i>English</i>
Information about course leader / teachers	<i>Lecturer: Associate Professor Kateryna Shchurska, shchurska.kateryna@ill.kpi.ua, @shchurska (telegram) Seminars: Associate Professor Kateryna Shchurska, shchurska.kateryna@ill.kpi.ua, @shchurska (telegram)</i>
Course placement	<i>Google classroom. Course code yz7qhnz</i>

Details Curriculum of the discipline

1. Description of the discipline , its purpose, subject of study and learning outcomes

Description of the discipline.

The purpose of the discipline. The purpose of the course is to form in applicants for the degree of Doctor of Philosophy the ability and :

- assess the risks of modern biotechnology for the implementation of the environment, health of people, its compliance with national and international standards and practices;
- to revise the existing concepts of modern biotechnology and bioengineering by critically understanding and adapting newly created methods and technologies, generating original hypotheses;
- to evaluate critically the results obtained recommend alternative strategies for solving the problems of the establishment and regulation technology ;
- to develop new and improve existing biotechnologies based on understanding of modern scientific facts, concepts , theories in biotechnology and bioengineering.
- perform original research that creates new knowledge in the field of biotechnology and bioengineering and related interdisciplinary areas.

The subject of academic disciplines: PROBLEM ISSUES OF ECOBIOTECHNOLOGY AND BIOENERGY

Program learning outcomes.

As a result of studying the discipline " Problematic issues of ecobiotechnology and bioenergy " higher education students acquire the following general competencies and program results:

General competencies:

- Ability to search, process and analyze information from various sources.
- Ability to work in an international scientific context.
- Ability to generate new ideas (creativity), to conduct research at the appropriate level.

Program learning outcomes :

- Knowledge and understanding of problematic issues of modern biotechnology (including at the border of subject areas) and bioengineering to create the latest biotechnology.

- Knowledge and use of modern physiological, biochemical and genetic approaches to improve biological agents and regulation of biotechnological processes.

- Knowledge of modern methods of conducting research at the level of world achievements to obtain new knowledge and innovation, organization and planning of the experiment, the practice of publishing results.

- Plan and perform experimental and theoretical research using modern specialized knowledge and instrumental methods, critically analyze research results.

- Develop and implement scientific and innovative projects.

- Develop new and improve existing environmental biotechnology.

2. Prerequisites and postrequisites of the discipline (place in the structural and logical scheme of education according to the relevant educational program)

Prerequisites : have basic knowledge of ecology , biotechnology, methods of analysis, renewable energy, biology, chemistry, level of English language proficiency not lower than A2.

Postrequisites : knowledge obtained on the basis of this course, graduates of the degree of Doctor of Philosophy are used in research of properties of biological objects, own scientific work, interpretation of the received results and definition of influence on environment of the developed technology.

3. The content of the discipline

Section 1. Problematic issues of ecobiotechnology

Section 2. Problematic issues of bioenergy

4. Training materials and resources

Basic literature:

1. Khodadadi, Ehsan. (2014). A review of applications of biotechnology in the environment. International Journal of Farming and Allied Sciences. 3. 1319-1325.

2. Sobti, Ranbir Chander, Kumar Arora, Naveen, Kothari, Richa Environmental Biotechnology: For Sustainable Future. Springer Nature Singapore Pte Ltd. 2019 – 401 p. https://www.academia.edu/40048432/Environmental_Biotechnology_For_Sustainable_Future ISBN 978-981-10-7284-0
3. Singh, Gulgul & Khati, Akansha & Chauhan, Rikhi. (2020). Applications of Environment Biotechnology in Aquaculture- Review. 239-247.
4. “Biotechnology for the Environment in the Future: Science, Technology and Policy”, OECD Science, Technology and Industry Policy Papers, No. 3, OECD Publishing, Paris. <http://dx.doi.org/10.1787/5k4840hqhp7j-en>.
5. Environmental biotechnology - new approaches and prospective applications Edited by Marian Petre 2013 Iva Lipovic ISBN 978-953-51-0972-3.
6. Gavrilescu M. Environmental Biotechnology: Achievements, Opportunities and Challenges. Dynamic Biochemistry, Process Biotechnology and Molecular Biology 2010 4 (1) , 1-36
7. Both, A.J. & Benjamin, Laurence & Franklin, J. & Holroyd, Geoff & Incoll, L.D. & Lefsrud, M.G. & Pitkin, G.. (2015). Guidelines for Measuring and Reporting Environmental parameters for Experiments in Greenhouses. Plant Methods. 11. 10.1186/s13007-015-0083-5.
8. Wei-Hsin Chen, Keat Teong Lee and Hwai Chyuan Ong Biofuel and Bioenergy Technology. – 2019. – 425 p. <https://doi.org/10.3390/books978-3-03897-597-7>.
9. Sadhan Kumar Ghosh Biomass & Bio-waste Supply Chain Sustainability for Bio-energy and Bio-fuel Production Procedia Environmental Sciences 31 (2016) 31 – 39
10. Dheeraj Rathore, Anoop Singh, Divakar Dahiya, Poonam Singh Nigam Sustainability of biohydrogen as fuel: Present scenario and future perspective / [AIMS Energy](#). 2019. – 7(1). – P. 1 – 19.
11. Wu Y., Zhao F., Liu S., etc. Bioenergy production and environmental impacts [Electronic resource]: <https://link.springer.com/article/10.1186/s40562-018-0114-y>.
12. Monographic: Kuzminskiy Y. Bioelectrochemical hydrogen and electricity production. Theoretical bases, description and modeling of the process / Y. Kuzminskiy, K. Shchurska, I. Samarukha, G. Łagod. – Lublin: olitechnika Lubelska, 2013. – 102 p.
13. Dahiya A. *Bioenergy* 1st Edition Biomass to Biofuels /– Elsevier, 2014. – 670 p.
14. Kallistova, Anna & Merkel, Alexander & Tarnovetskii, I & Pimenov, Nikolay. (2017). Methane Formation and Oxidation by Prokaryotes. Microbiology. 86. 671-691. 10.1134/S0026261717060091.
15. Soubbotina T. P. Beyond economic growth : an introduction to sustainable development. – The International Bank for Reconstruction and Development/THE WORLD BANK. - 2005. – 211 p.
16. Bioenergy and environment/ edited by J. Pasztor, L. A. Kristoferson. – Oxford: Westview Press. – 419 p.
17. Asgher M, Bhatti HN, Ashraf M, Legge RL (2008) Recent developments in biodegradation of industrial pollutants by white rot fungi and their enzyme system. *Biodegradation* 19: 771.

Information resources:

1. <http://biomass.kiev.ua/> -
2. <http://www.sea.gov.ua>.
3. <http://www.menr.gov.ua/content/category/308>
4. <http://zakon.rada.gov.ua>.
5. www.opec.com.
6. <http://www.greenpeace.org>
7. <http://uecr.gov.ua/>
8. <http://www.uabio.org/>

Educational content

5. Methods of mastering the discipline (educational component)

2.1. Lectures

№ з/п	Title of the lecture topic and list of main questions (list of teaching aids, references to literature and tasks on VTS)
Section 1. Problematic issues of ecobiotechnology	
1.	<p style="text-align: center;">General ideas about ecobiotechnology.</p> <p>The purpose of studying the discipline, basic concepts. Stages of development of ecological biotechnology. Worldview significance of ecobiotechnology. Priority directions of development of environmental biotechnologies. Comparative data on the pace of development of biotechnology. Scientific basis of ecobiotechnology and its place in the system of modern knowledge. Ecological component of environmental biotechnologies - ecobiotechnologies. Organization of training in the field of environmental biotechnology</p> <p>Literature: 1, 2</p>
2.	<p style="text-align: center;">Modern ecobiotechnologies of soil remediation, wastewater treatment, biological treatment and deodorization of gas emissions</p> <p>Soil quality control and management. Landscape protection. Agroecological assessment of soils. Classification of methods and technologies. Remediation of soil from antibiotics and heavy metals. Ensuring optimal parameters. Biological and combined methods.</p> <p>Classification of deodorization methods. Biofilters and of any variety. Purification of air from microorganisms. Purification of gas emissions with the help of microalgae.</p> <p>Literature: 5-7</p>
Section 2. Problematic issues of bioenergy	
3.	<p style="text-align: center;">Bioenergy. Current state. Creation of new types of biofuels</p> <p>The structure of the single bioenergy space of Ukraine. The potential of renewable energy resources of the planet. Renewable energy sources in the total energy consumption of the world. Driving forces and factors that stimulate the development of renewable energy and, in particular, bioenergy in Ukraine.</p> <p>Biohydrogen. Biofuel cells. Features of accumulation and transformation of pollution by plants and algae. Equipment. Scope.</p> <p>Literature: 9 - 13.</p>

2.2. Seminars

№ з/п	The name of the topic of the lesson and a list of main questions	Number of hours
1	<p>Biofuel production with simultaneous wastewater treatment</p> <p>Literature: 9, 10, 15</p>	2

6. Independent student work

№ з/п	The name of the topic submitted for self-study	Number of hours
1.	Fundamentals of sustainable development of the state Literature: 1 7	2
2.	Biotechnological drugs are an alternative to chemical pesticides Literature: 5, 6	4
3.	The role of modern achievements in the creation of environmental technologies. Biological systems used in biotechnology. Literature: 1 -4	4
4.	The use of viruses to solve environmental problems Literature: 7	4
5.	The general state of the air environment in the world and in Ukraine, in particular. Classification of air pollution. Transformation of pollution in the atmosphere. Greenhouse effect. Acid rains. Modern ecobiotechnologies for cleaning gas emissions. Literature: 7	4
6.	The impact of human activities on the hydrosphere and its sources of pollution. Water consumers. Pollution of the oceans. Ecological condition of reservoirs of Ukraine. The impact of water pollution on the vital functions of organisms and human health. Literature: 3, 7	4
7.	Biotechnological methods of extraction of metals from mineral raw materials. Ecological advantages of using methods of bacterial extraction of metals from polymetallic ores. Literature: 7	4
8.	Assessment of biological pollution: modern approaches and methods. The concept of bioinvasion. Types of biological invasions. Introduction and its types. Deliberate introduction. Literature: 1-3	4

№ з/п	The name of the topic submitted for self-study	Number of hours
9.	Anthropogenic transformation and degradation of natural ecosystems Characteristics of the state of surface water resources of Ukraine. Methods of biochemical wastewater treatment. The main indicators of the process of biochemical wastewater treatment. Methods of aerobic cleaning. Methods of anaerobic purification. Cleansing from antibiotics. Literature: 1-3	4
10.	Processing and disposal of civilization waste. General characteristics of organic waste. Ensilage. Composting. Aerobic stabilization. Biofertilizers. Vermiculture and vermicomposting. Literature: 4-6	4
11.	Biogas. Prospects for the use of biogas plants in Ukraine. Technological factors of methanogenesis. Biogas quality factors. Methods of biogas purification. Literature: 7, 16	4
12.	Aerobic and anaerobic processes of substance destruction Literature: 7	4
13.	Environmental monitoring. General concepts. Biotesting and bioindication of natural objects. Literature: 8	4
14.	Environmental impact of bioenergy production Literature: 10, 15	4
15.	Energy potential of biomass. Solid, liquid and gaseous biofuels. Literature: 9, 10	4
16.	International cooperation of Ukraine in the field of bioenergy Literature: 9	4
17.	Analysis of the amount of pollution per capita Literature: 3, 7	4
18.	Sorting of solid waste for their energy use Literature: 7	4
19.	Mechanisms of exoelectrogenesis Literature: 13	4

№ з/п	The name of the topic submitted for self-study	Number of hours
20.	Liquid biofuels. Biotechnologies of bioethanol and biodiesel production. Environmental aspects of bioethanol and biodiesel use. Literature: 12	4
21.	Modular control work	4
22.	Preparation for the exam	30

Policy and control

1. The policy of the discipline (educational component)

The system of requirements for students:

- attending lectures and seminars is a mandatory component of the study of the material;
- at the lecture the teacher uses his own presentation material; uses the class on the platform G suite for education to teach the material of the current lecture, additional information, guidelines for tasks and more;
- student doing a report on the seminar using presentation materials, after the report answers questions from the audience and a teacher;
- Writing modular control work and going to seminary classes and without the use of assistive devices (mobile phones, tablets, etc.) ;
- Incentive points are awarded for participation in competitions of works of ecological and energy direction , preparations for reviews of scientific works or speeches at conferences with reports on the subject of the discipline. The number of encouraged points is not more than 10.

8.Types of control and rating system for assessing learning outcomes

Current control: Modular control work and report on the seminary lesson.

Calendar control : conducted twice a semester as a monitoring of the current state of compliance with the requirements of the syllabus.

Semester control: exam.

Conditions for admission to semester control marginally positive assessment and for the ICC and the terminal rating more than 40 points.

The student's rating in the discipline consists of points that the student receives for:

- 1) Writing 1 Modular control work - 40 points
- 2) Report at the seminar - 20 points
- 3) Exam - 40 points

2. Scoring criteria:

2.1. Execution of modular control work (MCR):

Each version of the MCR contains 8 questions with 5 points each.

Complete and correct answer to the question - 5 points,

the answer contains certain inaccuracies, small errors in the explanation - 4 points;

the answer contains weight and inaccuracies or is incomplete - 3 points,

The answer is not credited - 0-2 points.

2. 2. Report at the seminar:

The evaluation of the report consists of the following main parts:

Disclosure of the topic - 10 points,

The answer to the question - 6 points,

Making a presentation for the report - 4 points.

At the end of the semester, the **condition for admission to the exam is the student 's semester rating ≥ 40 .**

If after writing the exam the student's rating is ≥ 60 , **the grade is set according to the table.**

Table of correspondence of rating points to grades on the university scale :

:

<i>Scores</i>	<i>Rating</i>
100-95	Perfectly
94-85	Very good
84-75	Okay
74-65	Satisfactorily
64-60	Enough
Less than 60	Unsatisfactorily
Admission conditions are not met	Not allowed

3. Additional information on the discipline (educational component)

- the list of theoretical questions that are submitted for semester control (exam) is given in Annex 1;
- At the beginning of the semester, the teacher analyzes the existing distance learning courses on the subject of the discipline and offers students to take the appropriate free courses. After the student receives a certificate of successful completion of distance or online courses on the subject, the teacher closes the relevant part of the course (laboratory or lectures).

List of theoretical questions to be taken for the exam

1. Anthropogenic transformation and degradation of natural ecosystems.
2. Biohydrogen. Biofuel cells. Features of accumulation and transformation of pollution by plants and algae. Equipment. Scope.
3. Biogas. Prospects for the use of biogas plants in Ukraine. Technological factors of methanogenesis. Biogas quality factors. Methods of biogas purification.
4. Bioenergy. Current state.
5. Biological treatment and deodorization of gas and air emissions.
6. Biotesting and bioindication of natural objects.
7. Biotechnological methods of extraction of metals from mineral raw materials. Ecological advantages of using methods of bacterial extraction of metals from polymetallic ores.
8. Production of biofuels and prospects for its use in Ukraine. Solid biofuels - production and use.
9. Biofuel production.
10. Renewable energy sources in the total energy consumption of the world.
11. The impact of human activities on the hydrosphere and its sources of pollution.
12. The impact of water pollution on the vital functions of organisms and human health.
13. Energy potential of biomass in Ukraine.
14. Stages of development of ecological biotechnology.
15. General characteristics of organic waste. Ensilage. Composting. Aerobic stabilization. Biofertilizers. Vermiculture and vermicomposting.
16. The general state of the air environment in the world and in Ukraine, in particular. Classification of air pollution. Transformation of pollution in the atmosphere.
17. Soil quality control and management. Remediation of soil from antibiotics and heavy metals. Ensuring optimal parameters. Biological and combined methods.
18. Methods of biochemical wastewater treatment. The main indicators of the process of biochemical wastewater treatment. Methods of aerobic cleaning. Methods of anaerobic purification. Cleansing from antibiotics.
19. Environmental monitoring.
20. Scientific basis of ecobiotechnology and its place in the system of modern knowledge.
21. Assessment of biological pollution: modern approaches and methods.
22. Purification of air from microorganisms. Purification of gas emissions with the help of microalgae.
23. Processing and utilization of civilization wastes.
24. The concept of bioinvasion. Types of biological invasions. Introduction and its types. Deliberate introduction.

25. Liquid biofuels. Biotechnologies of bioethanol and biodiesel production. Environmental aspects of bioethanol and biodiesel use. Creation of new types of biofuels
26. The role of modern achievements in the creation of environmental technologies. Biological systems used in biotechnology.
27. Modern ecobiotechnologies for cleaning gas emissions.
28. Modern ecobiotechnologies of soil remediation.
29. Solid, liquid and gaseous biofuels.