National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"

Department of Ecology and
Plant Polymers Technology

Resource-efficient water circulation systems

Work program of the discipline (Syllabus)

Details of the discipline

Level of higher education	*The first (educational and professional)*
Branch of knowledge	*10 Natural Sciences*
Speciality	*101 Ecology*
Educational program	*Environmental safety*
Status of discipline	*Custom*
Form of training	*full-time/remote/mixed*
Year of preparation, semester	*4th year, spring semester*
Volume of discipline	*4 ECTS credits (120 hours)*
Semester control/ control measures	*Test*
Schedule of classes	*4 hours a week (1 hours of lectures, 2 hours of laboratory classes and 1 hours of practical classes)*
Language of instruction	*Ukrainian*
Information about kerivnik course / teachers	*Lecturer: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/glushko-olena-volodimirivna.html* *Practical /Seminary: https://ecopaper.kpi.ua/prokafedru/vykladachi/glushko-olena-volodimirivna.html* *Laboratory:https://eco-paper.kpi.ua/prokafedru/vykladachi/ivanenko-olenaivanivna.html*
Course placement	*https://do.ipo.kpi.ua/course/view.php?id=6408*

Program of discipline

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

Ukraine, with its insignificant water reserves, is in need of rational use of water resources like no other country. For industrial enterprises, the most acceptable option is to implement a water circulation system that allows for the repeated use of a limited amount of water in the technological process. However, there are few technological processes in industry that are not associated with water pollution. Therefore, the scope of this discipline includes the study of technological measures and techniques that improve the quality of used water to a level that allows its reuse.

The subject of the discipline « Resource-efficient water circulation systems» *– modern technological approaches and methods for implementing and organizing recycling and/or closed water use cycles in industry.*

In a period of significant water shortage, the use of water by industrial enterprises according to the direct-flow scheme (intake from the source - use in the technological process - treatment - discharge to

the source) is simply unacceptable. To implement resource-efficient water circulation systems, specialists are needed who are able to perform all the procedures for the development and implementation of such systems provided for by regulatory documents. Therefore, the study of this discipline is essential for a modern ecologist.

The purpose of the discipline « Resource-efficient water circulation systems »

The purpose of studying this discipline is to form a set of knowledge in the field of development of resource-efficient technologies for industrial water use. In accordance with the objective, the training of bachelors in this specialty requires the formation of students' competencies:

- *Knowledge and understanding of the subject area and professional activity;*
- *The ability to distinguish the technological processes of production, to determine the sources and ways of entering the natural environment of harmful components, to assess their impact on human health and the quality of the environment.;*
- *The ability to improve, design, implement and operate technologies and equipment for treatment and processing of raw gases, wastewater and solid waste*

According to the requirements of the program of the academic discipline "Resource Efficient Water Circulation Systems", students must demonstrate the following program learning outcomes after mastering it:

- *To understand the basic concepts, theoretical and practical problems in the field of natural sciences that are necessary for analysis and decision-making in the field of ecology, environmental protection and optimal use of nature;*
- *To carry out laboratory researches with use of modern devices, to provide sufficient accuracy of measurement and reliability of results, to process the obtained results;*
- *To develop technologies, to use processes and devices that ensure efficient separation, concentration, removal, destruction of harmful impurities in water systems and gas medium, processing and disposal of waste;*
- *To apply methodologies and technologies of design and implementation of environmental technologies and equipment, to carry out design and engineering activities.*

2. **Prerequisitions and requisition of disciplines (place in the structural and logical scheme of training according to the relevant educational program)**

The study of the discipline "Resource Efficient Water Circulation Systems" is based on the principles of integrating the various knowledge gained by students during the three years of bachelor's degree in the study of natural and engineering disciplines. The discipline "Resource Efficient Water Circulation Systems" significantly enhances the competencies that should ensure the solution of complex problems in the field of hydrosphere protection, rational use of water resources and is aimed at a deep rethinking of existing and creation of new holistic knowledge and professional practice. The discipline "Resource Efficient Water Circulation Systems" ensures the implementation of a bachelor's project.

3. **Contents of the discipline**

Section 1. Resource efficient water use

Topic 1: General provisions. Classification of water circulation systems. Basic schemes of water supply to settlements

Topic 2. Resource-saving water treatment technologies. The use of new reagents in water treatment technologies

Topic 3. Water circulation systems for municipal and domestic purposes

Section 2. Features of industrial water supply systems

Topic 3. Water treatment for water recycling systems

Topic 4. Water supply of thermal power plants

Topic 5. Industrial water supply. Organization of resource-efficient water circulation systems

4. Training materials and resources

Basic literature

1. *Т.О. Шаблій, В.М. Радовенчик, М.Д. Гомеля Застосування нових реагентів і технологій в промисловому водоспоживанні. К. Інфодрук, 2013. – 327 с.*
2. *Трус І.М. Маловідходні технології демінералізації води : монографія. – Київ: Кондор-Видавництво, 2016. – 252 с. ISBN 978-617-7458-07-3*
3. *Шадура В.О., Кравченко Н.В. Водопостачання та водовідведення: навчальний посібник.- Рівне: НУВГП, 2018.-343 с.*
4. *Орлов В.О. Водопостачання промислових підприємств: навч. посіб. /В.О. Орлов, Л.Л. Литвиненко, А.М. Орлова. - К.: Знання, 2014.-278 с.*

Additional literature

5. *Технологія та обладнання одержання питної та технічної води: Практикум (Частина 2). [Електронний ресурс]: навчальний посібник для студ. спеціальності 161 «Хімічні технології та інженерія», спеціалізації «Хімічні технології неорганічних речовин та водоочищення» / Н.М. Толстопалова, М.І. Літинська, Т.І. Обушенко, І.М. Астрелін, О.В. Сангінова; КПІ ім. Ігоря Сікорського – Електронні текстові дані (1 файл: 8,12 Мбайт). – Київ : КПІ ім. Ігоря Сікорського, 2020. – 181 с*.
6. *Айрапетян Т. С. Водне господарство промислових підприємств : навч. посібник – Харків : ХНАМГ, 2010.– 280 с.*
7. ***Гоме**ля М.Д., Радовенчик В.М., Шаблій Т.О. Сучасні методи кондиціонування та очистки води в промисловості. – К.: Графіка, 2007. – 193 с.*
8. *Сашко В. О., Терещенко Т. М. Водопостачання. Навчальний посібник. - Ресурсний центр ГУРТ, 2019.- 114с*.
9. *Корвер, А., Еверс, Л., Ф'юстер, Е., Галбрейт, Д., Генш, Р., Матта, Дж., Петер, М. (2021). Посібник із технологій водопостачання в умовах надзвичайних ситуацій. Німецька мережа WASH, Університет прикладних наук та мистецтв Південно-західної Швейцарії, Глобальний кластер WASH та Альянс сталого водовідведення. Берлін. Німеччина. ISBN: 978-3-033-08369-1*
10. *Водокористування в умовах сталого розвитку міських поселень : монографія / М. Я. Берещук, В. О. Ткачов ; Харків. нац. ун-т міськ. госпва ім. О. М. Бекетова. – Харків : ХНУМГ ім. О. М. Бекетова, 2019. – 205 с. ISBN 978-966-695-500-8*

Information resources on the Internet

1. *Професійна Асоціація Екологів України (ПАЕУ) - https://pae.com.ua/*
2. *Міністерство захисту довкілля та природних ресурсів України* - https://mepr.gov.ua/
3. *Бібліотека ім. В.І. Вернадського – www.nbuv.gov.ua*

Educational content

5. Methods of mastering the discipline (educational component)

Lecture classes

Lectures are aimed at:

- *providing modern, holistic, interdependent knowledge in the discipline "Modern technologies of air conditioning and water purification", the level of which is determined by the target installation for each specific topic;*
- *providing in the process of lecture creative work of graduate students together with the teacher;*
- *education of postgraduate professional and business qualities and development of their*

independent creative thinking;

- *formation of the necessary interest from graduate students and providing direction for independent work;*

- *determination at the current level of science development in the field of modern methods and processes of air conditioning, forecasting development for the coming years;*

- *display of methodological processing of the material (allocation of the main provisions, conclusions, recommendations, clear and adequate to their formulations);*

- *use for demonstration of visual materials, combining, if possible, them with the demonstration of results and samples;*

- *teaching research materials in a clear and high-quality language in compliance with structural and logical relations, explaining all the newly introduced terms and concepts;*

- *accessibility for perception by this audience.*

Practical classes

In the system of professional training of graduate students in this discipline, practical classes occupy 25% of the classroom load. Being an addition to the lecture course, they lay and form the foundations of the qualification of doctor of philosophy in the field of ecology, namely the protection of reservoirs from anthropogenic influence. The content of these classes and the methodology of their conduct should ensure the development of creative activity of the individual. They develop scientific thinking and the ability to use special terminology, allow you to test knowledge, therefore, this type of work is an important means of operational feedback. Practical classes should perform not only cognitive and educational functions, but also contribute to the growth of graduate students as creative workers in the field of environmental protection.

The main tasks of the cycle of practical classes:

- *helpaspirantssystematize, consolidate deepen knowledgetheoreticcharacter in the field of modern methods and technologies of air conditioning and water purification;*
- *to teach associativesinvention of practical tasks, to promote mastering and skills of performing calculations, graphic and othertasks;*
- *learners to work with scientific and reference literary schemes;*
- *to form the ability to learn independently, that is, to mastermethods, methods of methods of self-study, self-development of self-control.*

Laboratory classes

In the system of professional training of students, laboratory classes take up 50% of the classroom load. As a supplement to the lecture course, they lay the foundation and form the basis of the bachelor's degree in ecology. The purpose of laboratory classes is to develop students' experimental skills, research approach to the subject, and consolidate theoretical material.

6. Independent work of a student/graduate student

Independent work of students takes 40% of the time of studying the credit module. The main task of students' independent work is to master scientific knowledge in the field of designing wastewater treatment plants, effective wastewater treatment technologies, water treatment, design of water recycling and closed water use systems that are not included in the list of lecture topics through personal search for information, formation of an active interest in a creative approach to academic work.

Politics and control

7. Policy of discipline (educational component)

Rules for attending classes and behavior in classes

Attending classes is a mandatory component of assessment. Graduate students are obliged to take an active part in the educational process, not to be late for classes and not to miss them without a good reason, not to interfere with the teacher to conduct classes, not to be distracted by actions that are not related to the educational process.

Rules for assigning incentive and penalty points

incentive points can be awarded by the teacher only for the performance of creative works in the discipline or additional online specialized courses with the receipt of a relevant certificate:

- *https://www.coursera.org/learn/water*
- *https://www.coursera.org/learn/water-part-2*
- *https://www.coursera.org/learn/water-management*
- *https://ukrvodokanal.in.ua/kurs-onlajn-navchan-na-temu-gigiyena-vody/*
- *https://www.coursera.org/learn/global-environmental-management*

However, their amount cannot exceed 10% of the rating scale..
Penalty points within the discipline are not provided.

Deadline and overlay policy

In case of debts in the discipline or any force majeure circumstances, graduate students should contact the teacher through accessible (provided by the teacher) communication channels to solve problematic issues and coordinate the algorithm of actions for working out.

Academic Integrity Policy

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the absence of references when using printed and electronic materials, quotes, opinions of other authors. Invalid hints and write-offs when writing tests, conducting classes; passing the credit for another graduate student; copying of materials protected by the copyright system without the permissionof the author of the work.

The policies and principles of academic integrity are defined in Section 3 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"https://kpi.ua/code.

Policy of academic behavior and ethics

Graduate students should be tolerant, respect the opinion of others, object to formulate in the correct form, constructively maintain feedback in the classroom.

The norms of ethical behavior of students and employees are defined in Section 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"https://kpi.ua/code.

8. Types of control and rating system for evaluating learning outcomes (RCOs)

Distribution of educational time by types of classes and tasks in the discipline according to the working curriculum:

Semester	School time		Distribution of training hours				Control measures		
	Loans	acad. H.	Lecture	Practical	Lab. Rob.	IWS	MCT	HCW	Semester control
8	4	120	18	18	36	48	1	-	Test

A student's grade in a credit module is based on the points he or she receives for writing a homework assignment, a module test, completing laboratory work, and working in practical classes.

The semester control is a test.

System of rating (weight) points and evaluation criteria

A student's credit module rating consists of the points he or she receives for:

- writing a module test;

- performing laboratory work;

- two reports in practical classes;

he weighting score for the module test is 20 points.

Assessment criteria for the module test

Completeness and signs of response	***Points***
"excellent", complete answer, at least 90% of the required information (complete, error-free solution of the task)	*20-18*
"good", a sufficiently complete answer, at least 75% of the required information or minor inaccuracies (complete solution of the task with minor inaccuracies)	*17-15*
"satisfactory", incomplete answer, and some mistakes (the task was completed with certain shortcomings)	*14-10*
"unsatisfactory", the answer does not meet the conditions for "satisfactory"	*9- 0*

The weighting score for laboratory work is 10. The maximum number of points for laboratory work is equal to: 10 points x 4 semester hours = 40 points.

The necessary conditions for student admission to laboratory work are:

- availability of the protocol of the relevant laboratory work;

- a positive answer to the questions of the incoming express control of the quality of the student's theoretical preparation for the laboratory work (express control is carried out in the form of an oral survey conducted at the beginning of the class). In case of non-compliance with these conditions, the student is not allowed to perform the laboratory work.

Evaluation criteria	***Points***
"excellent" - timely complete completion of laboratory work, calculations based on the data of the experiment, design and defense	*10-9*
"good" - timely completion of laboratory work, shortcomings in calculations and design	*8-6*
"Satisfactory" - untimely completion of laboratory work, gross errors in calculations and design	*5-1*
"unsatisfactory" - the laboratory work was not completed	*0*

The weighting score for reports at practical classes is 10.

Maximum number of points: 10 points x 4 answers = 40 points

Criteria for evaluating reports

Completeness and signs of response	***Points***
"excellent", the content of the report is fully covered, conclusions are drawn, the report is well presented	*10-9*
"good", the content of the report is not fully covered, conclusions are drawn, an informative presentation is made	*8-6*
"Satisfactory", the content of the report is sufficiently covered, no conclusions are given, the report is not presented	*5-2*
"unsatisfactory", the report does not meet the requirements for "satisfactory"	*1-0*

Thus, the rating scale for the credit module is 100 points

$R = R_{MCT} + R_{lw}. + R_a = 20+40+40=100$ *points*

At the first assessment (week 8), a student receives a "pass" if their current rating is at least 20 points. At the second assessment (week 14), a student receives "passed" if his or her current rating is at least 50 points.

A prerequisite for admission to the test is the completion of all laboratory work, passing the module test and reports in practical classes, and a rating of at least 60 points.

Students who have a rating of less than 60 points at the end of the semester, as well as those who want to improve their ECTS score, take a test. In this case, all previous grades are canceled. The grade for the test is final. The test consists of five questions from different sections of the syllabus. Each question of the test (r1, r_2, r_3, r_4, r_5) is rated from 0 to 20 points. The sum of points obtained for the semester, or the sum of points for each of the five questions of the test is converted to a final grade according to the table:

Score	***Score***
95... 100	*Perfectly*
85... 94	*very good*
75...84	*well*
65... 74	*Satisfactory*
60...64	*enough*
RD < 60	*Disappointing*
Admission conditions not met	*not allowed*

Work program of the discipline (syllabus):

Compiled by Associate Professor, Candidate of Technical Sciences, Hlushko O.V.

***Approved** by the Department E and PPT (protocol No _14_ from _18.05.2023)*

According tothe Methodical Commission
of the Faculty of Engineering and Chemistry (protocol No 10 from 26.05.2023)