



Design of water supply systems

Work program of the discipline (Syllabus)

Details of the discipline

Level of higher education	<i>The first (educational and professional)</i>
Field of knowledge	<i>10 Natural sciences</i>
Speciality	<i>101 Ecology</i>
Educational program	<i>Environmental safety</i>
Discipline status	<i>Normative</i>
Form of study	<i>full-time/remote/mixed</i>
Year of preparation, semester	<i>4th year, spring semester</i>
Scope of discipline	<i>4 ECTS credits (120 hours)</i>
Semester control/ control measures	<i>Test</i>
Schedule of classes	<i>3 hours a week (2 hours lectures and 1 hour of practical classes)</i>
Language of instruction	<i>Ukrainian</i>
Information about the course / teachers	Lecturer: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/vizytka/radovenchik-vyacheslav-mikhajlovich.html Practical /Seminar: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/vizytka/radovenchik-vyacheslav-mikhajlovich.html
Course placement	https://do.ipk.kpi.ua/course/view.php?id=5017

The program of the discipline

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

Water resources are one of the vital components of the hydrosphere of the globe and the necessary foundation of socio-economic development in general, meeting the basic needs of people, activities in the field of food production, preservation of ecosystems.

Ukraine belongs to low-income countries in terms of water supplies available for use. In addition, the long-term consequences of human intervention in ecosystems have led to significant qualitative and quantitative changes and anthropogenic load.

The significant economic downturn that has occurred in the past two decades has led to a reduction in water use in the country.

To ensure balanced use and protection of water, it is necessary to: develop comprehensive programs for monitoring, protecting and using sources of water supply to the population and drinking water quality in the regions of Ukraine, introduce low-water and water-saving technologies, new modern means of water treatment and disinfection in technologies used at water supply facilities and strengthen management support for entrepreneurs' efforts to create domestic water treatment equipment.

Recognizing the priority of rational use of water resources and drinking water, market mechanisms and economic incentives for consumers to economically treat water resources are being established in the country - the ecological cost of water consumption and its pollution should become clear to all segments of the population, and in this matter the main lever should be a wide explanatory work, involvement of the media in these processes, environmental NGOs.

The analysis of the existing legislative framework of Ukraine on the protection and reproduction of water resources, providing the population with quality drinking water indicates a real need to develop a law on national directions of state policy on the regulation of water relations.

The subject of the discipline "Design of water supply systems" is the implementation of technical and technological approaches that guarantee a stable supply of mankind with high-quality drinking water in accordance with their needs.

To a large extent, the solution of water supply problems will be determined by the level of training of specialists working in this field, including state environmental safety management institutions, scientific institutions and organizations, enterprises.

To successfully solve the problems of providing water to all segments of the population while ensuring the stable development of mankind, specialists must be fluent in information, be able to solve complex problems of supplying enough water in conditions of its shortage at the highest technological and scientific level.

The purpose of the discipline "Design of water supply systems"

The purpose of studying this discipline is the formation of a complex of knowledge in the field of modern technologies in the field of boron, transportation and distribution of water resources, scientific developments in the field of improving the efficiency of their use, a set of skills and abilities necessary for the introduction into production and management of modern we and new method and technology of water supply pits, creation of effective systems for the accumulation and storage of water.

- *on the development and understanding of the theoretical foundations of ecology, environmental protection and balanced nature management;*
- *from date to assessment of the impact of technogenesis processes on the state of the environment and the identification of environmental risks associated with production activities;*
- *from date to use the basic principles and components of environmental management;*
- *to develop design and working technical documentation in the field of environmental technologies, to draw up structural schemes with elements of equipment and industrial buildings, to draw up completed design and development.*

According to the requirements of the program of the discipline "Design of water supply systems", students after mastering it must demonstrate the following programmatic learning outcomes:

- *Demonstrate an understanding of the basic principles of managing environmental actions and/or environmental projects. **PO 01.***

- *Understand the basic concepts, theoretical and practical problems in the field of natural sciences, which are necessary for the analysis and decision-making in the field of ecology, environmental protection and optimal use of nature. **PO 03.***

- *To participate in the development of projects and practical recommendations for environmental protection. **PO 22.***

- *To apply methodologies and technologies of design and implementation of environmental technologies and equipment, to carry out design and engineering activities. **PO 27.***

- *To carry out technological and hydraulic calculations of sewage treatment plants, to draw up the energy and material balance of devices, to perform a parametric calculation of equipment, to choose typical structures in construction, to draw up general plans of industrial enterprises. **PO 29.***

2. Prerequisites and post-requisitions of disciplines (place in the structural and logical scheme of education according to the relevant educational program)

The study of the discipline "Design of water supply systems" is based on the principles of integration of various knowledge gained by students during the study of natural and engineering-technical disciplines. Discipline "Design of water supply systems" is a fundamental basis that should ensure the solution of complex problems in the field of guaranteed provision of society with high-quality water resources, rational use of material and energy resources and is aimed at a deep rethinking of existing and

the creation of new holistic knowledge and professional practices in the field of water supply and water consumption.

3. Contents

Chapter 1: Water Supply Systems.

Water supply systems. Water supply of industrial enterprises. Circulating and closed water supply systems. Spare and regulating tanks. Methods for calculating the required volume of regulating and spare tanks. Water supply and water withdrawal from the network.

Section 2: Design of water supply networks.

Determination of the diameter of water supply lines at a given estimated flow rate. The study of pressure losses in the pipes. The equation for the distribution of flow in water supply networks. Initial distribution of threads in ring networks. Theoretical foundations of verification hydraulic calculations in water supply networks. Theory and methods of internal linking of ring networks. Methods for calculating networks, taking into account their joint work with water heaters in the presence of unfixed selections. Zoning of water supply systems.

Section 3: Equipment of water supply networks.

Equipment of water supply networks. Pipes. Fittings of water supply and distribution systems.

Chapter 4: Water Intake Facilities.

Water intake facilities. General provisions. Water intakes in open water. Calculation of the area of entrance windows, the area of grids, grids. Tips, siphon and self-flowing pipes, coastal wells.

Chapter 5: Facilities for Receiving Groundwater.

Facilities for receiving groundwater. Tubular drilling wells. Calculation of the perfect well in pressure aquifers. Mine wells. Horizontal water intake. Facilities for the captage of spring water.

Section 6: Pumps and pumping stations.

Pumps and pumping stations. The connection of individual elements of the systems in relation to the necessary pressures created. Dynamic and volumetric pumps. Characteristics of pumps. Classification of pumping stations, their categories. Equipment of pumping stations.

Chapter 7: Cooling structures.

Cooling the facilities of circulating water supply systems. Features of heat exchange in cooling reservoirs. Splash pools. Cooling towers, their types and designs.

4. Learning materials and resources

Basic literature

1. Khoruzhyi P.D., Khomutetska T.P., Khoruzhyi V.P. *Resource-saving technologies of water supply.* – K.: Agrarian Science, 2008. – 534 p.
2. Shadura V.O., Kravchenko N.V. *Water supply and sanitation: textbook* – Rivne: NUWGP, 2018. – 343 p.
3. Matsiyevska O.O. *Water supply and sanitation: Textbook.* - Lviv Polytechnic Publishing House, 2015. – 144 p.
4. *Special water supply: pidruchnyk (educational publication corrected and supplemented)* / O.A. Petukhova, S.A. Hornostal, Y.V. Uvarov – Kh.: NUCZU, 2015 – 256 p.

Further reading

5. Radovenczyk V.M. *Fundamentals of hydrology of land and oceanology* / V.M. Radovenczyk, M.D. Gomel, Yu.A. Omelchenko. - Sevastopil: SNUYAE & P, 2008. – 176 p.
6. Orlov V.O. *Water supply of industrial enterprises (textbook)*. – K.: Publishing House "Znannya", 2014. – 278 p.
7. *Rules of technical operation of water supply and sanitation systems of settlements of Ukraine. As amended in 2015. Order of the State Committee of Ukraine on Housing and Communal Services of 21.07.1995 No30. Directory. in the Ministry of Justice 21.07.1995, No231/767. Media27.11.2015, No302. 144 p.*

Information resources on the Internet

1. Ministry of Environmental Protection and Natural Resources in Ukraine - <https://mepr.gov.ua>.
2. Industrial Ecology. Community of Environmental Specialists - <http://www.eco.com.ua/>
3. Professional Association of Ecologists of Ukraine (PAEU) - <https://paeu.com.ua>.
4. Ministry for Communities and Territories Development - <https://www.minregion.gov.ua>.
5. State Agency of Water Resources of Ukraine - <https://www.davr.gov.ua/pro-vidomstvo>

Educational content

5. Methods of mastering the discipline (educational component)

Lectures

Lectures are aimed at:

- providing modern, holistic, interdependent knowledge of the discipline "**Design of water supply systems**", the level of which is determined by the target setting for each specific topic;
- ensuring in the process of the lecture the creative work of students together with the teacher;
- education of students' professional and business qualities and the development of their independent creative thinking;
- formation of students' necessary interest and providing direction for independent work;
- determining the current level of development of science in the field of water supply, forecasting its development for the coming years;
- reflection of the methodological processing of the material (selection of the main provisions, conclusions, recommendations, clear and adequate to their formulations);
- use for demonstration of visual materials, combination, if possible, them with a demonstration of results and samples;
- teaching materials in a clear and high-quality language in compliance with structural and logical connections, explaining all newly introduced terms and concepts;
- accessibility for perception by this audience.

No s/n	The title of the topic of lectures and a list of main issues (list of didactic means, references to literature and tasks for the IWS)	Hours
1	<u>Water supply systems.</u> Water on Earth. Surface and underground sources of water supply. Classification of water supply systems. Water supply of industrial enterprises and the population. Principles of creating closed water supply systems. Spare and regulating tanks. Literature: [1. p.7-39; 283-315; 2. c.9-30; 3. C.6-10]. Tasks on the IWS – Types of water supply sources [6 p. 7-13]. Basic designs of spare tanks [3 p. 49-53].	<u>4</u>
2	<u>Metodi wastewater treatment and watertreatment.</u> The composition of natural and wastewater. Classification of water treatment	<u>4</u>

	<p>methods. Methods for determining the required volume of regulating and spare tanks.</p> <p>Literature: [1. p.321-379; 3. pp.31-45].</p> <p>Tasks on the IWS – Basic designs of adjusting tanks [3 c. 49-53].</p>	
3	<p><u>Water supply and water withdrawal from the network.</u></p> <p>Types of water pipes. Road and transit costs. Determination of the diameter of water supply lines at a given estimated flow rate. Calculation of the diameter of the pipeline with a significant number of selection points.</p> <p>Literature: [1. c.209-226; 2. C.74-87; 4. pp.56-66].</p> <p>Tasks on IWS – Vopre-conductive networks and their types [1 c. 237-249].</p>	<u>2</u>
4	<p><u>Determination of pressure losses in pipes.</u></p> <p>The main causes of pressure loss in the pipes. Existing methods for calculating pressure losses. Modes of operation of pipelines. The equation for the distribution of flows in water supply networks.</p> <p>Literature: [1. c.249-280; 2. C.77-91; 4. C.66-83].</p> <p>Task on IWS – Calculation of pressure losses in pipes [4 c. 84-101].</p>	<u>2</u>
5	<p><u>Calculation of ring networks.</u></p> <p>Initial distribution of threads in ring networks. Theoretical foundations of verification hydraulic calculations in water supply networks. Theory and methods of internal linking of ring networks.</p> <p>Literature: [1. c.253-263; 2. c.129-140; 4 .p.84-86].</p> <p>Tasks on the IWS – Lobachov-Cross method [4 p. 86-94].</p>	<u>2</u>
6	<p><u>Calculation of ring and branched networks.</u></p> <p>Branched networks. Advantages and disadvantages of both types of networks. Methods for calculating networks, taking into account their joint work with water heaters in the presence of unfixed selections. Zoning of water supply systems.</p> <p>Literature: [1. p.266-283; 4. c.94-101].</p> <p>Tasks on the IWS – The Lobachov-Cross method [4 p. 86-94].</p>	<u>2</u>
7	<p><u>Equipment of water supply networks.</u></p> <p>Pipes, their types and materials. Advantages and disadvantages of different types of pipes. Fittings of water supply and distribution systems. Additional equipment of pipelines. Basic methods of water intake from surface water bodies. Water intakes in open water. Constructions of water intake structures. Conditions for the device of water intakes of various types.</p> <p>Literature: [1. p.141-197; 2. C.91-123].</p> <p>Tasks for IWS – Water fittings [2 p. 107-129]. Constructions of water intake structures [1 p. 141-185].</p>	<u>2</u>
8	<p><u>Calculation of water intake structures.</u></p> <p>Features of calculations of water intake structures. Calculation of the area of entrance windows, the area of grids, grids. Tips, siphon and solitary pipes, coastal wells. Estimated water consumption.</p> <p>Literature: [1. pp.153-199].</p> <p>Tasks on the IWS – Structures of water intake structures [2 p. 44-49].</p>	<u>2</u>
9	<p><u>Facilities for receiving groundwater.</u></p> <p>Tubular drilling wells, their structure and use. Equipment trubchastykh drilling wells. Creation of trubchasty drilling wells. Calculation of the perfect well in pressure aquifers.</p> <p>Literature: [1. c.67-105; 2. C.36-41].</p> <p>Task on the IWS – Calculation in the odozabernykh structures [1 p. 73-101].</p>	<u>2</u>
10	<p><u>Facilities for receiving groundwater.</u></p> <p>Mine wells. Horizontal water intake. Beam catchments. Facilities for the captage of spring water. Infiltration catchment. Equipment of mine wells. Classification of pumps. Structure and principle of operation of different types of pumps. pumps in water supply systems. The connection of individual elements of the system in relation to the necessary and created pressures.</p>	<u>2</u>

	<p>Literature: [1. p.109-138; 3. c.113-126]. <i>Tasks on the IWS – Water intake facilities [1 p. 73-101]. Modern constructions of pumping equipment [3 p.45-54].</i></p>	
11	<p><u>Pumps and pumping stations.</u> <i>Dynamic and volumetric pumps. The main characteristics of pumps. The concept of geometric and vacuum heights. Selection of pumps according to their characteristics.</i> Literature: [1. p.30 - 315]. <i>Tasks for IWS – Bwidow and the work of special types of pumps [4 c. 113-126].</i></p>	<u>2</u>
12	<p><u>Nasos and pumping stations.</u> <i>Classification of pumping stations, their categories. Use of pumps and pumping stations in water supply systems. Equipment of pumping stations.</i> Literature: [1. p.307-315]. <i>The task at the IWS is High-capacity pumps for large-scale water supply systems [4 p. 113-126].</i></p>	<u>2</u>
13	<p><u>Cooling facilities.</u> <i>Water cooling processes in coolers. Heat transfer between media. Water transmission by radiation. Schemes of reservoirs-coolers. Water circulation schemes in cooling water bodies. Thermal calculation of the cooling reservoir. The main structures and reservoirs-coolers. Features of heat exchange in cooling reservoirs.</i> Literature: [6. p.176-208]. <i>The task at the CPC is circulating water supply. Laws of heat transfer [1 c. 56-59].</i></p>	<u>4</u>
14	<p><u>Cooling devices of circulating water supply systems.</u> <i>Splash pools. Spraying nozzles. Cooling towers, their types and designs. Water distribution and spraying cooling tower devices.</i> Literature: [6.p.176-208]. <i>The task of the IWS is to get along with cooling structures [1. c. 56-59].</i></p>	<u>4</u>
	Just	36

Practical classes

In the system of professional training of students in this discipline, practical classes occupy 33% of the classroom load. Use special terminology, allow you to check 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 students as creative workers in the field of environmental protection.

The main objectives of the cycle of practical classes:

- *help students systematize, consolidate and deepen theoretical knowledge in the field of modern water supply methods;*
- *teach students techniques for solving practical problems, promote mastering the skills and abilities of performing calculations, graphic and other tasks;*
- *teach them to work with scientific and reference literature and diagrams;*
- *to form the ability to learn independently, that is, to master the methods, methods and techniques of self-learning, self-development and self-control.*

No s/n	The name of the topic of the lesson and the list of main issues (list of didactic support, references to literature and tasks on the IWS)	Hours
1	<p><i>Calculation of the main parameters of surface watercourses. Analysis of the cross section of the watercourse.</i> Literature: 5 [51-56]. <i>Tasks on the IWS – Basic concepts of hydrology and hydrometry. Characteristics of water flows [5 p.51-56].</i></p>	2

2	<p>Calculation of the main parameters of underground flows. Analysis of the permeable properties of the soil.</p> <p>Literature: 5 [45-49].</p> <p>The task for the IWS is Darcy's Law. The main characteristics of soils. movement of water masses in underground horizons [5 p.45-49].</p>	2
3	<p>Selection of design of adjusting and spare tanks. Determination of the required volume of adjusting and spare tanks.</p> <p>Literature: 1 [283-302].</p> <p>The task on the IWS is to determine the height of the water tower to maintain the required pressure in the system [1 s.283-289].</p>	2
4	<p>Determination of the diameter of water supply lines at a given estimated flow rate. Calculation of the diameter of the pipeline with a significant number of selection points.</p> <p>Literature: [1. c.209-221].</p> <p>The problem on the IWS is the Equation of continuity. Pressure and non-pressure water pipes [5 p.31-35].</p>	2
5	<p>Calculation of pressure losses in pipes. The choice of empirical coefficients for calculations.</p> <p>Literature: [1 p. 209-231].</p> <p>Task on IWS – Change in the properties of the surface of pipes during operation [2 s.137-144].</p>	2
6	<p>Calculation of ring networks. Methodes of the internal binding of ring networks.</p> <p>Literature: [1. c.253-262].</p> <p>The task on the IWS is the Lobachov-Cross method [1. p.257-262].</p>	2
7	<p>Calculation of the area of entrance windows, the area of grids, grids. Estimated water consumption.</p> <p>Literature: [1. p.180-185].</p> <p>Tasks on the IWS – Construction of water intake structures [1. p.153-185].</p>	2
8	Modular control work	2
9	Test	2
	Just:	18

6. Independent work of the student

Independent work of students takes 55% of the time to study the course, also includes preparation for the test. The main task of independent work of students is to master scientific knowledge in the field of water supply, which are not included in the list of lecture issues, through personal search for information, the formation of an active interest in a creative approach in educational work. problems of methods of analysis of water supply systems and, on the basis of analyzes, to come to their own reasonable conclusions.

No s/n	The name of the topic submitted for independent study	Number of hours of IWS
<i>Section 1. Water supply systems.</i>		
1	Types of water supply sources [6 p. 7-13]. Basic designs of spare tanks [3 p. 49-53]. Basic structures of regulating tanks [3 p. 49-53]. Water supply networks and their types [1 p. 237-249]. Basic concepts of hydrology and hydrometry. characteristics of water flows [5 p.51-56]Darcy's law. Basic characteristics of soils. Movement of water masses in underground horizons [5 p.45-49]. Basic designs of adjusting tanks [3 p. 49-53].	8
<i>Section 2. Design of water supply networks.</i>		
2	Preconducting networks and their types [1 c. 237-249]. Calculation of	6

	<i>pressure losses in pipes [4 c. 84-101]. Lobachov-Cross method [4 p. 86-94]. The equation of continuity. Pressure and non-pressure water pipes [5 p.3 1-35]. Change in the properties of the pipe surface during operation [2 p.137-144].</i>	
<i>Section 3. Equipment of water supply networks.</i>		
3	<i>Plumbing fittings [2 p. 107-129]. Constructions of water intake structures [1 p. 141-185].</i>	6
<i>Section 4. Water intake facilities.</i>		
4	<i>Constructions of water intake structures [2 p. 44-49]. Calculation in odosabornu structures [1 c. 73-101].</i>	8
<i>Section 5. Facilities for receiving groundwater.</i>		
5	<i>Calculation in odosabornu structures [1 c. 73-101]. Water intake facilities [1 p. 73-101]. Modern constructions of pumping equipment [3 p.45-54]. Water intake facilities [1 p. 73-101].</i>	8
<i>Section 6. Pumps and pumping stations.</i>		
6	<i>Modern constructions of pumping equipment [3 p.45-54]. Bwidow and operation of special types of pumps [4 c. 113-126]. Pumps of high capacity for large-scale water supply systems [4 c. 113-126].</i>	10
<i>Section 7. Cooling facilities.</i>		
7	<i>Circulating water supply. Laws of heat transfer [1 c. 56-59]. Getting along with cooling structures [1. c. 56-59].</i>	10
8	<i>Preparation for on trolworkand from sections 1-7</i>	4
9	<i>Passed</i>	6
	Total hours	66

Policy and control

7. Policy of the discipline (educational component)

Rules for attending classes and behavior in the classroom

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 solely for performing creative work in the discipline or additional completion of online specialized courses with the receipt of the appropriate certificate:*
- <https://cropaia.com/water-treatment-pro/>
- https://www.shortcoursesportal.com/studies/290047/water-management.html?ref=search_card
- https://www.shortcoursesportal.com/studies/155752/the-city-and-the-water.html?ref=search_card

But their amount cannot exceed 10 % of the rating scale.

The ethics of deadlines and rescheduling

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

Academic Integrity Policy

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the lack of links when using printed and electronic materials, quotes, opinions of other authors. Unacceptable hints and write-offs when writing tests, conducting classes; passing the exam for another student; copying materials protected by the copyright system without the permission of the author of the work.

The policy and principles of academic integrity are defined in Chapter 3 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Read more: <https://kpi.ua/code>

Academic Conduct and Ethics Policy

Students should be tolerant, respect the opinions of others, formulate objections in the correct form, constructively maintain feedback in the classroom.

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

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

Distribution of study time by types of classes and tasks in the discipline in accordance with the working curriculum:

Semester	Study time		Distribution of study hours				Control measures		
	Loans	acad. H.	Lecture	Practical	Lab. Rob.	IWS	MCT	HCW	Semester control
8	4	120	36	18	-	66	1	–	Passed

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

1 - two tests (planned according to the work plan of the MCT is divided into 2 works lasting 45 minutes each);

2 - work in practical classes;

3 - express survey at lectures.

The system of rating (weight) points and evaluation criterion

1. Express survey at lectures:

Weight score –5.

The maximum number of points in the survey at the lecture classes of at least 7 students is $5 \times 5 = 25$ points

Criteria for assessing students' knowledge:

Completeness and signs of response	Points
Clear and complete answer to the question	5
The answer made some inaccuracies or errors	4... 3
The answer does not contain the wording of terms, laws and formulas	2... 1
Answer not credited	0

2. Modular control (R_m)

Weight score – 20. The maximum number of points for all tests is: 20 points x 2 works = 40 points

Criteria for evaluating tests

Mark	Completeness of the answer
17... 20	"excellent", creative disclosure of one of the issues, fluency in the material
13...16	"good", incomplete disclosure of one of the questions or full answer with minor inaccuracies
10...12	"satisfactory", Incomplete disclosure of the issue (at least 60% of the information required) and minor errors
1...9	Unsatisfactory work (does not meet the requirements for 3 points)
0	Lack of work.

3. Practical work:

Weight score – 5. The maximum number of points for all practical work is equal to:

5 points × 7 p/p = 35 points.

Criteria for assessing students' knowledge:

Completeness and signs of response	Points
Clear and timely execution and design of work	5
Minor inaccuracies were made in the response	4
Mistakes have been made in the work that distort the result	3
Late execution of work, deficiencies in the design	1-2
Failure to do practical work	0

Calculation of the scale (R) of the rating:

Thus, the rating scale for the discipline is:

$$R=25+40+35=100 \text{ points}$$

According to the results of educational work in the first 7 weeks, the "ideal student" should score 40 points. At the first certification (8th week), a student receives "enrolled" if his current rating is at least 20 points.

According to the results of educational work for 13 weeks of study, the "ideal student" should score 90 points. At the second certification (14th week), a student receives "enrolled" if his current rating is at least 45 points.

The maximum amount of points is 100. To receive credit from the credit module "automatic" you need to have 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 grade in the ECTS system, perform a test paper. The task of the test consists of four questions of different sections of the work program from the list provided in the guidelines for mastering the credit module.

Each test question (r_1, r_2, r_3, r_4) is estimated at 25 points according to the grading system:

- "excellent", complete answer (at least 95% of the necessary information) – 25 - 24 points;
- "very good", a sufficiently complete answer (at least 85% of the necessary information or minor inaccuracies) – 23 - 20 points;
- "good", sufficiently complete answer (at least 75% of the necessary information or minor inaccuracies) – 19 - 17 points;
- "satisfactory", incomplete answer (at least 65% of the necessary information and some errors) – 16 - 13 points;
- "enough", incomplete answer (at least 60% of the necessary information and some errors) – 13 - 10 points;
- "unsatisfactory", unsatisfactory answer – 9 - 0 points.

The sum of points for a non-four test questions is transferred to the test score according to the table.

Rating scale in the discipline

$R = r_1 + r_2 + r_3 + r_4$	University scale
95... 100 points	Perfectly
85... 94 points	Very good
75... 84 points	Well
65... 74 points	Satisfactory

<i>60...64 points</i>	<i>Enough</i>
<i>R < 60 points</i>	<i>Disappointing</i>
<i>If $r_c < 40$ points or other conditions for admission to the test are not met</i>	<i>Not allowed</i>

9. Additional information on the discipline (educational component)

List of questions for the standings

1. *Describe the processes of flowering, fouling and overgrowth.*
2. *Describe the chemical methods of water purification.*
3. *Describe the thickness of the ice on rivers and lakes.*
4. *Describe the circulating water supply system.*
5. *Explain the flow rate and module.*
6. *Classify the lanes of the sanitary protection zone of water intake structures.*
7. *Classify pumping stations by purpose and location.*
8. *Describe the advantages and disadvantages of a closed water supply network.*
9. *Describe the steel pipes.*
10. *Classify groundwater.*
11. *Explain the physical methods of water purification.*
12. *Explain the definition of the diameter of the water supply.*
13. *Explain the turbidity of surface waters, sediments and their quantity.*
14. *Describe the natural and operational reserves of groundwater.*
15. *Describe the conditions for water intake from surface sources.*
16. *Explain the size of the first strip of the sanitary protection zone for watercourses.*
17. *Classify pumping stations according to the nature of control and layout.*
18. *Explain the advantages and disadvantages of an extensive water supply network.*
19. *Explain the law of laminar movement of groundwater.*
20. *Describe the asbestos-cement pipes.*
21. *Explain the technical and economic calculation of the water supply.*
22. *Explain the size of the first strip of the sanitary protection zone for watercourses.*
23. *Classify pumping stations according to the nature of control and layout.*
24. *Classify water supply systems.*
25. *Give the main water supply schemes for industrial enterprises.*
26. *Describe the mine wells.*
27. *Describe the channel-type water intake.*
28. *Describe the size of the first strip of the sanitary protection zone for reservoirs.*
29. *Explain heat transfer when evaporatively cooling water.*
30. *Give the main technical characteristics of the pumps.*
31. *Classify water supply networks.*
32. *Describe reinforced concrete pipes.*
33. *Describe the water filtration rate. The concept of filtration coefficient.*
34. *Calculate the branched networks.*
35. *Classify cooling ponds.*
36. *Explain the structure of the water supply system from surface sources.*
37. *Describe the main components of the pressure that the pumping station should create.*
38. *Describe the perfect and imperfect well.*
39. *Describe coastal water intakes.*
40. *Describe the dimensions of the first strip of the sanitary protection zone for groundwater intakes.*
41. *Give efficiency to the pump.*
42. *Describe the concept of specific water flow in the network.*
43. *Classify plumbing fittings.*
44. *Describe the calculation of ring networks.*

45. Describe the speed of water in the river. Its changes in the cross section of the channel.
46. Describe the structure of the water supply system from an underground source.
47. Give the normative value of water consumption by the population.
48. Give methods of water intake from rivers.
49. Explain the radius of exposure and the decrease in static water levels.
50. Describe the size of the second strip of the sanitary protection zone for watercourses.
51. Describe the principle of operation of the centrifugal pump.
52. Explain the concept of travel costs.
53. Describe the schemes of water circulation in cooling water bodies.
54. Describe the locking and control valves.
55. Classify spare and regulating tanks.
56. Give a thermal calculation of the cooling reservoir.
57. Give the permissible water speeds in the river.
58. Explain the fluctuations in water levels in surface water bodies.
59. Cite the main structures of cooling ponds.
60. Describe the change in water consumption by the population during the day.
61. Classify water intake facilities according to the method of receiving water.
62. Describe the splashing devices.
63. Describe horizontal catchments.
64. Describe the size of the second strip of the sanitary protection zone for reservoirs.
65. Describe the principle of operation of the airlift.
66. Explain the definition of the estimated water consumption at the site.
67. Describe the water fittings.
68. Describe the water towers.
69. Classify water supply systems.
70. Give general requirements for water sources.
71. Describe the water distribution and irrigation devices of the cooling towers.
72. Give the components of the total calculated water consumption.
73. Classify water intake facilities by layout.
74. Describe the water intake of the infiltration type.
75. Cite the requirements for water supply networks.
76. Describe the dimensions of the second strip of the sanitary protection zone for groundwater intakes.
77. Describe the cast iron pipes.
78. Cite the main groups of technological processes using water.
79. Describe the safety fittings.
80. Describe the water columns and tanks.
81. Describe the direct-flow water supply system.
82. Bring overpressure for buildings of different heights.
83. Classify water intake facilities by type of water supply source.
84. Cite groups of structures for the captage of spring water.
85. Describe the permissible activity in each strip of sanitary protection zones.
86. Give a thermal calculation of cooling towers.
87. Give the main difficulties in the design of water pipes.
88. Give the basic requirements for pipelines.
89. Describe the tower cooling towers.
90. Describe the definition of pressure loss in pipes.
91. Describe pneumatic water installations.
92. Describe the radiator cooling towers.

Questions for tests

MKR 1

№1

1. The processes of flowering, fouling and overgrowth.
2. Chemical methods of water purification.

3. *The thickness of the ice on rivers and lakes.*
4. *Circulating water supply system.*
5. *Flow rate and module.*

№2

1. *Groundwater classification.*
2. *Physical methods of water purification.*
3. *Turbidity of surface waters, sediments and their quantity.*
4. *Natural and operational reserves of groundwater.*
5. *Conditions for water intake from surface sources.*

№3

1. *The law of laminar movement of groundwater.*
2. *Classification of water supply systems.*
3. *Basic water supply schemes for industrial enterprises.*
4. *Mine wells.*
5. *Channel-type water intake.*

№4

1. *Water filtration rate. The concept of filtration coefficient.*
2. *The structure of the water supply system from surface sources.*
3. *The main components of the pressure, which should create a pumping station.*
4. *Perfect and imperfect well.*
5. *Water receivers of the coastal type.*

№5

1. *The speed of water in the river. Its changes in the cross section of the channel.*
2. *The structure of the water supply system from an underground source.*
3. *The normative value of water consumption by the population.*
4. *Methods of water intake from rivers.*
5. *Radius of impact and reduction of static water level.*

№6

1. *Permissible speeds of water in the river.*
2. *Fluctuations in water levels in surface water bodies.*
3. *Change in water consumption by the population during the day.*
4. *Classification of water intake facilities according to the method of water intake.*
5. *Horizontal catchments.*

№7

1. *Classification of water supply systems.*
2. *General requirements for water supply sources.*
3. *Components of the total calculated water consumption.*
4. *Classification of water intake facilities according to the layout.*
5. *Water intake of infiltration type.*

№8

1. *The main groups of technological processes using water.*
2. *Direct-flow water supply system.*
3. *Overpressure for buildings of different heights.*
4. *Classification of water intake facilities by type of water supply source.*
5. *Groups of structures for the captage of spring water.*

MKR 2

№1

1. *Classification of strips of the zone of sanitary protection of water intake structures.*
2. *Classification of pumping stations by purpose and location.*
3. *Advantages and disadvantages of a closed water supply network.*
4. *Steel pipes.*
5. *Determination of the diameter of the water supply.*

№2

1. *The dimensions of the first strip of the sanitary protection zone for watercourses.*

2. *Classification of pumping stations by the nature of control and layout.*
3. *Advantages and disadvantages of an extensive water supply network.*
4. *Asbestos-cement pipes.*
5. *Technical and economic calculation of the water supply.*

№3

1. *The dimensions of the first strip of the sanitary protection zone for reservoirs.*
2. *The main technical characteristics of the pumps.*
3. *Classification of water supply networks.*
4. *Reinforced concrete pipes.*
5. *Calculation of branched networks.*

№4

1. *The dimensions of the first strip of the sanitary protection zone for groundwater intakes.*
2. *Pump efficiency.*
3. *The concept of specific water consumption in the network.*
4. *Classification of water fittings.*
5. *Calculation of ring networks.*

№5

1. *The dimensions of the second strip of the sanitary protection zone for watercourses.*
2. *The principle of operation of the centrifugal pump.*
3. *The concept of travel costs.*
4. *Locking and regulating fittings.*
5. *Classification of spare and regulating tanks.*

№6

1. *The dimensions of the second strip of the sanitary protection zone for reservoirs.*
2. *The principle of operation of the airlift.*
3. *Determination of the estimated water consumption at the site.*
4. *Water fittings.*
5. *Water towers.*

№7

1. *The dimensions of the second strip of the sanitary protection zone for groundwater intakes.*
2. *Requirements for water supply networks.*
3. *Cast iron pipes.*
4. *Safety fittings.*
5. *Water columns and tanks.*

№8

1. *Permissible activity in each strip of sanitary protection zones.*
2. *The main difficulties in the design of water pipes.*
3. *Basic requirements for pipelines.*
4. *Determination of pressure loss in pipes.*
5. *Pneumatic water installations.*

Work program of the discipline (syllabus):

Compiled prof., Doctor of Technical Sciences, Radovenchyk V.M.

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