



### Characteristics of water quality, the basics of water treatment

#### Working program of the discipline (Syllabus)

Details of the discipline	
Level of higher education	<i>First (Bachelor)</i>
Branch of knowledge	<i>16 Chemical and bioengineering</i>
Speciality	<i>161 Chemical technology and engineering</i>
Educational program	<i>Industrial ecology and resource-efficient clean technologies</i>
Status of discipline	<i>Optional educational components</i>
Form of training	<i>External</i>
Year of preparation, semester	<i>3rd year/ autumn semester</i>
Volume of discipline	<i>4 ECTS credits (120 hours)</i>
Semester control/ control measures	<i>final test</i>
Schedule of classes	<i>4 hours of lectures, 4 hours of practical work, 10 hours of laboratory work.</i>
Language of instruction	<i>Ukrainian</i>
Information about the course /teachers	Lecturer: <a href="https://eco-paper.kpi.ua/pro-kafedru/vykladachi/tverdokhlib-mariya-mikolajivna.html">https://eco-paper.kpi.ua/pro-kafedru/vykladachi/tverdokhlib-mariya-mikolajivna.html</a> Practical /Seminary: <a href="https://eco-paper.kpi.ua/pro-kafedru/vykladachi/tverdokhlib-mariya-mikolajivna.html">https://eco-paper.kpi.ua/pro-kafedru/vykladachi/tverdokhlib-mariya-mikolajivna.html</a> Laboratory classes: <a href="https://eco-paper.kpi.ua/pro-kafedru/vykladachi/tverdokhlib-mariya-mikolajivna.html">https://eco-paper.kpi.ua/pro-kafedru/vykladachi/tverdokhlib-mariya-mikolajivna.html</a>
Course placement	<a href="https://do.ipk.kpi.ua/course/view.php?id=5911">https://do.ipk.kpi.ua/course/view.php?id=5911</a>

#### Program of discipline

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

The problem of our country is not even in the amount of natural waters, but in their uneven distribution and high level of pollution. The population consumes spring water without proper control of its quality. In existing laboratories, water quality control is not always possible to comprehensively analyze the state of certain waters. Therefore, the training of specialists who at a high level have knowledge of assessing water quality, water treatment technologies is necessary. Simply choosing equipment, without a deep understanding of chemicalism and water purification mechanism, does not allow you to create reliable technologies that ensure high efficiency of water purification. It is also obvious that with the effective treatment of wastewater, the condition of Ukraine's aquatic ecosystems will improve.

**The subject of the discipline "Characteristics of water quality, the basis of water treatment"** is the implementation of the theoretical foundations of water treatment and water use in the processes of water treatment depending on the impurities contained in it, which will ensure the proper quality of purified water.

To a large extent, the solution of this problem will be determined by the level of training of specialists working in the field of environmental protection, including individual enterprises, institutions, organizations.

In order to successfully solve the problems of protection and preservation of natural water bodies, such specialists should be well aware of modern methods and technologies of water purification and water treatment.

The purpose of the discipline is to form students a set of knowledge related to solving the issues of water purification from dissolved and insoluble impurities, a set of skills and skills necessary for conducting scientific research in this direction, to create modern and new methods and technologies for

the preparation of drinking water and wastewater treatment, for qualified management of technological processes in the field of water supply to industry and utilities.

In accordance with the purpose of preparing bachelors in this specialty requires the formation of students' competencies:

- the ability to use the theoretical fundamentals of ecology, environmental protection and sustainable nature management, the basic principles and components of environmental management;
- 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 apply up-to-date experimental methods of working with technological objects in industrial and laboratory conditions.

In accordance with the requirements of the program of the discipline "**Characteristics of water quality, the basics of water treatment**", students after its assimilation must demonstrate the following programmatic learning results:

- to understand the basic environmental laws, rules and principles of environmental protection and nature management.;
- to select and use appropriate equipment, tools and methods to solve complex problems of chemical engineering, control and management of technological processes of chemical production;
- to assess the state of the environment, to determine the level of impact of the company (production) on the environment, to determine the main pollutants of the company (production).

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

The study of the discipline "**Characteristics of water quality, the basics of water treatment**" is based on the principles of integration of various knowledge gained by students during the bachelor's degree in the study of natural and engineering-technical disciplines: "General and inorganic chemistry", "Organic chemistry", "Analytical chemistry", "Industrial ecology", "Chemistry of high molecular weight compounds".

The discipline "**Characteristics of water quality, the basics of water treatment**" is the fundamental basis for the study of the following disciplines: "Environmental safety of production", "Control and management of chemical and technological processes" and ensures the implementation of the bachelor's project.

## **3. Contents of the discipline**

### **Section 1. Characteristics of natural waters. General requirements for water quality.**

Topic 1 Characteristics of the composition of the waters of natural water sources.

Topic 2. Requirements for water quality and their classification.

### **Section 2. Physico-chemical bases of water treatment processes.**

Topic 3. Methods of water treatment.

Topic 4. Reagent (chemical) methods of water softening.

Topic 5. Coagulation in the processes of water purification and water treatment.

Topic 6. Theoretical foundations of ion exchange desalination and water softening.

Topic 7. The use of ion metabolism to remove biogenic elements from natural waters.

Topic 8. Membrane methods of water purification.

Topic 9. Basics of removal of ferum and manganate compounds from water.

## **4. Educational materials and resources**

### **Basic literature**

1. Gomel M. D., Shabliy T. O., Radovenchik Y.V. Physicochemical bases of water purification processes: textbook. – K.: Condor-Publishing House, 2019. – 256 p.
2. Radovenchik Ya.V., Gomel M.D. Physicochemical methods of water purification. Textbook. – K.: Condor-Publishing House, 2016. – 264 cc.
3. Gomel M.D., Krysenko T.V., Omelchuk Y.A. Methods and technologies of wastewater treatment: Teaching. posib. Sevastopol: Institute of Nuclear Energy and Industry, 2012. – 244 cc.

4. Shabliiy T.O., Radovenchyk V.M. Gomel M.D. Application of new reagents and technologies in industrial water consumption.- K.: Infoprint, 2014. – 302c.
5. Gomel M. D., Radovenchyk V.M. Shabliiy T. O. Modern methods of air conditioning and water purification in industry. -K.: Graphics, 2007. – 168 p.
6. Characteristics of water quality, base of water treatment. Laboratory workshop [Electronic resource]: teaching. posib. for stud. specialties 101 "Ecology", 161 "Chemical technologies and engineering" / KPI them. Igor Sikorsky Kyiv Polytechnic Institute; compiled by: M. D. Gomel, T. O. Shabliiy, Y. V. Nosachova., M.M. Tverdokhlib – Electronic text data (1 file: 1.02 MB). – Kyiv: KPI them. Igor Sikorsky Kyiv Polytechnic Institute, 2022. - 69c.
7. Truss I.M., Galish V.V., Skyba M.I., Radovenchyk Ya.V., Gomel M.D. New highly effective methods of purification from soluble and insoluble hunts: monograph. / – K.: Condor-Publishing House, 2020. – 272 p.

**Additional literature**

8. Galish V.V., Truss I.M., RadovenchykYa.V., Fleischer G.Yu., Gomel M.D. Complex technologies of water purification from heavy metal ions: monograph. – K.: Publishing house "Condor", 2020. – 152c.
9. Zapolsky A.K. Water supply, drainage and water quality: Textbook. – K.: Higher shk.. 2005 – 671 cc
10. Truss I.M. Low-waste technologies of water demineralization: monograph. – K.: Condor-Publishing House, 2016. – 250 p.
11. Petruk V. G., Severin L. I., Vasytkivskiy I. V., Bezvozyuk I. I. Environmental technologies. Tutorial. Part 2 : Methods of wastewater treatment – Vinnytsia: VNTU, 2014. – 258 p.
12. Petruk V. G., Vasytkivskiy I. V., Bezvozyuk I. I., Petruk R. V., Turchyk P. M. Environmental technologies. Tutorial. Part 3: Methods of processing sewage sludge – Vinnytsia: VNTU, 2013. – 324 p.

**Information resources on the Internet**

13. Ministry of Environmental Protection and Natural Resources of Ukraine - <https://mepr.gov.ua/>
14. Industrial ecology. Community of environmental professionals - <http://www.eco.com.ua/>
15. Professional Association of Ecologists of Ukraine (PAAU) - <https://paeu.com.ua/>
16. National Library. V.I. Vernadsky – <http://www.nbu.gov.ua/>
17. Electronic archive of educational materials KPI them. Igor Sikorsky Kyiv Polytechnic Institute – <https://ela.kpi.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 "**Characteristics of water quality, the basis of water treatment**", the level of which is determined by the target installation for each specific topic;
- ensuring in the process of lecturing the creative work of students together with the teacher;
- education of students of professional and business qualities and development of their independent creative thinking;
- formation of students' necessary interest and determination of the direction for independent work;
- determination at the current level of science development in the field of modern methods and processes of water treatment, forecasting development for the coming years;
- reflection of methodical processing of the material (allocation of the main provisions, conclusions, recommendations, clear and adequate wording of them)
- 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;
- availability for perception by this audience.

No s/p	<b>The name of the lecture topic and the list of main issues (list of didactic means, references to literature and tasks at the IWS)</b>	Hours
<b>Section 1. Characteristics of natural waters. Withagal requirements for water quality.</b>		
1	<p><b>Topic 1. Characteristics of the composition of the waters of natural water sources.</b>                      Characteristics of the air of dislocation, soil, underground (artesian) waters. Basic characteristics of drinking water quality, their permissible levels.                      Literature: [1] p. 8-37; [2] c. 9-24; [3] p. 9-20; [9] p. 53-66; c. 81-102.                      Tasks at the SRS: Characteristics of fresh water resources. Modern approaches to assessing water quality. Ecological and hygienic classification of natural reservoirs.</p>	0,5
<b>Section 2. Physico-chemical bases of water treatment processes.</b>		
2	<p><b>Topic 3. Methods of water treatment.</b>                      Assessment of phase-dispersed state of pollution in water. The choice of method of water purification from the composition of contaminants. Methods for removing mechanical and colloidal impurities. Removal from water of impurities of the molecular degree of dispersion. Adjusting the content of ions in water. Disinfection of water.                      Literature: [1] p. 20-21; p. 38-43; [3] c. 18-20; [9] c. 107-122; c. 381-392.                      Tasks at the SRS: The main approaches to choosing the most effective method of purification of natural waters. Use a combination of cleaning methods. Modern methods and materials used in the processes of water treatment and water purification.</p>	0,5
3	<p><b>Topic 4. Reagent (chemical) methods of water softening.</b>                      The use of reagents to correct water hardness. Reagent methods of water softening. Combined methods of reagent water softening. Technologies of utilization and processing of sediments in water softening technologies.                      Literature: [4] p. 86-151; [5] c. 7-14; [9] c. 462-472; [10] c. 8-34;                      Tasks at the SRS: Water softening for production needs.</p>	0,5
4	<p><b>Topic 5. Coagulation in water purification and water preparation processes.</b>                      Coagulation and flocculation in the processes of lighting and discoloration of water. Regulation of the main parameters of the coagulation and flocculation process. The effect of reagents on the efficiency of lighting and discoloration of water during its protection, flotation or filtering.                      Literature: [1] p. 39-113; [2] c. 42-48; [4] c. 7-85; [7] 132-156; [8] 56-67; [9] c. 190-242.                      Tasks at the SRS: The theory of stability of ion-stabilized colloidal systems.</p>	0,5

5	<p><b>Topic 6. Theoretical foundations of ion exchange desalination and water softening.</b>  The use of ion exchange softening and desalination of water in the preparation of drinking, technical and energy water. Methods of regeneration of ion exchange filters. Processing of regeneration solutions.  Literature: [1] p. 165-193; [2] c. 130-136; [4] c. 174-196; [9] p. 394-419; [10] p. 60-70.  Tasks on SRS: Ionite selectivity. Use mixed-action filters to desalination of water.</p>	0,5
6	<p><b>Topic 7. Inthe use of ion metabolism to remove biogenic elements from natural waters.</b>  Purification of groundwater and surface water from nitrates and phosphates by ion exchange method.  Literature: [1] p. 241-244; [4] c. 196-209.  Tasks at the SRS: Biochemical purification of water from nitrates and phosphates.</p>	0,5
7	<p><b>Topic 8. Membrane methods of water purification</b>  The use of membrane methods of demineralization in the processes of purification of tap water, purification of artesian and surface waters during the purification of drinking water. The use of baromembrane methods in obtaining technical and energy water. Disposal of concentrates.  Literature: [1] p. 195-221; [2] c. 181-199; [4] c. 218-244; [9] p. 242-460; [10] p. 83-146.  Tasks at the SRS: Stabilization treatment of water in membrane cleaning processes. The use of antiscalants in baromembrane water purification processes.</p>	0,5
8	<p><b>Topic 9. Basics in the watering of ferum and manganate compounds.</b>  Decontamination and demanganization in the preparation of drinking water. Application of simplified aeration, ionic exchange of catalytic oxidation and combined methods.  Literature: [1] p. 238-239; [8] c. 9-93; c. 100-108; [9] c. 477-480.  Tasks at the SRS: Features of the composition of ferum and manganese compounds in natural waters.</p>	0,5
<b>Total hours</b>		<b>4</b>

### Practical classes

In the system of professional training of students in this discipline , practical classes are provided. but also to promote the growth of students as creative workers.

The main tasks of the cycle of practical classes:

- help students systematize, consolidate and deepen knowledge of a theoretical nature in the field of modern methods and technologies of air conditioning and water purification;
- teach students techniques for solving practical problems, contribute to mastering the skills and abilities of performing calculations, graphic and other tasks;
- teach them to work with scientific and reference literature and schemes;
- to form the ability to learn independently, that is, to master the methods, methods and techniques of self-study, self-development and self-control.

No s/p	The name of the topic of practical training and the list of main issues (list of didactic means, references to literature and tasks at the IWS)	Hours
1	<p><u>The main indicators of water quality.</u>  Chemical components of natural waters and their importance for assessing water quality. Requirements for water quality for various purposes. Moderntandart water quality. Classification of impurities and water pollutants by their phase-dispersed state. Methods forpouncing the physical and chemical properties of water.  Literature: [1] p. 8-37; [2] c. 9-24; [3] p. 9-20; [9] p. 53-66; c. 81-102.  Tasks on the SRS. Laboratory and production control of water quality. Additional treatment of water after its purification.</p>	1

2	<p><u><i>Ion exchange technologies of water purification.</i></u>  <i>The choice of ion exchange materials for water purification with specified characteristics. Calculation of the exchange capacity of ionite in static and dynamic conditions. Development of a scheme for water purification from nitrates and phosphates.</i>  <i>Literature: [1] p. 165-194; [2] c. 130-159; [9] 193-232, 287-299; [3d] p. 84-146, 173-190, 198-211.</i>  <i>Tasks on the SRS. Inreagents for the regeneration of ionites, depending on the type of ions and ionite.</i></p>	1
3	<p><u><i>Iron removal and demanganization of water.</i></u>  <i>Non-reactive and reagent methods for extracting ferum and manganese compounds from water. Calculation of the dose of reagents for oxidation of ferrum and manganate compounds to water.</i>  <i>Literature: [1] 38-84; [2] c. 64-69; [7] 132-156; [8] 56-67; [9] 104-141.</i>  <i>Tasks on the SRS. Necessary conditions for the oxidation process of ferrum and manganate compounds in the aquatic environment.</i></p>	1
4	Modular control work	1
	<b>Total hours</b>	<b>4</b>

### Laboratory classes

The purpose of laboratory and practical classes is to develop students' experimental skills, a research approach to the study of the subject, fixing theoretical material.

No s/p	Name of laboratory work	Hours
1	Entry. Safety briefing, familiarization with the program of laboratory works, issuance of methodological literature.	0,5
2	Removal of iron from water by aeration	2
3	Removal of nitrates from water by the ion exchange method	2
4	Regeneration of anionite AB-17-8 in $\text{NO}_3^-$ alkali form	2
5	Protection of laboratory work	1,5
6	Test.	2
	<b>Total hours</b>	<b>10</b>

### 6. Independent work of a student/postgraduate student

Independent work takes 85% of the time to study the credit module, including preparation for the test. introduction of the latest water treatment technologies, based on the characteristics of water and the requirements for the quality of purified water.

No s/p	Name of the topic submitted for self-study	Number of hours of IWSS
<b>Section 1. Characteristics of natural waters. General requirements for water quality.</b>		
1	<p>Water resources of Ukraine. Dynamics of water use in Ukraine. Water consumption by utilities, industry and agriculture. Characteristics of fresh water resources. Modern approaches to assessing water quality.  <i>Literature: : [1] p. 8-37; [2] c. 9-31; [7] 1-41; [8] 7-18; [9] 42-71; [10] 49-55.</i></p> <p>Ecological and hygienic classification of natural reservoirs. Soluble and insoluble impurities in water. Calculation of the integral indicator of water quality. Requirements for water quality for various purposes.  <i>Literature: [1] p. 85-113; [3] c. 70-97.</i></p>	22

**Section 2. Physicochemical bases of water treatment processes.**

2	<p>The main approaches to choosing the most effective method of purification of natural waters. Use a combination of cleaning methods. Modern methods and materials used in the processes of water treatment and water purification.  <b>Literature: [1] p. 20-21; p. 38-43; [3] c. 18-20; [9] c. 107-122; c. 381-392.</b></p> <p>Water softening for production needs. Use of complex reagents. Modern approaches to creating conditions for deep water softening.  <b>Literature: [2] p. 25-250; [4] p. 86-151; [5] c. 7-14; [9] c. 462-472; [10] c. 8-34.</b></p> <p>The theory of stability of ion-stabilized colloidal systems. Conditions of coagulation of lyophobic colloidal systems. Kinetics of coagulation of hydrophobic ashes. Advantages and disadvantages of metal salts in water purification.  <b>Literature: : [1] p. 38-84; [2] c. 32-48; c. 58-69; [7] 132-156; [8] 56-67; [9] p. 213-234.</b></p> <p>Selectivity of ionites. Synthetic ionites, the main methods of obtaining. Use mixed-action filters to desalination of water. Synthetic ionites, the main methods of obtaining. Inreagents for the regeneration of ionites, depending on the type of ions and ionite.  <b>Literature: [1] p. 165-193; [2] c. 130-159; [4] c. 174-196; [9] 397-413; [10] p. 60-70.</b></p> <p>Stabilization treatment of water in membrane cleaning processes. The use of antiscalants in baromembrane water purification processes. Use reverse osmosis installations for home and industrial purposes.  <b>Literature: [1] p. 195-221; [2] c. 181-209; [4] c. 218-244; [9] 486-488. [10] p. 83-146.</b></p> <p>Features of the composition of ferrum and manganese compounds in natural waters. Necessary conditions for the oxidation process of ferrum and manganate compounds in the aquatic environment.  <b>Literature: [1] p. 238-239; [8] c. 9-93; c. 100-108; [9] c. 477-480.</b></p>	68
3	<b>Preparation for MCW</b>	<b>6</b>
4	<b>Preparation for the test</b>	<b>6</b>
	<b>Total hours</b>	<b>102</b>

**Politics and control**

**7. Policy of discipline (educational component)**

**Rules for attending classes and behavior in classes**

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**

- encouraging points can be credited by the teacher only for the performance of creative works in the discipline or additional passage of online specialized courses with the receipt of the appropriate certificate:
- <https://www.coursera.org/learn/water-treatment>
- <https://www.shortcoursesportal.com/studies/56436/introduction-to-drinking-water-treatment.html>

- [https://www.shortcoursesportal.com/studies/113424/drinking-water-treatment.html?ref=search\\_card](https://www.shortcoursesportal.com/studies/113424/drinking-water-treatment.html?ref=search_card)

But their amount can not 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, 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 exam for another student; copying of materials protected by the copyright system without the permission of 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". Read more: <https://kpi.ua/code>

### **Policy of academic behavior and ethics**

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". Read more: <https://kpi.ua/code>

## **8. Types of control and rating system for assessing 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		
	Credits	acad. H.	Lecture	Practical	Lab. woks.	IWS	MCW	HCW	Semester control
5	4	120	18	4	10	102	1	-	final test

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

The student's rating from the credit module consists of points that he receives for his work in practical classes and laboratory work, for writing modular control work.

### **System of rating (weight) points and evaluation criteria**

#### Performing tasks in practical classes.

Forsolving tasks and active participation in these classes is 10 points.

#### Performing laboratory work.

The weight score for 1 laboratory work is 12 points, a total of 5 laboratory works are provided.

Criteria for evaluating the implementation of laboratory work

Completeness and signs of the task	Points
The work is completed in full without errors, the protocol with the relevant conclusions is correctly executed, the work for protection is submitted in a timely manner, the student shows in-depth knowledge of work issues, confidently and in detail answers the questions posed during the defense.	10
The work was completed in full with minor errors or inaccuracies, in general, a correctly executed protocol with relevant conclusions, work for protection was submitted in a timely manner, during the protection of work, the student shows knowledge of work issues, almost confidently answers the questions posed;	8-9



<i>The work was completed in full with minor errors or inaccuracies with vaguely formulated conclusions, the work for protection was not submitted in a timely manner, during the defense the student shows uncertainty, shows weak knowledge of work issues, does not always give comprehensive answers to questions.</i>	<i>7-5</i>
<i>The work is not completed in full, there are no conclusions in the work, the work for protection is not submitted in a timely manner during the defense, the student cannot answer any question posed on the topic of work.</i>	<i>1-4</i>
<i>Rotot not executed.</i>	<i>0</i>

### Modular control work

*The maximum number of points for modular control work is: 30 points*

*Criteria for evaluating the control work and*

<i>Completeness and signs of response</i>	<i>Points</i>
<i>Full answer (at least 90% of the required information), examples are given</i>	<i>30</i>
<i>Hfull disclosure of one of the questions or a full answer with minor inaccuracies</i>	<i>29-15</i>
<i>Hfull answer (at least 60% of the required information) and minor errors</i>	<i>14-8</i>
<i>The answer is superficial without analyzing parameters, conditions, materials, facts, incomplete conclusions</i>	<i>7-3</i>
<i>Control work is not counted</i>	<i>0</i>

*Thus, the rating semester scale of the credit module is:*

$$R_c = 12 \cdot 5 + 10 + 30 = 100 \text{ points}$$

*According to the results of educational work for the first 7 weeks, the "ideal student" should score 40 points. At the first certification (8th week), the student receives "enrolled" if his current rating is not less than 20 points.*

*According to the results of educational work for 18 weeks of study, the "ideal student" should score 90 points. At the second certification (week 16), the student receives "enrolled" if his current rating is not less than 40 points.*

*The maximum amount of points is 100. To obtain a credit module score from the "automatic" module, you need to have a rating of at least 60 points. A prerequisite for admission to the standings is a rating of at least 40% of the rating scale (R), that is, 40 points.*

*Students who scored less than 0.6 R during the semester, as well as those who want to increase the overall rating, perform scoring control work. At the same time, all points received by them during the semester are canceled. The tasks of the control work contain questions that relate to different sections of the credit module. The list of scoring questions is given in Section 9. To obtain a scoring assessment, the amount of all R rating points received during the semester is transferred according to the table:*

<b>Score</b>	<b>Score</b>
<i>95... 100</i>	<i>Perfectly</i>
<i>85... 94</i>	<i>very good</i>
<i>75...84</i>	<i>well</i>
<i>65... 74</i>	<i>Satisfactory</i>
<i>60...64</i>	<i>enough</i>
<i>RD 60&lt;</i>	<i>Disappointing</i>
<i>Admission conditions not met</i>	<i>not allowed</i>

### **9. Additional information on the discipline (educational component)**

***Approximate list of questions submitted for semester control:***

- 1. Describe the ecological state of the upper water supply sources.*
- 2. Give fizichny and chicubic indicators of water quality.*

3. Describe organoleptic and bacteriological indicators of water quality.
4. Give ecologically-gigantic requirements for the quality of drinking water from surface and underground watersupply.
5. What water quality standards do you know? What documents are they defined by?
6. Bring in the image to the quality of economic and drinking purposes, technical and energy water.
7. Give the classification of contaminants by phases of the dispersed composition.
8. What are the methods for adjusting the chemical composition of water and organoleptic properties do you know?
9. What determines the choice of water purification method?
10. Describe the methods of water purification used to extract mechanical and colloidal impurities.
11. Give the methods used to extract impurities from the species in the molecular state.
12. Why use methods for correcting the content of ions in water?
13. Give the main methods of water disinfection and the conditions for their use?
14. What is the essence of the method of reagent water softening?
15. What reagents are used to soften water? Give examples.
16. Offer technologies for the disposal and processing of sediments formed during the reagent water softening process.
17. What methods are used to illuminate and discolor water?
18. What is the essence of the method of water purification by coagulation and flocculation?
19. Describe the coagulants that are used to purify natural waters.
20. Give flocculants used in water preparation technologies.
21. What is the essence of ion exchange softening and desalination of water? Where is it used?
22. Characterize ion exchange materials used to soften water.
23. Present the forms of ionites and methods of their regeneration.
24. What is the essence of ion exchange purification of groundwater and surface water from nitrates and phosphates?
25. What types of ion exchange materials are used to hit nitrate and phosphate anions?
26. Provide ways to regenerate anionites after removing nitrates and phosphates with the production of valuable components.
27. Describe membrane methods of demineralization of water.
28. Give the classification of membranes.
29. Level the membrane processes used in water treatment.
30. Suggest ways to dispose of concentrates formed during membrane water purification.
31. Give the methods used to disinfect and demanganize water.
32. What materials of natural and synthetic origin are used in the processes of extraction of iron and manganese compounds from water.
33. What is the essence of the modification of filter loads for oxidation of iron and manganese compounds?

**Work program of the discipline (syllabus):**

**Compiled** assistant, Ph.D., Tverdokhlib M.M.

**Approved** by the Department of E and TRP (Protocol No. 14 dated 08.06.2022.)

**Approved** by the Faculty Methodical Commission (Protocol No. 10 of 24.06.2022.)