



Hydromechanical processes and equipment for the production of polymer and building materials and products

Work program of the educational component (Syllabus)

Details of the educational component

Higher education level	<i>First (bachelor's)</i>
Field of Knowledge	<i>13 Mechanical Engineering</i>
Specialty	<i>133 Industrial mechanical engineering</i>
Educational program	<i>OPP Engineering of equipment for the production of polymer and building materials and products Engineering of equipment for the production of polymeric and building materials and products</i>
Status of the educational component	<i>normative</i>
Form of study	<i>full-time</i>
Year of preparation, semester	<i>4th year, spring semester</i>
Scope of the educational component	<i>3,5 (105)</i>
Semester control / control measures	<i>Exam</i>
Class schedule	
Language of instruction	<i>Ukrainian</i>
Information about the course leader / teachers	<i>Lecturer: Doctor of Technical Sciences, Senior Researcher, Prof. Mikulionok Ihor Olehovych, i.mikulionok@kpi.ua, 066-748-65-65 Practical: Doctor of Technical Sciences, Senior Researcher, Prof. Mikuilonok Ihor Olehovych Laboratory: Doctor of Philosophy Vytvytskyi Viktor Myronovych</i>
Course placement	<i>http://login.kpi.ua/.</i>

Program of the educational component

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

The educational component "Hydromechanical processes and equipment for the production of polymer and building materials and products" is one of the basic educational components of the cycle of educational components of professional training, which lays the foundations for the training of specialists in industrial engineering (chemical, polymer and silicate engineering) and has a theoretical and practical direction.

The subject of the educational component "Hydromechanical processes and equipment for the production of polymer and building materials and products" is the theory of basic hydromechanical processes, the principles of construction and methods of calculations of machines and devices used to carry out these processes.

The purpose of the educational component "Hydromechanical processes and equipment for the production of polymer and building materials and products"

The purpose of the educational component is the process of forming a complex of knowledge by students about the main hydromechanical processes, making a reasonable choice of equipment for the implementation of hydromechanical processes and performing their parametric calculations.

In accordance with the goal, the training of bachelors in this specialty requires strengthening the formation of the following competencies:

Integral competence:

The ability of a person to solve complex specialized tasks and practical problems in a certain field of professional activity or in the process of training, which involves the application of certain theories and methods of the relevant sciences and is characterized by complexity and uncertainty of conditions.

Professional competencies:

- *ability to make effective decisions on the choice of structural materials, equipment, processes and combine theory and practice to solve an engineering problem (FC7);*
- *ability to analyze, select, assign processes and equipment for the production of polymer and building materials and products (FC11);*
- *the ability to describe and classify a wide range of technical objects and processes, based on deep knowledge and understanding, knowledge of related technical sciences (FC13).*

*According to the requirements of the program of the educational component "Hydromechanical Processes and Equipment for the Production of Polymer and Building Materials and Products", students after mastering it must demonstrate the following **program learning outcomes**:*

- *knowledge and understanding of the principles of technological, fundamental and engineering sciences that underlie the branch engineering of the relevant industry (PH1);*
- *knowledge and understanding of mechanics and mechanical engineering and prospects for their development (PH2);*
- *carry out engineering calculations to solve complex problems and practical problems in industrial engineering (PH4);*
- *analyze engineering objects, processes and methods (PH5);*
- *prepare production and operate products using automatic life cycle support systems (PH7);*
- *choose and apply the necessary equipment, tools and methods (PH9);*
- *to apply technical control tools to assess the parameters of objects and processes in industrial engineering (PH12);*
- *to carry out engineering of technological processes for the manufacture of polymer and building materials and products (PH15).*

2. Pre-requisites and post-requisites of the educational component (place in the structural and logical scheme of education according to the relevant educational program)

Prerequisites: *The educational component "Hydromechanical Processes and Equipment for the Production of Polymer and Building Materials and Products" is based on the study of the following educational components: "Mathematics", "Physics", "Chemistry", "Mechanics of Materials and Structures", "Technology of Polymer Processing", "Machine Parts", "Hydromechanics and Hydraulics", "Heat Transfer", "Mechanical Processes and Equipment for the Production of Polymer and Building Materials and Products".*

After-details: *The educational component "Hydromechanical processes and equipment for the production of polymer and building materials and products" ensures the implementation of a course project on processes and equipment for the production of polymer and building materials and products, as well as a diploma project.*

3. Content of the educational component

Topic 1. General provisions on hydromechanical processes

Topic 2. Separation of liquid and gas inhomogeneous systems

Topic 3. Mixing of liquid media

Topic 4. Fluidization of solid granular material

Topic 5. Intensification of hydromechanical processes

4. Training materials and resources

Basic literature

1. Mikulionok I. O. *Hydromechanical processes and equipment for the production of polymer and building materials and products*. 5th ed., revised. and supplemented. Kyiv : Igor Sikorsky Kyiv Polytechnic Institute, 2025. 102 p. URL: <https://ela.kpi.ua/handle/123456789/74533>.

2. Mikulionok I. O. *Mechanical and hydromechanical processes, apparatuses and machines of chemical technology*. Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2018. 172 p. URL: <https://ela.kpi.ua/handle/123456789/66408>

3. Mikulionok I. O. *Mechanical, hydromechanical and mass transfer processes and equipment of chemical technology*. Kyiv: NTUU "KPI", 2014. 340 p. URL: <https://ela.kpi.ua/handle/123456789/38169>

4. *Processes and equipment of chemical technology. Part 1: textbook*. / Y. M. Kornienko, Y. Y. Lukach, I. O. Mikulionok et al. Kyiv: NTUU "KPI", 2011. 300 p. (in Russian).

5. *Processes and equipment of chemical technology. Part 2: textbook*. / Y. M. Kornienko, Y. Y. Lukach, I. O. Mikulionok et al. Kyiv: NTUU "KPI", 2012. 416 p. (in Russian).

6. Mikulionok I. O. *Mechanical and hydromechanical processes, apparatus and machines of chemical technology: Practicum*. Kyiv: KPI. Igor Sikorsky, 2021. 174 p. URL: Access: <https://ela.kpi.ua/handle/123456789/41037>.

7. Vytvytskyi V. M., Sokolskyi O. L., Mikulionok I. O. *Mechanical and hydromechanical processes and equipment for the production of polymer and building materials and products. Laboratory practicum: nauch. posob.* Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2025. 42 p. URL: <https://ela.kpi.ua/handle/123456789/73644>.

Further reading

8. Mikulionok I. O., Kazak I. O. *Hydromechanical processes, apparatuses and machines of chemical technology. Practicum on educational discipline: manual*. (1 file: 2,346 MB). Kyiv: KPI. Igor Sikorsky, 2018. 73 p. URL: <http://ela.kpi.ua/handle/123456789/26157>

9. Mikulionok I. O. *Screw extruder mixing and dispersing units* // *Chemical and Petroleum Engineering*. 2013. Vol. 49, N 1–2. P. 103–109. DOI: 10.1007/s10556-013-9711-y

10. Mikulionok I. O. *Liquid mixers with magnetic stirrers (survey of patents)* // *Chemical and Petroleum Engineering*. 2013. Vol. 49, N 3–4. P. 246–250. DOI: 10.1007/s10556-013-9733-5

11. Mikulionok I. O. *Designs of rotary disk mixers (a survey of patents)* // *Chemical and Petroleum Engineering*. 2013. Vol. 49, N 5–6. P. 308–313. DOI: 10.1007/s10556-013-9746-0

12. Mikulionok I. O. *Removable Vortex Generators of Pressurized Tubular Channels with Round Cross-Section (Classification and Survey of Patents)* // *Chemical and Petroleum Engineering*. 2019. Vol. 54, N 11–12. P. 842–848. DOI: 10.1007/s10556-019-00560-6

13. Mikulionok I. O. *Classification of Rotary mixers with an adjustable working surface (review of patents)* // *Chemical and Petroleum Engineering*. 2020. Vol. 56, N 3–4. P. 237–244. DOI: 10.1007/s10556-020-00764-1

14. Mikulionok I. O., Ivanenko O. I. Practical use of the effects of Seebeck and Peltier (Review) // *Bulletin of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute": ser. "Chemical Engineering, Ecology and Resource Conservation"*. 2024. № 4(23). Pp. 9–34. DOI: 10.20535/2617-9741.4.2024.319010.

15. Mikulionok I. O. Use of Möbius Strip in Chemical Machine Design (Survey of Patents) // *Chemical and Petroleum Engineering*. 2021. Vol. 56, № 11–12. P. 1037–1042. DOI: <https://doi.org/10.1007/s10556-021-00880-6>.

16. Mikulionok I. O., Lukinyuk M. V. Applied application of the Mobius tape (Review) // *Bulletin of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute": ser. "Chemical Engineering, Ecology and Resource Conservation"*. 2025. № 2(24). Pp. 32–52. DOI: 10.20535/2617-9741.2.2025.333973.

17. Mikulionok I. O. Stabilization of the temperature of the working medium in the equipment of chemical plants (a survey of patents) // *Chemical and Petroleum Engineering*. 2015. Vol. 51, № 5–6. P. 324–327. DOI: 10.1007/s10556-015-0046-8.

18. Mikulionok I. O. Application of ferromagnetic materials to ensure the necessary thermal regime of technological equipment (Review) // *Energy technologies and resource saving*. 2019. № 1. Pp. 60–72 (in Russian). DOI: <https://doi.org/10.33070/etars.1.2019.06>.

19. Mikulionok I. O., Ivanenko O. I. Application of ferromagnetic materials for stabilization of the thermal regime of technological processes (Review) // *Bulletin of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" : ser. "Chemical Engineering, Ecology and Resource Conservation"*. 2024. № 3(23). Pp. 19–38. DOI: 10.20535/2617-9741.3.2024.312417.

Information resources on the Internet

20. DSpace NTB KPI them. Igor Sikorsky, <https://ela.kpi.ua/handle/123456789/38169>, <https://ela.kpi.ua/handle/123456789/41037>, <http://ela.kpi.ua/handle/123456789/26157>

21. Сайт кафедри ХПЧМ, <https://cpsm.kpi.ua/metodichni-rozrobki.html>.

22. Campus of Igor Sikorsky Kyiv Polytechnic Institute. Igor Sikorsky, <http://login.kpi.ua/>.

23. Official websites of patent offices, <https://sis.nipo.gov.ua/uk/search/simple/>, [http://worldwide.espacenet.com/advancedSearch?locale=en EP](http://worldwide.espacenet.com/advancedSearch?locale=en_EP), <http://www1.fips.ru/iiss/>.

Educational content

5. Methods of mastering the educational component

Lectures

Lectures are aimed at:

- providing modern, holistic, interdependent knowledge on the educational component "Hydromechanical processes and equipment for the production of polymer and building materials and products", the level of which is determined by the target setting for each specific topic;
- ensuring the creative work of students together with the teacher during the lecture;
- education of students' professional and business qualities and the development of independent creative thinking;
- formation of students' necessary interest and provision of direction for independent work;
- determination at the current level of development of science in the field of the current state of polymer processing technology;
- reflection of methodological processing of the material (highlighting the main provisions, conclusions, recommendations, clear and adequate to their formulation);
- use for demonstration of visual materials;
- teaching the materials of the educational component 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/p	Title of the lecture topic and a list of main questions (links to literature and tasks on the SRC)	Number of hours
1	Topic 1. General provisions on hydromechanical processes <i>Lecture 1. Definition and role of hydromechanical processes of chemical technology. Material balance of hydromechanical processes. Main criteria for the similarity of hydromechanical processes.</i> <i>References: [1, 2].</i> <i>List of didactic tools: The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture.</i> <i>Tasks on the SRS. Analysis of the physical content of the criteria for similarity of hydromechanical processes.</i>	2
2	Topic 2. Separation of liquid and gas inhomogeneous systems <i>Lectures 2, 3. Separation of liquid and gas inhomogeneous systems: separation by deposition under the influence of gravity. Kinetics of deposition under the action of gravity. Determination of the deposition surface of gravitational sedimentation tanks. Designs of gravity sedimentation tanks.</i> <i>References: [1, 2].</i> <i>List of didactic tools: The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture.</i> <i>Tasks on the SRS. Designs and principle of operation of the main types of gravity sedimentation tanks</i>	4
3	<i>Lecture 4. Separation by deposition under the action of inertial forces. Separation by deposition under the action of centrifugal forces. Precipitation centrifugation.</i> <i>References: [1, 2].</i> <i>List of didactic tools: The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture.</i> <i>Tasks on the SRS. Designs and principle of operation of precipitation centrifuges</i>	2
4	<i>Lecture 5. Separation by deposition under the action of electric field forces.</i> <i>References: [1, 2].</i>	2

No. s/p	Title of the lecture topic and a list of main questions (links to literature and tasks on the SRC)	Number of hours
	<i>List of didactic tools: The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture. Tasks on the SRS. Designs and principle of operation of the main types of electrostatic precipitators.</i>	
5	Lecture 6. Separation of liquid and gas inhomogeneous systems by filtration: general provisions; differential equation of filtration; kinetic equation of filtering through a layer of granular material; kinetic equation of filtration. References: [1, 2]. <i>List of didactic tools: The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture. Tasks on the SRS. The procedure for determining the porosity of a layer of granular material consisting of particles of certain shapes and sizes.</i>	2
6	Lecture 7. Transformation of the kinetic equation of filtration. Filter designs. Centrifugal filtering. Designs of filter centrifuges. Separation of gas inhomogeneous systems when they come into contact with liquid. Other methods of separation of inhomogeneous systems. Selection of methods and equipment for separation of heterogeneous systems. References: [1, 2]. <i>List of didactic tools: The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture. Tasks on the SRS. Designs and principle of operation of the main types of filters and filter centrifuges.</i>	2
7	Topic 3. Mixing of liquid media Lecture 8. Mixing of liquid media: general provisions; classification of liquids; types of mixing. Mixing using rotary devices. Modified Reynolds and Euler criteria. Stirring with rotary devices: energy loss for stirring; agitator designs. References: [1, 2]. <i>List of didactic tools: The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture. Tasks on the SRS: Basic properties of non-Newtonian fluids. and the principle of operation of the main types of devices with agitators.</i>	2
8	Topic 4. Fluidization of solid granular material Topic 5. Intensification of hydromechanical processes Lecture 9. Fluidization of solid granular material; general provisions; hydrodynamics of the fluidized layer; basic parameters. Intensification of hydromechanical processes. References: [1, 2]. <i>List of didactic tools: The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture. Tasks on the SRS. Designs and principle of operation of the main types of fluidized bed devices. Designs and principle of operation of equipment for intensification of hydromechanical processes.</i>	2
Just		18

Practical (seminar) classes

In the system of professional training of students in this educational component, practical classes occupy 33.3% of the classroom load. Being an addition to the lecture course, they lay and form the foundations of the qualification of a bachelor in industrial engineering, namely polymer processing technology. The content of these classes and the methods of their conduct should ensure the development

of creative activity of the individual. They develop practical thinking and the ability to use special terminology, and allow you to test your knowledge, so this type of work is an important means of prompt feedback. Practical (seminar) classes should perform not only cognitive and educational functions, but also contribute to the growth of students as creative workers in the field of industrial engineering.

The main tasks of the cycle of practical (seminar) classes:

- to help students systematize, consolidate and deepen knowledge of a theoretical nature in the field of modern mechanical processes, devices and machines of chemical technology;
- to teach them to work with scientific, technical and reference literature and other sources of scientific and technical information;
- to form the ability to learn independently, that is, to master the methods, ways and techniques of self-study, self-development and self-control.

No. s/p	Title of the topic of practical (seminar) classes and a list of main issues (links to literature and tasks on the SRC)	Number of hours
1	Topic 2. Separation of liquid and gas inhomogeneous systems 2.1 Separation by deposition by gravity Practical lesson 1. Calculation of the dust precipitation chamber. References: [6, 8].	2
2	Practical lesson 2. Calculation of gravity rowing sedimentation tanks. References: [5, 7].	2
3	2.2 Separation by deposition under the action of centrifugal force Practical lesson 3. Cyclone calculation. References: [6, 8].	2
4	2.3 Separation by deposition under the action of electric field forces Practical lesson 4. Calculation of a batch tubular electrostatic precipitator. References: [6, 8].	2
5	2.4 Separation by filtering Practical lesson 5. Calculation of the drum vacuum filter. References: [6, 8].	2
6	Practical lesson 6. Venturi scrubber calculation. References: [6, 8].	2
7	Topic 3. Mixing of liquid media Practical lesson 7. Calculation of the apparatus with a mechanical stirring device. References: [5, 7].	2
8	Topic 4. Fluidization of solid granular material Practical lesson 8. Calculation of the fluidized bed apparatus. References: [6, 8].	2
9	Practical lesson 9. Modular control work. References: [1, 2].	2
Just		18

Laboratory classes

In the system of professional training of students in this educational component, laboratory classes occupy 33.3% of the classroom load. They lay and form the foundations of students' qualifications. The content of these classes and the methods of their conduct should ensure the development of creative activity of the individual. They develop the ability to use special terminology, allow you to test knowledge, so this type of work is an important means of prompt feedback. Laboratory classes should perform not only cognitive and educational functions, but also contribute to the growth of students as creative workers.

The main tasks of the cycle of laboratory classes:

- to help students systematize, consolidate and deepen knowledge of a theoretical nature in the field of modern mechanical processes, devices and machines of chemical technology;
- to teach students to solve practical problems,
- to contribute to the improvement of skills and abilities in performing calculations;
- to form the ability to learn independently, that is, to master the methods, ways and techniques of self-study, self-development and self-control.

No. s/p	Title of the topic of laboratory work and a list of main questions (list of didactic support, references to literature and tasks on SRS)	Number of hours
1	Introductory lesson. Safety briefing. Topic 3. Mixing of liquid media Laboratory work 17. Study of the process of mixing bulk materials in a vane mixer. References: [7]	4
2	Topic 3. Mixing of liquid media Laboratory work 18. Study of energy parameters of the mixing process of viscous liquids. References: [7]	4
3	Topic 3. Mixing of liquid media Laboratory work 19. Study of mixing liquids in a container with a propeller agitator. References: [7]	4
4	Topic 3. Mixing of liquid media Laboratory work 20. Investigation of the mixing process of non-Newtonian liquids. References: [7]	4
5	Summing up. Protection of laboratory reports	2
Just		18

6. Independent work of a student

Independent work takes 48.6% of the time spent studying the educational component, including preparation for the exam. The main task of students' independent work is to master knowledge in areas that are not included in the list of lecture questions through personal search for information, the formation of an active interest in a creative approach in educational work. In the process of independent work within the educational component, the student must learn to deeply analyze modern approaches to the development and implementation of the latest technologies for processing polymer materials.

No. s/p	Name of the topic submitted for independent study	Number of CPC hours
1	Topic 1. General provisions on hydromechanical processes Tasks on the SRS: Analysis of the physical content of the criteria for similarity of hydromechanical processes. Literature [1, 2].	1
2	Topic 2. Separation of liquid and gas inhomogeneous systems Tasks on the SRS: Designs and principle of operation of the main types of gravity sedimentation tanks. Literature [1, 2].	2
3	Tasks on the SRS: Designs and principle of operation of precipitation centrifuges.	1

No. s/p	Name of the topic submitted for independent study	Number of CPC hours
	<i>Literature [1, 2].</i>	
4	Tasks on the CPS: Designs and principle of operation of the main types of electrostatic precipitators. <i>Literature [1, 2].</i>	1
5	Tasks on the SRS: The procedure for determining the porosity of a layer of granular material consisting of particles of certain shapes and sizes. <i>Literature [1, 2].</i>	2
6	Tasks on CPS: Designs and principle of operation of the main types of filters and filter centrifuges. <i>Literature [1, 2].</i>	2
7	Topic 3. Mixing of liquid media Tasks on the SRS: Basic properties of non-Newtonian fluids. <i>Literature [1, 2].</i>	2
8	Tasks on the SRS: Designs and principle of operation of the main types of apparatus with agitators. <i>Literature [1, 2, 10, 11, 13].</i>	2
9	Topic 4. Fluidization of solid granular material Tasks on the SRS: Designs and principle of operation of the main types of fluidized bed apparatus. <i>Literature [1, 2].</i>	2
10	Topic 5. Intensification of hydromechanical processes Tasks on the SRS: Designs and principle of operation of equipment for intensification of hydromechanical processes. <i>Literature [1, 2, 12, 14–19].</i>	2
	<i>Preparation for modular control work [1, 2].</i>	4
11	<i>Preparation for the exam [1, 2].</i>	30
Just		51

Individual tasks

According to the working curriculum, individual tasks are not provided.

Tests

The working curriculum provides for modular control work, which is carried out in the form of a test.

Policy and control

7. Educational Component Policy

Rules for attending classes and behavior in the classroom

Attendance at classes is a mandatory component of assessment. 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's conduct, not to be distracted by actions that are not related to the educational process.

Rules for the implementation and defense of practical work (seminar classes):

- *performance of practical work (tasks for seminar classes) takes place during the hours of practical classes and SRS and is sent to the teacher's e-mail or telegram;*
- *in accordance with the "Code of Honor", practical work (tasks for seminar classes) and preparation of answers to theoretical and practical questions are performed by students independently;*

- The rules for the defense of practical works (tasks for seminar classes) are based on the rating system for evaluating learning outcomes.

Rules for assigning incentive and penalty points:

- Incentive points are not provided.
- Penalty points within the educational component cannot exceed 10% of the starting rating.

Deadline and retake policy

In case of debts from the educational component 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

Violation of the Code of Academic Integrity of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" is a serious violation, even if it is unintentional. The Code is available at the link: <https://kpi.ua/code.3>.

In particular, compliance with the Code of Academic Integrity means that all work on exams and tests must be done individually. When doing independent work, students can consult with teachers and with other students, but must solve problems on their own, guided by their own knowledge, skills and abilities. References to all resources and sources (e.g. in computer workshop reports, independent papers or presentations) should be clearly defined and properly designed. That is, the absence of references when using printed and electronic materials, quotes, opinions of other authors is unacceptable.

Academic Conduct and Ethics Policy

Students should be tolerant, respect the opinions of others, formulate objections in the correct form, and 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.2>.

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

Distribution of study time by types of classes and tasks from the educational component according to the working curriculum:

Semester	Study time		Distribution of training hours					Control measures		
	Loans	Acad. H.	Lecture	Practice.	Labor.	Ind. work	CPC	FDM	WGR	Semester certification
8	3,5	105	18	18	18	–	51	1	–	Exam

Current control: Reports on practical and laboratory classes, modular control work.

Calendar control: carried out twice a semester as a monitoring of the current state of fulfillment of the requirements of the syllabus.

Semester control: exam.

The student's rating in the educational component consists of the points that he receives for:

- 1) performance and defense of practical work (a total of 7 works at the teacher's choice);
- 2) performance and defense of laboratory work (2 works in total);
- 3) performance of modular control work;
- 4) answer at the exam (in writing with oral defense).

System of rating (weight) points and evaluation criteria

1. Practical classes:

Weight score – 3. Maximum number of points in all practical classes

equals: 3 points × 7=21 points.

Evaluation criteria (the solution of the problem should be received by the teacher by the end of the corresponding pair):

Score 3 is given provided that the problem is solved without errors;

Score 2 is given if the problem is solved with a minor error after correcting the corresponding error;

Score 1 is given if the problem is solved with several minor errors after correcting the corresponding errors;

A score of 0 is given if the problem is solved with a significant error, the teacher does not receive the solved problem on time (by the end of the corresponding pair) or is absent from the practical lesson without a valid reason.

In case of obtaining 0 points, the student can provide the teacher with the solution of the problem after the completion of the corresponding pair, but in order to receive positive points, the student must defend the corresponding problem to the teacher during the interview.

2. Laboratory classes:

Weight score – 6. The maximum number of points for all laboratory work is: 12 points × 2=24 points.

- Preparation for work:

Score 2 is given subject to a positive answer;

Score 1 is given subject to a positive answer with a slight error;

A score of 0 is given if the answer is unsatisfactory.

- performing laboratory work

Score 2 is given subject to active performance of work;

Score 1 is given if the work is not actively performed enough;

A score of 0 is given in case of unsatisfactory performance of work.

- Quality of protection:

points 8-7 are given subject to an excellent answer;

points 6-4 are given subject to the correct answer with minor errors of various levels;

points 3-1 are given under the condition of uncertainty with significant errors of various levels;

A score of 0 is given if the answer is unsatisfactory.

3. Modular control work:

Weight score – 5. The maximum number of points for the test is 5 points × 1= 5 points.

Score 5 is given if at least 95% of the questions are answered;

Score 4 is given if at least 85% of the questions are answered;

a score of 3–2 is given if 75% of questions are answered;

Score 1 is given if 60% of questions are answered;

A score of 0 is given if less than 60% of the questions are answered.

Incentive points are not provided.

Penalty points are given for:

– lack of admission to laboratory work due to unsatisfactory incoming control – 1 point;

– absence from a laboratory lesson without a valid reason – 1 point;

– untimely (later than at the control lesson) defense of laboratory work – 1 point.

The total number of penalty points cannot exceed 5 (10% of the starting component).

The maximum amount of points of the starting component is 50. A prerequisite for admission to the exam is the enrollment of all laboratory work and the starting component of the rating is at least 25 points (50% of the maximum amount of points of the starting component).

According to the results of educational work for the first 7 weeks, the "ideal student" should score 20 points. At the attestation (8th week), the student receives "enrolled" if his current rating is at least 10 points.

According to the results of 15 weeks, the "ideal student" should score 40 points. At the second attestation (14th week), the student receives "enrolled" if his current rating is at least 20 points.

The maximum amount of points for the RC semester is 50:

$$RC = R_{pz} + R_{lb} + R_{micron} = 21 + 24 + 5 = 50 \text{ points.}$$

At the exam, students perform a written test. Each task contains two theoretical and one practical questions. Each theoretical question is evaluated at 20 points, and the practical question is evaluated at 10 points.

System for evaluating theoretical issues (r_{T1}, r_{T1}):

- "excellent", complete answer (at least 95% of the required information) – 20-19 points;
- "good", a sufficiently complete answer (at least 75% of the necessary information or minor inaccuracies) – 18-15 points;
- "satisfactory", incomplete answer (at least 60% of the necessary information and some errors) – 14-12 points;
- "unsatisfactory", unsatisfactory answer – 0 points.

Practical Question Evaluation System (r_{Tp}):

- "excellent", complete answer (at least 95% of the required information) – 10 points;
- "good", a sufficiently complete answer (at least 75% of the required information or minor inaccuracies) – 9-8 points;
- "satisfactory", incomplete answer (at least 60% of the required information and some errors) – 7-6 points;
- "unsatisfactory", unsatisfactory answer – 0 points.

The maximum rating of the exam test is

$$RE = RT1 + RT2 + R_{Pr} = 20 + 20 + 10 = 50 \text{ points.}$$

Conditions for admission to semester control: enrollment of all laboratory work and the starting component of the semester rating of at least 25 points.

The sum of starting points and points for the exam test work is converted to the exam grade according to the table:

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

Score	Score
100-95	Perfectly
94-85	Very good
84-75	Well
74-65	Satisfactory
64-60	Dostagno
Less than 60	Disappointing
Not met the conditions of admission	Not allowed

9. Additional information on the educational component

List of questions submitted for semester control

Theoretical issues

1. *Derive the differential equation of filtering.*
2. *Derive a dependence to determine the sedimentation surface of the sedimentation tank.*
3. *Derive the kinetic equation of filtering through a layer of granular material.*
4. *Derive the kinetic equation of filtering.*
5. *Derive modified Reynolds and Euler criteria.*
6. *Give the areas of use for fluidization of solid granular material.*
7. *Give a classification of liquids.*
8. *Give a classification of liquids. Explain how non-Newtonian fluids are characterized.*
9. *Give the main criteria for the similarity of hydromechanical processes. Explain their physical content.*
10. *Give a scheme for calculating the material balances of hydromechanical processes.*
11. *Give and characterize the main criteria for the similarity of hydromechanical processes.*
12. *What are the main types of mixing. Explain the mechanism of cavitation stirring.*
13. *What are the main types of agitators. Justify the choice of agitator.*
14. *Name the stages of separation of suspensions in filter centrifuges.*
15. *Substantiate the advantages and disadvantages of fluidization of solid granular material.*
16. *Justify the use of oil seals, thrust bearings and stabilizers in devices with mixers?*
17. *Justify the advantages and disadvantages of filters that work under vacuum.*
18. *Justify the components on which the power of the centrifuge drive is consumed.*
19. *Justify the shape of the liquid surface in the rotating rotor of the centrifuge.*
20. *Justify the factors that affect the power of the agitator drive*
21. *Justify why the suspension is stirred in the drum vacuum filter, but not in the belt vacuum filter.*
22. *Justify in which cases filtration can occur at a constant filtration rate and an increasing pressure drop.*
23. *Justify in which cases filtration can occur at the filtration rate and pressure drop that decreases.*
24. *Justify why it is not necessary to stir the suspension in a belt vacuum filter, but in a disc filter it is necessary.*
25. *Justify what the separation factor is in the processes of deposition under the action of centrifugal forces. Explain how you can increase its value in a cyclone and a sedimentation centrifuge.*
26. *Describe groups and types of non-Newtonian fluids.*
27. *Describe the calculation sequence of the belt vacuum filter.*
28. *Describe the cases in which filtration can occur with a constant pressure drop and a decreasing filtration rate.*
29. *Under the influence of what forces can disperse particles be deposited in chemical equipment?*
30. *Show the importance of hydromechanical processes in chemical technology.*
31. *Explain for what purpose liquid media are mixed.*
32. *Explain the nature of the ideal and real fluidization curves.*
33. *Explain why hydrocyclones are impractical to use to purify water from quartz grains of sand.*
34. *Explain what factors determine the filtration rate.*
35. *Explain the purpose of installing reflective partitions in stirring machines.*
36. *Explain the purpose of ensuring the difference in the speeds of the screw and the rotor of the screw centrifuge.*
37. *Explain why the hydraulic resistance of a fluidized bed is a constant value.*
38. *Explain why the corona electrode is made in the form of a wire.*
39. *Explain what is the driving force behind filtering.*
40. *Explain what the porosity (intergrain voidness) of a layer of granular material is.*
41. *Explain what the degree of filling of the centrifuge rotor is. Analyze its characteristic meanings.*
42. *Explain what the degree of expansion of the fluidized layer is.*
43. *Explain what the degree of expansion of the fluidized layer is. How does the hydraulic resistance of the fluidized bed depend on it?*
44. *Explain what the separation factor is in the processes of deposition under the action of centrifugal forces. Analyze the ways to increase its value.*

45. Explain what the filtration rate is. What does it depend on?
46. Explain how critical fluidization rates can be determined for a certain layer of granular material.
47. Explain how hydromechanical processes can be intensified. Give examples of intensification, separation and preparation of heterogeneous systems.
48. Explain what factors determine the degree of gas purification in electrostatic precipitators. Analyze the use cases of dry and wet electrostatic precipitators.
49. Analyze the types of ionization of the gas flow. Explain which one is used for precipitation in electrostatic precipitators.
50. Analyze what factors determine the rate of deposition under the influence of gravity. Explain the concept of particle shape coefficient.
51. Analyze the need for stiffness rings inside the filter bags of the filter bags. Explain why bag filters are not suitable for cleaning wet gases.
52. Analyze the main groups and types of non-Newtonian fluids. What factors determine the viscosity of these fluids?
53. Analyze under the influence of what forces dispersed particles can be deposited.
54. Analyze in which cases it is advisable to use a dust collection chamber. Analyze under the influence of what forces the deposition occurs in this apparatus.
55. Analyze the centrifugation cycle time. Explain how to determine the deposition time of suspended particles in a precipitation centrifuge.
56. Formulate the concepts of "heterogeneous system", "dispersion medium", "dispersed phase",. Give examples of liquid and gas inhomogeneous systems.
57. Formulate the concepts of "heterogeneous system", "dispersed phase", "dispersion medium". Give examples of binary inhomogeneous systems.
58. Formulate what free and compressed deposition is.

Practical issues

1. Analyze the basics of calculating a dust precipitation chamber.
2. Analyze the basics of calculating a gravity rowing sedimentation tank.
3. Analyze the basics of calculating a cyclone.
4. Analyze the basics of calculating a batch depositing centrifuge.
5. Analyze the basics of calculating a tubular electrostatic precipitator.
6. Analyze the basics of plate electrostatic precipitator calculation.
7. Analyze the basics of calculating constant filtering.
8. Analyze the basics of drum vacuum filter calculation.
9. Analyze the basics of calculating a foam dust collector.
10. Analyze the basics of calculating a venturi scrubber.
11. Analyze the basics of calculating an apparatus with a mechanical stirring device.
12. Analyze the basics of calculating the fluidized bed apparatus.

List of questions submitted for modular control work

1. There is a liquid with a density $\rho_{\text{of P}}$ and particles of solid material with a density $\rho_{\text{of T}}$. At what ratio of densities ρ_{P} and ρ_{T} is it possible to obtain a suspension from the specified liquid and particles?
2. There are two liquids that are practically insoluble in each other. Which of the two liquids should be distributed in the form of droplets in the other to obtain an emulsion from them?
3. Which of the deposition rates of these suspended particles in a dispersion medium is greater: free or compressed deposition?
4. How does the rate of deposition of suspended particles in a dispersion medium depend on its viscosity?
5. What is the shape of the free surface of the liquid in the rotating rotor of the sedimentation centrifuge?

6. *In a precipitating centrifuge, the suspension is separated, and the density of suspended particles is less than the density of the dispersion medium. Which particles have a higher radial velocity?*
7. *What is the driving force of filtration in a capacitive filter?*
8. *What is called the average filtration rate?*
9. *What is the resistivity of the sediment?*
10. *What are Newtonian fluids?*
11. *In which of the following non-Newtonian fluids does the viscosity decrease with increasing shear rate and does not depend on time?*
12. *What is the name of the mixing of a liquid medium, in which the movement of this medium is formed with the help of a flooded jet that flows out of the nozzle?*
13. *What is circulating mixing of a liquid medium?*
14. *With an increase in the speed of rotation of the agitator, the power spent on mixing the liquid medium increases. How does the value of the power criterion change if the movement of the liquid medium in the apparatus is laminar?*
15. *How do the internal devices of the apparatus with a mechanical stirring device change the power spent on stirring the liquid medium with the agitator?*
16. *What is a monodisperse material?*
17. *What is the porosity of a layer of solid bulk material?*
18. *What is the fluidization working number?*
19. *What is the porosity of a stationary layer of spherical particles of a certain diameter?*
20. *How does the hydraulic resistance of a monodisperse layer of solid material in ideal fluidization depend on the reduced velocity of the liquefaction agent?*

Work program of the educational component (syllabus):

Compiled by *Professor of the Department of Chemical Engineering, Doctor of Technical Sciences, Senior Researcher, Professor Mikulionok Ihor Olehovych*

Approved *by the Department of Chemical, Polymer and Silicate Engineering (Minutes No. 17 of 04.06.2025).)*

Approved *by the Methodological Commission of the Faculty of Engineering and Chemistry (Minutes No. 11 dated 27.06.2025).)*