



Polymer processing technology

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 (full-time)</i>
Year of preparation, semester	<i>3rd year, autumn semester</i>
Scope of the educational component	<i>5 (150)</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. Mikulionok 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 "Polymer Processing Technology" is the basic educational component of the cycle of educational components of professional training, which lays the foundations for the training of specialists in industrial engineering (polymer engineering) and is primarily theoretical.

***The subject of the educational component "Polymer Processing Technology"** is the main properties of polymers and polymeric materials, their technological and operational properties, as well as the main technological processes and equipment for their processing into various products made of polymers and polymeric materials.*

The purpose of the educational component "Technology of polymer processing"

The purpose of the educational component is the process of forming a complex of knowledge by students regarding the basic properties of polymers and polymeric materials, as well as the theoretical foundations of polymer processing technology.

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 competence:

- Ability to make effective decisions on the choice of structural materials, equipment, processes and combine theory and practice to solve an engineering problem (FC7).

According to the requirements of the program of the educational component "Polymer Processing Technology", 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);
- choose and apply the necessary equipment, tools and methods (PH9).

2. Pre-requisites and 2 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 "Polymer Processing Technology" is based on the study of the following educational components: "Chemistry", "Physics", "Materials Science", "Machine Parts", "Mechanics of Materials and Structures".

Post-requisites: The educational component "Polymer Processing Technology" provides the following educational components: "Rheology", "Mechanical Processes and Equipment for the Production of Polymer and Building Materials and Products", "Hydromechanical Processes and Equipment for the Production of Polymer and Building Materials and Products", as well as the course 2project on technological equipment and course work on processes and equipment for the production of polymer and building materials and products.

3. Content of the educational component

Section 1. General information about polymers and materials using them

Topic 1.1. Basic information about polymers and plastics.

Topic 1.2. Technological properties of polymeric materials.

Section 2. Classification of methods for processing polymeric materials

Topic 2.1. Classification of methods for processing polymeric materials.

Section 3. Preparatory processes for the processing of polymeric materials

Topic 3.1. Preparatory processes for the processing of polymeric materials.

Chapter 4. Form-forming processes of processing polymeric materials

Topic 4.1. Rolling and calendaring.

Topic 4.2. Extrusion.

Topic 4.3. Heat treatment of products made by continuous molding.

Topic 4.4. Injection molding .

Topic 4.5. Pressing.

Topic 4.6. Rotational molding.

Topic 4.7. Formation of products from sheet and film thermoplastics.

Topic 4.8. Formation of polymer films by watering from the solution.

Topic 4.9. Production of rubber products by dipping.

Topic 4.10. Technology of gas-filled plastic masses.

Topic 4.11. Technology of fiberglass products.

Topic 4.12. Technology of products from rubber compounds.

Chapter 5. Final processes of processing polymeric materials

Topic 5.1. Assembling products from polymers and plastics.

Topic 5.2. Machining of blanks and products made of polymers and plastics.

Topic 5.3. Metallization of products made of polymers and plastics.

Topic 5.4. Decorative processing of products made of polymers and plastics.

4. Training materials and resources

Basic literature

1. Mikulionok I. O. Technology of polymer processing. 5th ed., revised. and supplemented. Kyiv : Igor Sikorsky Kyiv Polytechnic Institute, 2025. 314 p. URL: <https://ela.kpi.ua/handle/123456789/74268>.
2. Mikulionok I. O. Technological Foundations of Polymer Material Processing: Textbook. Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2024. 296 p. URL: <https://ela.kpi.ua/handle/123456789/68766>.
3. Mikulionok I. O. Technological Foundations of Processing of Polymers, Plastics and Rubber Mixtures. Posib. Kyiv: NTUU "KPI", 2015. 312 p. (in Russian).
4. Mikulionok I. O., Sokolskyi O. L. Polymer materials and products from them (obtaining, processing, properties) : terminol. slov. Kyiv: NTUU "KPI", 2015. 208 p. URL: <https://ela.kpi.ua/handle/123456789/37632>.
5. Mikulionok I. O. Equipment and processes of processing thermoplastic materials using secondary raw materials: monograph. Kyiv: IVC "Publishing House "Polytechnic", 2009. 265 p. URL: <https://ela.kpi.ua/handle/123456789/28259>.
6. Mikulionok I. O. Modeling of equipment of technological lines for processing plastics and rubber mixtures on the basis of rolling machines: monograph. Kyiv: NTUU "KPI", 2013. 243 p. URL: <https://ela.kpi.ua/handle/123456789/37520>.
7. Lukashova V. V., Mikulionok I. O., Radchenko L. B. Extrusion of 3foam polymers: monograph. Kyiv: NTUU "KPI", 2011. 176 p. URL: <https://ela.kpi.ua/handle/123456789/37522>.
8. Voznyuk V. T., Mikulionok I. O. Intensification of the process of manufacturing extruded polymer pipes: monograph. Kyiv: NTUU "KPI", 2012. 142 p. URL: <https://ela.kpi.ua/handle/123456789/37521>.

Further reading

9. Mikulionok I. O., Radchenko L. B. Processing of secondary raw materials by extrusion: monograph. Kyiv: NTUU "KPI", 2006. 184 p. URL: <https://ela.kpi.ua/handle/123456789/38062>.
10. Tadmor Z., Gogos C. G. Principles of polymer processing. 2nd ed. Hoboken: John Wiley & Sons, 2006. 961 p. URL: <http://www3.fi.mdp.edu.ar/procesamiento1/material/Tadmor-Gogos.pdf>.
11. Rauwendaal C. Polymer extrusion. 5th ed. Munich: Carl Hanser Verlag GmbH & Co. KG, 2014. 950 p. URL: <https://doi.org/10.3139/9781569905395>.
12. Vlachopoulos J., Vlachopoulos N. D. Understanding rheology and technology of polymer extrusion. Dundas, ON, Canada: Polydynamics Inc., 2019. 337 p. URL: http://www.mie.uth.gr/ekp_yliko/Rheo_Tech_Book_Part_A.pdf.
13. Mikulionok I. O. Handling of polymer-, glass- and metal-containing household waste: monograph. Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2022. 112 p. URL: <https://ela.kpi.ua/handle/123456789/48555>.
14. Mikulionok I. O., Gavva O. M., Kryvoplyas-Volodina L. O. Innovative equipment for the preparation and processing of polymeric materials and rubber mixtures: monograph. Kyiv: NUFT, 2022. 139 p. URL: <https://ela.kpi.ua/handle/123456789/57427>.
15. Mikulionok I. Classification and analysis of polymer and rubber waste shredder designs // Proceedings of the Tavria State Agrotechnological University. 2023. Vol. Vol. 23, No. 1. Pp. 41–62 (in Russian). DOI: 10.31388/2078-0877-2023-23-1-41-62.
16. Zworykin K. O., Zworykin L. O. Welding of plastics. Manual. Kyiv: KMM Publ., 2013. 184 c.

17. Mikulyonok I. O. *Equipment for preparing and continuous molding of thermoplastic composites* // *Chemical and Petroleum Engineering*. 2013. Vol. 48, N 11–12. P. 658–661. DOI: 10.1007/s10556-013-9676-x.

18. Mikulionok I. O. *Classification of Processes and Equipment for Manufacture of Continuous Products from Thermoplastic Materials* // *Chemical and Petroleum Engineering*. 2015. Vol. 51, N 1–2. P. 14–19. DOI: 10.1007/s10556-015-9990-6.

Information resources on the Internet

19. Dspace NTB KPI 4pi. Igor Sikorsky, <https://ela.kpi.ua/handle/123456789/35084>, <https://ela.kpi.ua/handle/123456789/37632>, <https://ela.kpi.ua/handle/123456789/28259>, <https://ela.kpi.ua/handle/123456789/37520>, <https://ela.kpi.ua/handle/123456789/37522>, <https://ela.kpi.ua/handle/123456789/37521>, <https://ela.kpi.ua/handle/123456789/38062>.

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

21. Campus of Igor Sikorsky Kyiv Polytechnic Institute4. Igor Sikorsky, <http://login.kpi.ua/>.

22. Official websites of patent offices, <https://sis.nipo.gov.ua/uk/search/simple/>, <http://worldwide.espacenet.com/advancedSearch?locale=en> EP

Educational content

5. Methods of mastering the educational component

Lectures

Lectures are aimed at:

- providing modern, holistic, interdependent knowledge on the educational component "Polymer Processing Technology", 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
Chapter 1. General information about polymers and materials using them		
1	Topic 1.1. Basic information about polymers and plastics Lecture 1. Basic information about polymers. Basic information about polymer synthesis. Basic information about plastics. Fillers and composite materials using polymers. Rubbers and materials based on them. References: [1–4]. <u>List of didactic tools:</u> The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture.	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
	<u>Tasks on the SRS.</u> The latest polymer materials with high performance properties.	
2	Topic 1.2. Technological properties of polymeric materials Lectures 2, 3. The main tasks of thermoplastic processing (Properties of thermoplastic polymers and materials with their application. Basic properties of thermoplastics. Technological properties. Indicators that determine the technical purpose of products). Rheology. Types of deformation of polymers. Newtonian and nonNewtonian of liquids. Viscous and thermophysical properties of polymer melts. References: [1–4]. <u>List of didactic tools:</u> The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture.	4
Chapter 2. Classification of methods for processing polymeric materials		
3	Topic 2.1. Classification of methods for processing polymeric materials Lecture 4. General information. Preparatory methods for recycling plastics. Molding methods of plastics processing. Final methods for recycling plastics. References: [1–3, 5, 10]. <u>List of didactic tools:</u> The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture.	2
Chapter 3. Preparatory processes for the processing of polymeric materials		
4	Topic 3.1. Preparatory processes for the processing of polymeric materials Lecture 5. Receiving, storing and transporting polymeric materials. Drying of polymeric materials. Mixing of polymers and materials with their application. Painting of polymers and materials using them. References: [1–3, 5, 13, 14]. <u>List of didactic tools:</u> The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture. <u>Tasks on the SRS.</u> The latest methods and equipment for crushing and grinding waste.	2
Chapter 4. Form-forming processes of processing polymeric materials		
5	Topic 4.1. Rolling and calendering Lectures 6, 7. Rolling and calendering. General information. Rolling. Design features of rollers. Calendering. Design features of calenders. References: [1–3, 6]. <u>List of didactic tools:</u> The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture. <u>Tasks on the SRS.</u> Features of the structure of technological lines for processing polymeric materials and rubber mixtures by the roller-calender method.	4
6	Topic 4.2. Extrusion Lectures 8–10. Extrusion. General information. General information about 5semi-extruders. General structure and principle of operation 5 of semi-extruders. General structure and principle of operation of combined and cascade extruders. Classification of products obtained by extrusion. Technology of sleeve films by extrusion with blowing of a polymer sleeve. Technology of flat films by extrusion method with cooling on rolls. Technology flat films by extrusion with cooling in a water bath. Technology of oriented films. Technology of production of combined film materials. Technology of production of multilayer polymer films by 5semi-extrusion. Production technology polymer sheets. Technology for the production of smooth polymer pipes and molded products. Technology for applying a polymer coating to the core. Technology for	6

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>the production of volumetric products by extrusion with blowing.</i> Topic 4.3. Heat treatment of products made by continuous molding <i>References: [1–3, 8, 9].</i> <i>List of didactic tools:</i> The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture. <i>Tasks on the SRS.</i> The latest technologies for the production of flat polymer meshes.	
7	Topic 4.4. Injection molding <i>Lecture 11. Injection molding. General information. Features of the injection molding process.</i> <i>References: [1–3].</i> <i>List of didactic tools:</i> The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture. <i>CPC Assignment:</i> Latest Injection Molding Techniques and Equipment.	2
8	Topic 4.5. Pressing <i>Lecture 12. Pressing. General information. Requirements for materials for pressing. Features of the pressing process. The influence of the parameters of the pressing process on the quality of products.</i> <i>References: [1–3].</i> <i>List of didactic tools:</i> The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture. <i>Tasks on CPS:</i> The latest methods and equipment for pressing polymers.	2
9	Topic 4.6. Rotary molding Topic 4.7. Formation of products from sheet and film thermoplastics <i>Lecture 13. General information about rotational formation. Features of the process of rotational formation. General information about the formation of products from sheet and film thermoplastics. Features of the rotary molding process.</i> <i>References: [1–3].</i> <i>List of didactic tools:</i> The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture.	2
10	Topic 4.8. Formation of polymer films by watering from the solution. Topic 4.9. Production of rubber products by dipping <i>Lecture 14. Formation of polymer films by pouring from the solution. Manufacture of rubber products by dipping.</i> <i>References: [1–3].</i> <i>List of didactic tools:</i> The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture.	2
11	Topic 4.10. Technology of gas-filled plastic masses <i>Lecture 15. Technology of gas-filled plastic masses.</i> <i>References: [1–3, 7].</i> <i>List of didactic tools:</i> The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture. <i>Tasks on the SRS.</i> Classification of gas-filled plastic masses.	2
12	Topic 4.11. Technology of fiberglass products. Topic 4.12. Technology of products made from rubber compounds <i>Lecture 16. Technology of fiberglass products. Technology of products made of rubber compounds.</i> <i>References: [1–3].</i> <i>List of didactic tools:</i> The lecture uses a laptop with an electronic version of the	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>lecture and a projector. Visual samples, diagrams and drawings for the lecture. Tasks on the SRS. Classification of fiberglass products.</i>	
Chapter 5. Final processes of processing polymeric materials		
13	Topic 5.1. Assembling products from polymers and plastics. Topic 5.2. Machining of blanks and products made of polymers and plastics Lecture 17. Assembly of products from polymers and plastics. Machining of blanks and products from polymers and plastics. References: [1–3, 15]. <u>List of didactic tools:</u> The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture. <u>Tasks on the SRS.</u> Classification of methods of welding and bonding plastics.	2
14	Topic 5.3. Metallization of products made of polymers and plastics. Topic 5.4. Decorative processing of products made of polymers and plastics Lecture 18. Metallization of products made of polymers and plastics. Decorative processing of products made of polymers and plastics. References: [1–3]. <u>List of didactic tools:</u> The lecture uses a laptop with an electronic version of the lecture and a projector. Visual samples, diagrams and drawings for the lecture. <u>Tasks on the SRS.</u> The latest methods and equipment for metallization of polymers and plastics.	2
Just		36

Practical (seminar) classes

In the system of professional training of students in this educational component, practical (seminar) classes occupy 50% 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 the technology of polymer processing. 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, allow you to test 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 theoretical knowledge in the field of polymer processing 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.*

Seminar classes include control of knowledge, skills and abilities, formulation of a general problem (task) by the teacher and its discussion with the participation of students. At each of the seminar classes, the teacher organizes a discussion on predetermined problems. On the basis of individual tasks, students prepare abstracts of speeches on these problems.

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 1.1. Basic information about polymers and plastics	4

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
	<i>Seminar classes No. 1, 2. Discussion on one of the topics:</i> 1) <i>Advances in non-woven fabrics technology.</i> 2) <i>Advances in fibrous material technology.</i> 3) <i>Advances in film material technology.</i> 4) <i>Advances in multilayer film material technology.</i> 5) <i>Achievements in the technology of sheet and roll polymer materials.</i> 6) <i>Advances in polymer mesh technology.</i> 7) <i>Advances in corrugated polymer pipe technology.</i> 8) <i>Achieving the technology of polymer-insulated cable products.</i> 9) <i>Achievements in the technology of gas-filled polymeric materials and products.</i> 10) <i>Another topic (agrees with students).</i> <u>List of didactic tools: personal computer and projector.</u>	
2	Topic 3.1. Preparatory processes for the processing of polymeric materials <i>Seminar No. 3. Discussion on one of the topics indicated in lesson 1.</i> <u>List of didactic tools: personal computer and projector.</u>	2
3	Topic 4.1. Rolling and calendering <i>Seminar lesson No. 4. Discussion on one of the topics indicated in lesson 1.</i> <u>List of didactic tools: personal computer and projector.</u>	2
4	Topic 4.2. Extrusion <i>Seminar lesson No. 5. Discussion on one of the topics indicated in lesson 1.</i> <u>List of didactic tools: personal computer and projector.</u>	2
6	Topic 4.10. Technology of gas-filled plastic masses <i>Seminar lesson No. 6. Discussion on one of the topics indicated in lesson 1.</i> <u>List of didactic tools: personal computer and projector.</u>	2
7	Topic 4.11. Technology of fiberglass products <i>Seminar lesson No. 7. Discussion on one of the topics indicated in lesson 1.</i> <u>List of didactic tools: personal computer and projector.</u>	2
8	Topic 5.3. Metallization of products made of polymers and plastics <i>Seminar lesson No. 8. Discussion on one of the topics indicated in lesson 1.</i> <u>List of didactic tools: personal computer and projector.</u>	2
9	<i>Seminar lesson No. 7 Modular test work</i>	2
Just		18

Laboratory classes

In the system of professional training of students in the educational component, laboratory classes occupy 25% 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. 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 theoretical knowledge in the field of modern polymer processing technologies;*
- *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	Laboratory work 1. <i>Determination of bulk density of bulk polymeric materials</i> <i>References: [1–3].</i>	2
2	Laboratory work 2. <i>Determination of the angle of natural slope of bulk polymeric materials</i> <i>References: [1–3].</i>	2
3	Laboratory work 3. <i>Identification of polymers by physical and chemical properties</i> <i>References: [1–3].</i>	2
4	Colloquium on Papers 1–3	2
5	Laboratory work 4. <i>Study of Mechanical Characteristics of Film Materials</i> <i>References: [1–3].</i>	2
6	Laboratory work 5. <i>Determination of mixing quality by statistical methods</i> <i>References: [1–3].</i>	2
7	Laboratory work 6. <i>Study of technological parameters of the extrusion line operation</i> <i>References: [1–3].</i>	2
8	Colloquium on Papers 4–6	2
9	Defense of the report from laboratory classes	2
Just		18

6. Independent work of a student

Independent work takes 52% of the time of 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	<i>Topic 1.1. Basic information about polymers and plastics.</i> <i>The latest polymer materials with high performance properties.</i> <i>References [1–3].</i>	4
2	<i>Topic 3.1. Preparatory processes for the processing of polymeric materials.</i> <i>The latest methods and equipment for crushing and grinding waste.</i> <i>Literature [1–3, 5, 13, 15].</i>	4
3	<i>Topic 4.1. Rolling and calendering.</i> <i>Tasks on CPS: Features of the structure of technological lines for processing polymeric materials and rubber mixtures by the roller-calender method.</i> <i>References [1–3, 6].</i>	4
4	<i>Topic 4.2. Extrusion.</i> <i>The latest technologies for the production of flat polymer meshes.</i> <i>Literature [1–3, 8, 11, 12].</i>	8
5	<i>Topic 4.4. Injection molding.</i> <i>CPC Assignment: Latest Injection Molding Techniques and Equipment.</i>	4

No. s/p	Name of the topic submitted for independent study	Number of CPC hours
	<i>References [1–3].</i>	
6	<i>Topic 4.5. Pressing.</i> <i>Tasks on CPS: The latest methods and equipment for pressing polymers.</i> <i>References [1–3].</i>	4
7	<i>Topic 4.10. Technology of gas-filled plastic masses.</i> Classification of gas-filled plastic masses. <i>References [1–5, 7].</i>	4
8	<i>Topic 4.11. Technology of fiberglass products.</i> <i>Topic 4.12. Technology of products from rubber compounds.</i> Classification of fiberglass products. <i>References [1–3].</i>	4
9	<i>Topic 5.1. Assembling products from polymers and plastics.</i> <i>Topic 5.2. Machining of workpieces and products made of polymers.</i> Classification of methods of welding and bonding plastics. <i>Literature [1–3, 16].</i>	4
10	<i>Topic 5.3. Metallization of products made of polymers and plastics.</i> <i>Topic 5.4. Decorative processing of products made of polymers and plastics.</i> The latest methods and equipment for metallization of polymers and plastics. <i>Literature [1, 2].</i>	4
11	<i>Preparation for modular control work.</i> <i>References [1–3].</i>	4
12	<i>Exam preparation</i>	30
Just		78

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
5	5	150	36	18	18	–	78	1	–	Exam

Current control: Reports on practical (seminar) 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) active participation in seminars (participation in 4 seminars);
- 2) performance and defense of laboratory work (6 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. Seminar classes:

Weight score – 5. Maximum number of points in all practical classes equals: 5 points × 4 = 20 points.

Evaluation criteria:

Score 5 is given subject to active and creative participation in the seminar;

a score of 4-3 is set under the condition of active or creative participation in the seminar;
 a score of 2-1 is given subject to participation in the seminar;
 A score of 0 is given if you are present at the seminar without participating in it or absent from the seminar without a valid reason.

2. Laboratory classes:

Weight score – 4. The maximum number of points for all laboratory work is: 4 points × 6 = 24 points.

- Preparation for work:

Score 1 is given subject to a positive answer;

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

- performing laboratory work

point 1 is given subject to active performance of work;

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

- Quality of protection:

Score 2 is given subject to an excellent answer;

Score 1 is given if the answer is correct with minor errors;

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

3. Modular control work:

Weight score – 6. The maximum number of points for the test is 6 points × 1 = 6 points.

Score 6 is given if at least 95% of the questions are answered;

a score of 5-4 is given if at least 85% of the questions are answered;

Score 3 is given if at least 75% of the questions are answered;

a score of 1-2 is given if at least 60% of the 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) delivery of laboratory work – 1 point.

The total number of penalty points cannot exceed 10 (10% 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:

$$RC = R_{sz} + R_{lb} + R_{mkr} = 20 + 24 + 6 = 50 \text{ points.}$$

At the exam, students perform a written test. Each task contains two theoretical questions. The list of questions is given in the methodological recommendations for mastering the educational component. Each question is evaluated at 25 points.

System for evaluating theoretical issues (r_{T1} , r_{T2}):

– "excellent", complete answer (at least 95% of the required information) – 25-24 points;

- "good", a sufficiently complete answer (at least 75% of the necessary information or minor inaccuracies) – 19-23 points;
- "satisfactory", incomplete answer (at least 60% of the required information and some errors) – 15-18 points;
- "unsatisfactory", unsatisfactory answer – 0 points.

The maximum rating of the exam test is

$$RE=RT1 + RT2 = 25+25 = 50 \text{ points.}$$

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 educational component

List of questions submitted for semester control

Theoretical issues

1. Make an overview of the viscosity and thermophysical properties of polymer melts.
2. Make an overview of the final methods for recycling plastics. Provide general information about the process of dyeing polymers and materials using them.
3. Make an overview of the main methods of agglomeration and granulation of shredded waste.
4. Make an overview of the main methods of crushing and grinding waste.
5. Make an overview of the main methods for sorting shredded waste.
6. Make an overview of the main types of dispersed, reinforced and dispersed-reinforced structures of composite materials.
7. Make an overview of the preparatory methods for recycling plastics.
8. Make an overview of molding methods for recycling plastics.
9. Provide information about the definition and approximation of rheological and thermophysical properties.
10. Provide information about flow curves.
11. Provide information about fillers and composite materials using polymers.
12. Provide information about Newtonian and non-Newtonian fluids.
13. Provide information about the thermophysical and rheological properties of composite materials.
14. Provide information about the thermal stability of polymers.
15. Provide general information about rolling and calendering.
16. Provide general information about extrusion.
17. Provide general information about single-worm extruders. Analyze the general structure and principle of operation of a single-worm extruder.
18. Provide general information about the process of mixing polymers and materials using them.

19. Provide general information about the heat treatment of products made by continuous molding.
20. Provide general information about polymer waste disposal.
21. Provide general information about the formation of products from sheet and film thermoplastics.
Analyze the features of the thermoforming cycle.
22. Provide general information regarding the classification of methods for processing polymeric materials.
23. Justify the relationship between the melt yield index and the melt viscosity.
24. Justify the manifestation of highly elastic properties of the polymer melt in the areas of inlet and outlet of molding elements.
25. Analyze the manufacture of rubber products by dipping.
26. Analyze the highly elastic properties of polymers.
27. Analyze the decorative processing of products made of polymers and plastics.
28. Analyze the general structure and principle of operation of combined and cascade extruders.
29. Analyze the final methods for recycling plastics.
30. Analyze waste storage and transportation.
31. Analyze the dehydration of shredded waste.
32. Analyze the design and principle of operation of a closed-type batch mixer with oval rotors.
33. Analyze the metallization of polymer and plastic products.
34. Analyze the machining of workpieces and products made of polymers and plastics.
35. Analyze the basic information about polymers.
36. Analyze the basic properties of thermoplastics.
37. Analyze the main parameters of the viscous flow.
38. Analyze the features of the injection molding process.
39. Analyze the features of the pressing process.
40. Analyze the features of the rotary molding process.
41. Analyze the features of the process of forming polymer films by watering from the solution.
42. Analyze the indicators that determine the technical purpose of products.
43. Analyze the reception, storage and transportation of polymeric materials.
44. Analyze the washing of shredded waste.
45. Analyze the welding process of polymeric materials and make an overview of the main welding methods.
46. Analyze the relaxation properties of polymers.
47. Analyze the drying of polymeric materials.
48. Analyze the technological indicators of the viscosity of polymer melts. Melt flow rate.
49. Analyze the technology of fiberglass products.
50. Analyze the technology for the production of smooth polymer pipes.
51. Analyze the technology for the production of combined film materials.
52. Analyze the technology for the production of volumetric products by blowing extrusion.
53. Analyze the technology for the production of linear products.
54. Analyze the technology for the production of polymer sheets.
55. Analyze the technology of gas-filled plastic masses.
56. Analyze the technology of applying a polymer coating to the core.
57. Analyze the technology of oriented films.
58. Analyze the technology of flat films by extrusion with cooling on rolls.
59. Analyze the technology of sleeve films by extrusion with blowing of a polymer sleeve.
60. Analyze the fractionation of shredded waste.

List of questions submitted for modular control work (MCR in the form of a test)

1. What are high molecular weight compounds?
2. What is a linear polymer?
3. What is the name of a copolymer that basically contains links of two or more different monomers connected randomly?

4. What are thermoplastic polymers (thermoplastics)?
5. What are reactoplastic polymers (reactoplasts)?
6. What are crystalline polymers?
7. As a result of what type of chemical reaction, polymer macromolecules are formed as a result of the opening of multiple chemical bonds (i.e., the polymer consists of structural units corresponding to the elementary composition of monomers)?
8. As a result of a chemical reaction of what type, in addition to the macromolecule of the polymer, low molecular weight compounds are also formed?
9. What is the criterion for dividing polyethylene into high-pressure polyethylene, low-pressure polyethylene and medium-pressure polyethylene?
10. What is polymer plasticization?
11. What is polymer plasticization?
12. What is rubber?
13. What are Newtonian fluids?
14. In which of the following non-Newtonian fluids does the viscosity decrease with increasing shear rate and does not depend on time?.
15. What types of deformations are characteristic of polymers?.
16. What is polymer melt flow curve?
17. How does the intermolecular separation (SMP) of a polymer affect melt flow stability?
18. How does the polymer processing temperature affect the melt flow stability?
19. How Does Polymer Melt Flow Rate Affect Melt Flow Stability?
20. How does the highly elastic deformation that develops during the deformation of the polymer melt cause specific effects?
21. High-pressure polyethylene is also called:
22. Which filler gives the best sound insulation properties to a polymer composite material?
23. The first polymer has a higher melt flow rate (PTR) compared to the second, determined at the same values of temperature and pressure. Which of the polymers has a higher effective viscosity under the conditions for determining PTR?
24. The first polymer has a higher melt flow rate (PTR) compared to the second, determined at the same values of temperature and pressure. Which of the polymers has a higher effective viscosity under the conditions for determining PTR?
25. What is the name of the destruction of polymers that occurs when they are simultaneously exposed to water and acids or alkalis?
26. What is the difference between the process of crushing polymer waste and the process of crushing polymer waste?
27. What is the most common method of destroying polymer waste?
28. Why are moistened polymer granules dried before processing?
29. What is the washing of crushed polymer waste with rotating brushes called?
30. Dispensers are used for:
31. What is the main purpose of the mixing process preceding the molding of polymer material products?
32. What is the most common method of dyeing products made of polymeric materials?
33. The fundamental difference between the processes of rolling and calendering of polymeric materials is:
34. Polymer material rolling process:
35. The process of calendering polymeric materials:
36. What type of equipment do rollers belong to?
37. Which surface of the polymer sheet is cooled more intensively on a horizontal roller table without the use of fans on it?
38. With the help of which equipment of the technological line for the production of roll materials on the basis of a calender is the operation of its components of periodic (cyclic) action, for example, a two-rotor mixer and a receiving (winding) device, as well as a continuous action, for example, a calender, coordinated?

39. *What is the most commonly used criterion for single-worm extruders?*
40. *What functional zones (in the order of movement of the processed material) is the working channel of a classic single-worm extruder divided?*
41. *Industrial production of films by extrusion with sleeve blowing can be carried out according to the following schemes of the direction of movement of the sleeve from the head to the receiving and winding equipment of polymer films:*
42. *Industrial production of films by extrusion with sleeve blowing vertically downwards is limited:*
43. *What is biaxially oriented film?*
44. *What is a combination film?*
45. *Calibration of smooth polymer pipes along the outer diameter is carried out during the extrusion process by stretching them to the walls of the calibration device using:*
46. *What method is usually used to apply a continuous layer of electrical insulation to a cable product?*
47. *Styrofoams are:*
48. *What shape of worms are most common in single-worm extruders?*
49. *What is the screw cutting pitch of a worm of single-worm extruders in most cases?*
50. *What Is the Most Common Way to Reduce the Volume of the Worm Channel in the Melting Zone of a Single-Worm Extruder?*
51. *What is the most common type of polymer material extrusion process?*
52. *The production of multilayer polymer films by co-extrusion involves:*
53. *Cooling of smooth polymer pipes in the cooling device is carried out mainly:*
54. *What is the main disadvantage of the extrusion method of producing bulk products by blowing from a preform (on the example of making PET bottles)?*
55. *What heat transfer method is implemented in the drum type cooling device of the calender line?*
56. *What heat transfer method is implemented in the polymer pipe cooling bath?*
57. *Fiberglass is a composite material, the mandatory components of which are:*
58. *What technological equipment is used to coat the fabric?*
59. *On what type of extruder can the melt degassing be carried out most simply and efficiently?*
60. *Effective cooling of smooth polymer pipes by immersion (passing a pipe through a layer of water in a cooling bath) is primarily limited by:*

Work program of the educational component (syllabus):

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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).)*