



Materials and equipment for the manufacture of polymer packages

Work program of the educational component (Syllabus)

Details of the educational component

Higher education level	<i>First (educational and professional)</i>
Field of Knowledge	<i>13 Mechanical Engineering</i>
Speciality	<i>131 Applied Mechanics</i>
Educational program	<i>Packaging and packaging equipment engineering</i>
Status of the educational component	<i>Mandatory</i>
Form of study	<i>full-time (full-time)</i>
Year of preparation, semester	<i>2nd year, 3rd semester</i>
Scope of the educational component	<i>4/120 year. (72 auditoriums, 48 SRS)</i>
Semester control / control measures	<i>Passed</i>
Class schedule	<i>4 hours per week (2 hours of lectures, 1 hour of practical and 1 hour of laboratory classes)</i>
Language of instruction	<i>Ukrainian</i>
Information about the course leader / teachers	http://intellect.cpsm.kpi.ua/profile/sde9
Course placement	<i>Sikorsky Platform</i>

Program of the educational component

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

In recent decades, high-molecular compounds have firmly entered our lives. Polymers are widely used in all spheres of life and activity of mankind: in industry and agriculture, in science and technology, in all types of transport. The modern packaging industry, as well as our everyday life, is unthinkable without the use of a wide range of polymeric materials.

The subject of the educational component is polymer packaging materials, equipment for processing polymeric materials into packaging products and technological processes occurring in equipment.

1.1. The purpose of the educational component is to participate in the formation of the following competencies in accordance with the requirements of the educational program.

Knowledge and understanding of the subject area and understanding of professional activities (GC 02). Ability to analyze materials, structures and processes based on the laws, theories and methods of mathematics, natural sciences and applied mechanics (FC 01). Ability to prescribe the technological process for the manufacture of packaging polymer material or product and determine the appropriate technological equipment for the implementation of the technological process (FC 13).

According to the requirements of the educational program, students, after mastering the educational component, must demonstrate the following program learning outcomes:

To know the features of technological processes for the manufacture of polymer packaging materials and products, to assign technological processes for their manufacture, to perform typical calculations of machines and equipment for the production of polymer packaging materials, products and parts (PRN 18).

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)

Successful application of the materials of this course requires students to be trained in Materials Science. It can be basic for the following courses: Fundamentals of Packaging Design, Operation and Maintenance of Technological Equipment, Paper and Cardboard Packaging Technologies, Technological Processes and Equipment. Interdisciplinary coursework, Fundamentals of CAD/CAM/CAE application and diploma design.

Content of the educational component

Topic 1. Polymeric materials in packaging
Topic 2. Technological properties of polymer packaging materials
Topic 3. Press equipment
Topic 4. Roller equipment
Topic 5. Extrusion equipment
Topic 6. Polymer injection molding, pneumatic, vacuum, rotary and centrifugal molding equipment
Topic 7. Disposal of waste polymers

3. Training materials and resources

Basic literature

1. Materials and equipment for the manufacture of polymer packaging. Home test: Textbook / Compilers: D.E. Sidorov, L.N. Gurieva. – Kyiv, NTUU "KPI. I. Sikorsky", 2023 – 13 p.
2. Gavva O.M., Bespalko A.P., Volchko A.I., Kokhan O.O. Packaging equipment: Textbook. – Kyiv: IAC "Upakovka", 2010. – 744 p. (in Russian).
3. Technological foundations of processing polymeric materials [Electronic resource] : study. Manual for applicants for a bachelor's degree in the educational programs "Engineering of Packaging and Packaging Equipment" of the specialty 131 "Applied Mechanics" and "Engineering of Equipment for the Production of Polymer and Building Materials and Products" of the specialty 133 "Industrial Engineering" / I. O. Mikulonok. 2nd ed., reworked. and supplements. ; KPI. Igor Sikorsky. – Electronic text data (1 file: 7.21 M bytes). – Kyiv: KPI. Igor Sikorsky, 2020. – 292 p. – Refs.: pp. 287–288. https://ela.kpi.ua/bitstream/123456789/35084/1/Pereroblennia-polimernykh-materialiv_NavchPosib.pdf
4. Sokolenko A.I. Packaging materials and their physical and chemical properties. Kyiv: Condor, 2015 – 400 p.
5. Food and beverage packaging. Krivoshey V., Khalaydzhi V. K.: IAC "Upakovka", 2018. - 216 p. (in Russian).

Additional

6. Methodical instructions for laboratory work on the educational component "Equipment for the manufacture of polymer packages" for students of the direction of training "Engineering Mechanics". /Compiled by: Sidorov D. E. – Kyiv, NTUU "KPI", 2011 – 25 p.
7. Methodical Instructions for Independent Work on the Educational Component "Equipment for the Manufacture of Polymer Packages" for Students of the Direction of Training 6.050502 "Engineering Mechanics" / Compiled by: D.E. Sidorov. – Kyiv: NTUU "KPI", 2013. – 12 p.
8. Methodical Instructions for the Implementation of the R&D on the Educational Component "Equipment for the Manufacture of Polymer Packages" for Students of the Direction of Training 6.050502 "Engineering Mechanics" / Compiled by: D.E. Sidorov. – Kyiv: NTUU "KPI", 2013. – 12 p.
9. Methodical instructions for practical classes on the educational component "Equipment for the manufacture of polymer packaging" for students of the direction of training "Engineering Mechanics". Compilers: Sidorov D. E. – Kyiv, 2012 – 35 p.
10. Sivetskyi V. I., Radchenko L. B. Fundamentals of modeling and design of worm extruders. Teaching. Pic. Kyiv: "Polytechnic", 2002. – 164 p. (in Russian).

11. *Equipment for processing composite materials by injection molding. Methodical instructions for laboratory work.* Compilers: Sivetskyi V.I., Sidorov D.E. et al. – Kyiv: "Polytechnic", 2003. – 44 p.
12. *Design of Machines for Processing of Polymers and Composite Materials. Methodical Instructions for Laboratory Work.* Compilers: Sivetsky V.I. et al. . – Kyiv: "Polytechnic", 2003. – 56p.
13. Skuberlyak O.V., Bashtannyk P.I. *Technology of processing polymeric and composite materials: Textbook.* – Lviv: "Rastr-7", 2007. – 376 p. (in Russian).
14. *Computer design of extrusion polymer equipment. Teaching. Pic.* Kyiv: "Polytechnic", 2003. – 184 p. (in Russian).
15. *Bulletin of NTUU "Igor Sikorsky Kyiv Polytechnic Institute". Series: Chemical Engineering, Ecology and Resource Saving.* ISSN: 2617-9741 (Print), ISSN: 2664-1763 (Online)
16. "Packaging" / Nats. University of Economics. Technologies, LLC "IAC "Upakovka"; Kiev. ISSN 2225-2975
17. «Modern packaging». Periodical : English, ISSN: 0026-8224, OCLC Number: 1716679

13. Information resources

Information resources

<https://cpsm.kpi.ua/ru/postuplenie/poleznye-statii/1381-vidi-i-funktsii-sovremennoj-upakovki.html>

Journal: <https://www.packaging.com.ua/katalog-predpriyatiy>

Electronic resources on the educational component:

- working curriculum of the educational component (syllabus) – on the electronic campus, on the Sikorsky platform and on the website of the department;
- rating system – in the electronic campus;
- methodological instructions for laboratory work – on the electronic campus and at the address <https://cpsm.kpi.ua/metodichni-rozrobki/2-kurs.html>;
- methodological instructions for independent work – on the electronic campus and at the address <https://cpsm.kpi.ua/metodichni-rozrobki/2-kurs.html>;
- methodological instructions for the implementation of practical tasks – in the electronic campus and at the address <http://cpsm.kpi.ua/mr.html> ;
- methodological guidelines for the implementation of the RWD – in the electronic campus, in the electronic repository of the library and at the address <https://cpsm.kpi.ua/metodichni-rozrobki/2-kurs.html>;
- lecture notes – on the Sikorsky platform.

Distance Certificate Courses:

1. https://www.udemy.com/course/learn-and-build-using-polymer/?gclid=Cj0KCQjwxdsHBhCdARIsAG6zhlXLJ29c-OWbswHxwYPtwhpH3QG5CnZQXqv0sm30czfVrBr kcP SOgaAjtZEALw wcB&matchtype=b&utm_campaign=LongTail la.EN cc.ROW&utm_content=deal4584&utm_medium=udemyads&utm_source=adwords&utm_term=. ag 78754142133 . ad 386748065892 . kw %2Bpolymer+%2Bcourse . de c . dm . pl . ti kwd-840344562152 . li 9061016 . pd .
2. <https://packagingschool.com/courses-polymers-in-packaging-101/>
3. <https://www.iopp.org/i4a/pages/index.cfm?pageid=4522>
4. <https://www.open.edu/openlearn/science-maths-technology/science/chemistry/introduction-polymers/content-section-1.1>
5. <https://sustainablepackaging.org/projects/esp/>
6. <https://www.polymercourses.com/our-courses/sustainability/designing-plastic-packaging/>

Other distance courses must be agreed with the teacher

5. Methods of mastering the educational component (educational component)

Lectures (36 hours)

Lectures are aimed at:

- *providing modern, holistic, interdependent knowledge on the educational component "Materials and equipment for the manufacture of polymer packaging", the level of which is determined by the target setting for each specific topic;*
- *ensuring the creative work of bachelors together with the teacher during the lecture;*
- *education of bachelors' professional and business qualities and the development of independent creative thinking in them;*
- *formation of the necessary interest in bachelors and providing direction for independent work;*
- *reflection of methodological processing of the material (highlighting the main provisions, conclusions, recommendations, clear and adequate to their formulation);*
- *use of visual materials for demonstration, combining, if possible, them with the demonstration of results and samples;*
- *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.*

<i>No. s/p</i>	<i>Title of the lecture topic and list of main questions</i>	<i>Hours</i>
<i>1</i>	<i>Topic 1. Polymeric materials in packaging</i> <i>Entry. The purpose and content of the educational component. General information about polymeric materials</i> <i>Properties that distinguish polymers from low molecular weight compounds; range of industrial products made of polymers; macromolecule, chain; Basics of classification.</i>	<i>22</i>
<i>2</i>	<i>Characteristics of High Molecular Weight Compounds</i> <i>Molecular weight distribution in polymers.</i>	<i>22</i>
<i>3</i>	<i>Characteristics of High Molecular Weight Compounds</i> <i>Configuration of macromolecules, conformation of macromolecules, supramolecular structures.</i>	<i>2</i>
<i>4</i>	<i>Polymeric materials in packaging: properties, uses, processing, features</i> <i>PE, PP, PS, PETF.</i>	<i>2</i>
<i>5</i>	<i>Polymeric materials in packaging: properties, uses, processing, features.</i> <i>PVC, PA, PC, F4. Artificial and synthetic fibers.</i>	<i>2</i>
<i>6</i>	<i>Topic 2. Technological properties of polymer packaging materials</i> <i>Technological properties of plastics and rubber compounds</i> <i>Powder, granules, flowability, natural slope angle, collapse angle, caking. Volumetric characteristics: bulk density and specific volume, density and specific volume of shaking. Frictional properties: coefficient of lateral pressure, coefficient of friction.</i>	<i>2</i>
<i>7</i>	<i>Technological properties of plastics and rubber compounds</i> <i>Physical condition. Thermomechanical curve. Destruction. Features of rubber processing: vulcanization, reversion. Temperature and time dependence. Heat shrinking.</i>	<i>2</i>
<i>8</i>	<i>Technological properties of plastics and rubber compounds</i> <i>Rheological properties: body models, viscosity, flow curves. Rheological properties of compositions based on oligomeric binders. Viscosity of suspensions.</i>	<i>2</i>

9	Topic 3. Press equipment Presses for processing polymer raw materials The essence of the pressing method. Processes that occur in the mold, cyclogram. General design and operation of the press.	2
10	Presses for processing polymer raw materials Pressing force. Technical characteristics (parameters) of the press	2
11*	Design and calculation of press components and parts* Beds and plates. Hydraulic cylinders. Plungers. Sealing movable and fixed joints. Batteries. Heating plates.	(2*)
12	Topic 4. Roller equipment Roller Machines The principle of operation of the roller machine. Operations performed on rollers. Operations performed on calenders. Classification and parameters of roll machines.	2
13	Roller Machines Processes that take place in the roller gap: the field of velocities and pressures, the thickness of the sheet and the performance of the roller pair, the spacer force, the torque on the roll and the power of the roll drive, the viscosity of the material in the gap.	2
14*	Design of the main components of roller machines* Rolls, roller bearings, adjustment mechanisms. 55swath gap, methods of compensation for roll deflection, roll drive, safety and emergency devices.	(2*)
15	Topic 5. Extrusion equipment Extrusion molding method Products that are made with worm extruders, general design of worm extruders, classification of extruders, kinematic diagrams of extruder layout options, worm design, special extruder zones, pressure distribution along the length of the extruder, combined and cascade extruders.	2
16*	Parametric calculation of the worm press Calculation of the geometry of the worm. Determination of the geometric coefficient of the head. Machine performance.	(2*)
17*	Determination of the differential pressure in the head Determination of the power of the drive motor.	(2*)
18	Topic 6. Polymer injection molding, pneumatic, vacuum, rotary and centrifugal molding equipment Injection pressing Characteristics of the method, cyclogram of work, scheme of product production, equipment for injection molding, injection molding machines, vertical injection molding machines.	2
19	Formation methods Pneumatic vacuum forming.	2
20	Blow molding Extrusion and injection molding methods	2
21	Topic 7. Disposal of waste polymers Disposal of polymer packaging materials Waste during production. Waste in use. Reuse.	2
22	Recycling of polymer packaging Technological schemes for the processing of polymer waste.	2
	Just	36

**-Optional*

Under the condition of blended or distance synchronous/asynchronous learning technology, it is proposed to teach the main lecture material in the review mode of presentation. Lectures 2, 3, 6-9, 12, 15, 18, 20 – if possible, in full. A full set of lecture material is posted on the Sikorsky platform and is available for self-study.

Practical classes (18 hours)

The purpose of the classes is to provide the ability to choose the type, design and perform basic calculations of technological equipment for the production of polymer packaging materials.

No. s/p	Name of the topic of the lesson	Hours
1*	<i>Drawing up kinematic and hydraulic diagrams of technological equipment</i>	2*
2*	<i>Parametric calculations of a hydraulic press for the manufacture of a packaging polymer product</i>	2*
3	<i>Study of the manufacturability of a plastic packaging product or technical work</i>	2
4	<i>Technical description of a polymer packaging product according to an individual task. Sketch.</i>	4
5	<i>Selection of the type and size of technological equipment for the manufacture of packaging products by injection molding</i>	2
6	<i>Calculation of the number of sockets in the mold for the manufacture of a packaging product by injection molding</i>	2
7	<i>Calculation of the elements of the casting system</i>	2
8*	<i>Influence of Casting Process Factors on the Quality of Packaging Polymer Product</i>	2*
9*	<i>Parametric calculation of the geometry of the extruder worm</i>	2*
10*	<i>Calculation of working bodies of technological equipment for strength and rigidity</i>	2
11	<i>FDM</i>	2
12	<i>Test/test</i>	2
	<i>Just</i>	18

** - optional, or optional*

Laboratory classes (18 hours)

The purpose of laboratory work is to improve knowledge and provide skills and abilities in the study of the design and kinematics of technological equipment for the manufacture of packaging products, features of technological processes, etc.

Each laboratory work is designed for 2 classroom hours (taking into account the time for admission to work on laboratory stands and defense of worked and calculated work). The first lesson is introductory, mandatory instruction on safety rules and rules of conduct when working in the laboratory.

No. s/p	Job Title	Number of classroom hours
1	<i>Introduction. Safety precautions. Introductory provisions.</i>	2
2	<i>Study of highly elastic deformations of elastomers</i>	2
3	<i>Study of the design, cyclogram of operation and main parameters of the frame hydraulic press</i>	2

4	<i>Study of design and energy-force parameters of rollers for polymer processing</i>	2
5	<i>Study of the design and kinematics of the worm machine</i>	2
6	<i>Study of the design, kinematics and hydraulic drive of the injection molding machine</i>	2
7	<i>Study of the Cyclogram of Injection Molding Machine Operation</i>	2
8	<i>Study of the design and kinematics of the calender</i>	2
9	<i>Study of the hardness of polymeric materials by the Shore method</i>	2
Total hours		18

Under the condition of mixed or distance synchronous/asynchronous learning technology, as part of the study of the material for the laboratory workshop, it is recommended to perform tasks in an adapted form using the Sikorsky platform. Current control can be carried out through a survey in the classroom or testing.

6. Independent work of a student

Independent work of students takes up to 40% of the time of studying the educational component. The main task of students' independent work is to master the issues that are not included in the list of lectures, through personal search for information, the formation of an active interest in a creative approach in educational work. educational literature, learns to use certificate distance courses.

No. s/p	Name of the topic submitted for independent study	Number of CPC hours
<i>Topic 1. Polymeric materials in packaging</i>		
1	<i>Examples of polymer packaging using various polymeric materials.</i>	4
<i>Topic 2. Technological properties of polymer packaging materials</i>		
2	<i>Thermophysical properties of polymer packaging materials. Viscosity of suspensions of melts of polymeric raw materials. Adhesion properties. Equation of state.</i>	2
<i>Topic 3. Press equipment</i>		
3	<i>Parameters of the pressing process, which are determined by the configuration of the product and the dimensions of the mold. Specific material intensity. Specific energy intensity. Heating plates.</i>	4
<i>Topic 4. Roller equipment</i>		
4	<i>Beds. Auxiliary devices: arrows and knives</i>	2
<i>Topic 5. Extrusion equipment</i>		
5	<i>Danger when working on worm machines. Production of granules, profiles, pipes, sheets, film.</i>	4
6	<i>Preparation for the MCR</i>	4
<i>Topic 6. Polymer injection molding, pneumatic, vacuum, rotary and centrifugal molding equipment</i>		
7	<i>Materials for injection molding packaging. Hydroforming. Obtaining PET containers. Rotational molding.</i>	4
<i>Topic 7. Disposal of waste polymers</i>		
8	<i>Materials that self-destruct. Recycling of raw materials.</i>	4
9	<i>Preparation and revision of calculations, reports, descriptions</i>	4
10	<i>OCD</i>	10
11	<i>Preparation for the test</i>	6
Total hours		48

You can independently complete the program of distance courses (Information resources on the Internet [6 – 8]).

Policy and control

7. Policy of the educational component (educational component)

Rules for attending classes and behavior in the classroom

Attendance at classes is a mandatory component of assessment. Bachelors 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 not related to the educational process. The grade for the exam cannot be obtained (put on the list) without the student personally attending the exam according to the schedule.

Rules for assigning incentive and penalty points

Incentive points can be awarded by the teacher only for the performance of creative (optional) work on the educational component.

Additional points (awarded individually) can be obtained by additional completion of on-line specialized courses with the receipt of the appropriate certificate:

7. https://www.udemy.com/course/learn-and-build-using-polymer/?gclid=Cj0KCQjwxdsHBhCdARIsAG6zhIXLj29c-OWbswHxwYPtwhpH3QG5CnZQXqv0sm30czfVrBr_kcP_SOgaAjtZEALw_wcB&matchtype=b&utm_campaign=LongTail_Ia.EN_cc.ROW&utm_content=deal4584&utm_medium=udemyads&utm_source=adwords&utm_term=.ag_78754142133.ad_386748065892.kw_%2Bpolymer+%2Bcourse.de_c.dm_pl.ti_kwd-840344562152.li_9061016.pd
8. <https://packagingschool.com/courses-polymers-in-packaging-101/>
9. <https://www.iopp.org/i4a/pages/index.cfm?pageid=4522>
10. <https://www.open.edu/openlearn/science-maths-technology/science/chemistry/introduction-polymers/content-section-1.1>
11. <https://sustainablepackaging.org/projects/esp/>
12. <https://www.polymercourses.com/our-courses/sustainability/designing-plastic-packaging/>

Other distance courses must be agreed with the teacher

Penalty points within the educational component can be received for late completion or defense of laboratory work.

Deadline and retake policy

In case of debts from the educational component or any force majeure circumstances, bachelors must contact the teacher through the available (provided by the teacher) communication channels to solve problematic issues and agree on an algorithm of actions for working out.

Academic Integrity Policy

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the absence of references when using printed and electronic materials, quotes, opinions of other authors. All tasks designed for individual performance must be performed personally by the student. Hints and cheating during writing tests, control, conducting classes are unacceptable; defense of laboratory work, passing the exam for another student; copying materials protected by the copyright system without the permission of the author of the work.

The policy and principles of academic integrity are defined in 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>

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>

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:

Semester	Study time		Distribution of training hours				Control measures		
	Loans	Acad. H.	Lecture	Practical	Lab. Rob.	SRS	FDM	OCD	Semester control
3	4	120	36	18	18	48	1	1	Passed

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

- Or for completing tasks from the laboratory workshop, tasks from practice, R&D and ICR (ICR can be carried out in the form of open tasks, surveys in classes, or tests (on the Sikorsky platform). Rating points received during the semester.
- Either for a test work (can be carried out in the form of open tasks, or in the form of tests on the Sikorsky platform); The test is carried out in the case when the student wants to increase the grade, or the semester rating is insufficient – in this case, the points of the semester rating are canceled.
- as well as (at the request of the student) for independent completion of alternative distance courses.

Semester control is a test.

System of rating (weight) points and evaluation criteria

1. Work in laboratory classes.

Weight score – 5. The maximum number of points for all laboratory work is: 5 points x 8 works = 40 points.

Criteria for assessing students' knowledge

Mark	Completeness of the answer
5	Timely full completion of the task, all calculations, schemes, tables, design and protection
4... 3	Minor shortcomings of calculations and registration
2... 1	Untimely completion of the task; deficiencies in calculations and registration or untimely protection
0	Failure to complete the task

2. Completing practice tasks.

Weight score – 5. The maximum number of points for all practical work is: 5 points x 6 lessons (classes on MCR, performance of OCD and test are not taken into account) = 30 points.

3. Tests.

Weight score – 15. Criteria for evaluating tests

Mark	Completeness of the answer
13- 15	Full Answer
10- 12	Full answer, but there was a clarifying question
5- 9	The answer does not contain secondary or dependent on the main parameters (materials)
3- 4	The answer does not include half of the main and a few minor parameters or materials

Up to 2	The answer is superficial without analysis of parameters, conditions, materials, incomplete conclusions
0	Test work not counted

4. Implementation of the RWD

Weight score – 15. The maximum number of points is: 15 points x 1 OCD = 15 points.

Criteria for evaluating OCD

Mark	Evaluation criteria
15	The work was done in a timely manner, without errors, well designed
14...12	The work was done in a timely manner, there are minor shortcomings in calculations and registration
11... 6	The work was not done on time, there are minor shortcomings in calculations and registration
5... 1	Significant shortcomings in calculations and registration
0	Work not counted

Penalty and incentive points:

1. for each hint (use of a hint) during control measures -1 point
2. for each use of a textbook, synopsis, etc. during control measures -2 points
3. systematic absences of the lecture course (-1...-5) points (unless prohibited by the Regulations on the organization of the educational process)
4. modernization of the laboratory base (+2...+5) points
5. Development of the didactic material of the course (+2...+5) points
6. participation in conferences (+5...+20) points
7. performing additional or optional tasks (according to the relevant criteria)

At the first attestation, the student receives "enrolled" if his current rating is at least half of the maximum possible at the time of the first attestation.

At the second attestation, a student receives "enrolled" if his current rating is at least half of the maximum possible at the time of the second attestation.

The maximum amount of points is 100. To receive credit from the credit module "automatically", you need to have a rating of at least 60 points.

Calculation of the rating scale: $R = R_{lab.} + R_{prakt} + R_{KR} + R_{DKR} = 40 + 30 + 15 + 15 = 100$ points.

Students who have a rating of less than 60 points at the end of the semester, as well as those who want to increase their grade, perform a test test. In this case, there are points for RWD, to which points for the test work are added. The rating scale for the educational component in this case is: $R = R_{RKR} + R_{hall.} = 15 + 85 = 100$ points

The task of the test consists of 4 questions from different sections of the program. Each question of the test is evaluated in (21... 22) points in accordance with the grading system:

Mark	Completeness of the answer
21..22	Full Answer
20	Full answer, but with a clarifying question
19... 15	Full answer, but there were minor inaccuracies (at least 90% of the information needed)
14...10	The answer does not contain secondary or dependent on the main parameters (materials) (at least 75% of the required information or minor inaccuracies)
9...5	The answer to the question does not provide half of the main and a few minor parameters or materials
4...1	The answer is superficial without analyzing parameters, conditions, materials, incomplete conclusions, requires additional questions
0	No answer provided

For independent completion of alternative distance courses and providing a certificate, up to 100 points are awarded. The total number of points from the educational component cannot exceed 100 points.

To obtain a score, the sum of all received rating points **R** is converted according to the table:

Score	Score
95...100	Perfectly
85...94	Very good
75...84	well
65...74	Satisfactory
60...64	enough
RD < 60	Disappointing
Not met the conditions of admission	not allowed

9. Additional information on the educational component

<https://cpsm.kpi.ua/>

Approximate list of questions that can be submitted to the ICR and to the test

1. Describe the properties that distinguish polymers from low molecular weight compounds
2. To provide a range of industrial (packaging) products made of polymers
3. Define it: macromolecule, chain; Fundamentals of polymer classification
4. Define SMR and give examples
5. Definition Dates: Macromolecule Configuration
6. Definitions: Conformation of macromolecules
7. Definition Dates: Supramolecular Structures
8. Polymeric materials in packaging: give properties, uses, processing methods, features. PE, PP, PS, PETF, PVC, PA, PC, F4
9. Determine what artificial and synthetic fibers are. Give examples and names of trademarks
10. Definitions: powder, granules, flowability, natural slope angle, collapse angle, caking
11. Define volumetric characteristics: bulk density and specific volume, density and specific volume of shaking
12. Describe the frictional properties of raw materials: lateral pressure coefficient, friction coefficient
13. Describe the thermophysical properties of polymeric raw materials
14. To give characteristics of the physical state of polymers. Compare with the physical and phase state
15. Give a thermomechanical curve of polymers and perform its analysis using the examples of crystalline and amorphous polymer
16. Describe the process of polymer destruction and give factors
17. Features of rubber processing: reveal the essence of vulcanization and reversion processes
18. To establish and apply the temperature and time dependence in the processing of polymer raw materials into products
19. Determine the physical essence of the process of shrinking polymers, give examples of heat-shrinking packaging
20. Rheological properties of polymers: to give the main rheological models of bodies
21. Rheological properties of polymers: what viscosity laws are used for calculations of technological processes?
22. Rheological properties: what are flow curves and how are they used?
23. To give the rheological properties of compositions based on oligomeric binders
24. Give dependencies for calculating the viscosity of suspensions
25. Adhesive properties
26. Equation of state
27. Describe the essence of the pressing method
28. Analyze the processes that occur in the mold, cyclogram
29. Draw a diagram of the general structure and describe the operation of the press
30. How are pressing forces calculated?
31. Analyze the parameters that are determined by the configuration of the product and the dimensions of the mold
32. Give a definition, chart and perform analysis: specific material intensity of the press
33. Give a definition, chart and perform analysis: specific energy intensity of the press
34. Describe the main parameters of the press. Give an example of the technical characteristics of the press
35. Describe the design of the bed and press plate
36. Describe the types and design of hydraulic cylinders
37. Describe the design of plungers
38. Describe the types and design of seals of movable and fixed joints
39. What are pressure accumulators? How do you calculate the capacity of a press pump?

40. Describe the design of heating plates
41. Describe the principle of operation of rollers
42. Give a list of operations performed on rollers
43. Provide a list of operations performed on calenders
44. Give the classification and parameters of roller machines
45. Analyze the processes that occur in the swath gap: the field of velocities and pressures, the thickness of the sheet and the performance of the roller pair, the spreading force, the torque on the roll and the power of the roll drive, the viscosity of the material in the gap
46. Describe the design: rolls, roll bearings
47. Give a diagram and describe the operation of the mechanism for adjusting the inter-shaft gap
48. Methods of compensation for roll deflection – give diagrams and perform analysis
49. Give a diagram and describe the operation of the roll drive
50. Where and what kind of safety and emergency devices are used in roller equipment?
51. Describe the design of the roll machine bed.
52. Where and how are auxiliary devices used: arrows and knives?
53. Give a range of products that are made using worm extruders
54. Make a schematic image, describe the general design of worm extruders
55. Give the principles of classification of extruders and provide examples
56. Provide kinematic diagrams of extruder layout options and analyze the disadvantages and advantages
57. Worm design: make a sketch and indicate the design features of its zones
58. Special areas of extruders: give examples of design and features of use
59. Depict the graphical dependence of the pressure distribution along the length of the extruder and perform its analysis
60. Combined and cascade extruders: : make diagrams and indicate design features
61. To indicate the hazards when working on worm machines and the precautions used
62. Give an algorithm for calculating (calculate) the geometry of the worm
63. Give an algorithm for determining the geometric coefficient of the head (perform the calculation)
64. Give an algorithm for determining the productivity of the machine (perform the calculation)
65. Give an algorithm for determining the pressure drop in the head (perform the calculation)
66. Give an algorithm for determining the power of the drive motor (perform the calculation)
67. Describe the technology for obtaining granules, profiles, pipes, sheets, films
68. Injection pressing: provide a definition and characterization of the method
69. Injection pressing: give a typical cyclogram of work
70. Injection pressing: depict the scheme for obtaining the product and perform a description of the work
71. What equipment is used for injection molding?
72. To depict the kinematic diagram of the injection molding machine and describe its operation
73. To depict the hydraulic diagram of the injection molding machine and describe its operation
74. To give a classification and main technical characteristics of injection molding machines
75. Make a schematic representation and describe the operation of a vertical injection molding machine
76. List and characterize the most common materials for injection molding packaging
77. To characterize the essence of the method of pneumatic vacuum forming and the resulting packaging products
78. To characterize the essence of the hydroforming method and the resulting packaging products
79. To characterize the essence of the method and the resulting packaging products: blow molding – extrusion method
80. To characterize the essence of the method and the resulting packaging products: blow molding – injection molding method
81. Describe the technological process of obtaining PET containers
82. To characterize the essence of the method and the resulting packaging products: rotary molding
83. To provide and analyze methods for the disposal of polymer packaging materials
84. To analyze the causes and methods of minimizing waste in the production of packaging products
85. Describe technological operations in the disposal of waste from the production of packaging products
86. Describe technological operations in waste disposal when using packaging products
87. Analyze the causes and methods of minimizing waste when using packaging products
88. Provide technologies for obtaining materials that self-destruct
89. To depict technological schemes for the processing of polymer waste

Work program of the educational component (syllabus):

Compiled by Assoc. Prof., Ph.D., Sidorov D.E.

Approved by the Department of KPSM (Minutes No. 17 of 04.06.2025)

Approved by the ICF Methodological Commission (Minutes No. 11 dated 27.06.2025)

