



Packaging Equipment

Work program of the educational component (Syllabus)

Details of the educational component

Higher education level	Second (Master's)
Field of Knowledge	G Engineering, Manufacturing and Construction
Speciality	G9 Applied Mechanics
Educational program	OPP Packaging and Packaging Equipment Engineering
Status of the educational component	Custom
Form of study	full-time (full-time)
Year of preparation, semester	1st year, spring semester
Scope of the educational component	5(150)
Semester control / control measures	Exam
Class schedule	3 hours per week (2 hours of lectures and 1 hour of practical classes)
Language of instruction	Ukrainian
Information about the course leader / teachers	Lecturer: Prof., Doctor of Technical Sciences, Sokolsky Oleksandr, https://cpsm.kpi.ua/sokolskij-oleksandr-leonidovich.html?tmpl=component Practical/Seminar: Prof., Doctor of Technical Sciences, Sokolsky Oleksandr, https://cpsm.kpi.ua/sokolskij-oleksandr-leonidovich.html?tmpl=component
Course placement	Sikorsky Platform

Program of the educational component

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

The syllabus "Packaging Equipment" is compiled in accordance with the educational and professional program for training masters of the specialty G9 - Applied Mechanics according to the educational program "Engineering of Packaging and Packaging Equipment".

The educational component belongs to the cycle of professional training.

The subject of the educational component is the development of packaging equipment, equipment of packaging lines, packaging materials and packaging process technology.

The purpose of the educational component "Packaging Equipment"

The purpose of the educational component is to strengthen the process of forming a complex of knowledge by students regarding the design features and methods of calculating packaging equipment for group, transport packaging and robotic systems.

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

Integral competence:

- Ability to solve complex problems and problems in applied mechanics or in the process of learning, which involves research on processes, equipment and/or innovations in this field and is characterized by uncertainty of conditions and requirements.

And:

- Ability to identify, pose and solve engineering-technical and scientific-applied problems (GC 01);
- Ability to describe, classify and model a wide range of technical objects and processes, based on a deep knowledge and understanding of the theories and practices of mechanical engineering, as well as knowledge of related sciences (FC 02).
- Ability to apply appropriate methods and resources of modern engineering to find optimal solutions to a wide range of engineering problems using modern approaches, forecasting methods, information technologies and taking into account existing limitations under conditions of incomplete information and contradictory requirements (FC 01).

According to the requirements of the program of the educational component **"Packaging Equipment"**, students after mastering it must demonstrate the following program learning outcomes:

- Apply specialized conceptual knowledge of the latest methods and techniques of design, analysis and research of structures, machines and/or processes in the field of mechanical engineering and related fields of knowledge (PRN 01).
- To develop and put into production new types of products, in particular, to carry out research and development work and/or to develop technological support for the process of their manufacture (PRN 02).
- Knowledge of packaging processes and general principles of packaging line design (PRN 12)

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)

This educational component is an applied development of theoretical courses taught to students: "Materials Science", "Resistance of Materials", "Technology of Mechanical Engineering", "Organization and Planning of Production", "Fundamentals of Operation and Repair of Technological Equipment".

The knowledge, skills and abilities acquired during the study of the educational component provide the study of the educational components "Packaging Equipment Engineering" and the diploma design of the future master's degree.

3. Content of the educational component

The main functions of packaging equipment are in manufacturing and industry. Classification of packaging equipment. Basic concepts and terminology adopted by DSTU for packaging processes, equipment. Status and prospects for the development of packaging equipment. General characteristics of consumer containers and auxiliary packaging products. Classification of equipment for packaging products in consumer containers. Analysis of the main and auxiliary packaging operations. General characteristics of the main and auxiliary technological operations of packaging products in transport containers. Typical design diagrams of equipment for packaging products in transport containers. Methods of group packaging. Classification of equipment for group packaging, typical design schemes. Typical design diagrams of equipment for forming and fastening transport packages. Equipment and machines for dismantling transport packages with group packages, transport containers and consumer containers. Typical design schemes of robots and manipulators for the formation of group packages and transport packages.

4. Training materials and resources

1. Kovalenko I.V. Packaging equipment. Lecture Notes: Teaching. Manual. – Kyiv: 2014. –210 p. (in Russian).
2. Gavva O.M., Bepalko A.P. Packaging equipment. - Kyiv: Upakovka, 2008.
3. Storozko I.I., Gavva O.M., Bepalko A.P., Volchko A.I. Terminological reference book of the packer. - Kyiv: IAC "Upakovka", 1999. - 80 p. (in Russian).

4. Kodra Yu.V., Stotsko Z.A., Gavrilchenko O.V. Loading devices of technological machines. Calculation and design: Teaching. Pic. – Lviv: "Beskyd Bit", 2008. – 356 p. (in Russian).
5. Polymer packaging: monograph / V.L. Shroeder, V.M. Krivoshey, N.V. Kulyk. – Kyiv: IAC "Upakovka", 2021. – 580 p. (in Russian).

Information resources on the Internet

1. Electronic archive of KPI
2. Website of the Department of Chemical Engineering, <http://cpsm.kpi.ua/mr.html>
3. Electronic campus of KPI. Igor Sikorsky, <http://login.kpi.ua/>
4. Sikorsky distance learning platform <https://sikorsky-distance.kpi.ua/>
5. It is possible to conduct On-line classes using the Zoom platform.
6. Packers Club of Ukraine - <http://www.upakjour.com.ua/klub-pakuvalnik%D1%96v/>
7. IAC "Packaging" - <http://www.packinfo.com.ua/>

Educational content

5. Methods of mastering the educational component

Lectures

Lectures are aimed at:

- providing modern, holistic, interdependent knowledge on the educational component "Packaging Equipment", the level of which is determined by the target setting for each specific topic;
- ensuring the creative work of applicants together with the teacher during the lecture;
- education of professional and business qualities in applicants and the development of independent creative thinking in them;
- formation of the necessary interest in applicants and providing direction for independent work;
- determination at the current level of development of science in the field of modern methods and processes of packaging, forecasting of development for the coming years;
- 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;
- presentation of research materials in a clear and high-quality language in compliance with structural and logical connections, explanation of all newly introduced terms and concepts;
- accessibility for perception by this audience.

No. s/p	Title of the topic of the lecture and a list of main questions (list of didactic tools, references to literature and tasks on the SRS)	Hours
1	Introduction. Equipment for packing products in transport containers. The main functions of packaging equipment in production and industry. Classification of packaging equipment. General characteristics of the main and auxiliary technological operations of packaging products in transport containers. References: [bases 1-5]. Tasks on the CPC: Typical design diagrams of equipment for packaging liquid, viscous and plastic products in transport containers. References: [bases 1-5].	2
2	Equipment for group packaging. Methods of group packaging. Classification of equipment for group packaging. Classification and analysis of technological schemes and modern equipment for stacking rigid and semi-rigid consumer containers with products in transport. Classification and design diagrams of devices and machines for forming, positioning and fastening transport	4

	containers. Basic layout schemes of flow lines for group packaging of products in transport containers. References: [bases 1-5]. Tasks on the CPC: Typical design diagrams of equipment for stacking soft packages with products in transport containers. References: [bases 2, 5].	
3	Equipment for forming, fastening transport packages and their dismantling. Classification of equipment for the formation of packages. Methods of fastening transport packages. References: [bases 1-5].	2
4	Fastening of bags with tensile and heat-shrinkable polymer films, tapes. Equipment classification. Typical design diagrams of equipment. Equipment for heat treatment of heat-shrinking film. References: [bases 1-5]. Tasks on the SRS: Typical design diagrams of devices and machines for fastening packages with metal and polymer tape. References: [bases 1, 2, 5].	4
5	Equipment for packaging products in containers. Technological processes of packing bulk, liquid products in special containers (soft, hard). References: [bases 1-5]. Tasks on the CPC: Technological processes of packaging bulk, liquid products in universal containers. References: [bases 1-5].	4
6	Typical design diagrams of devices and machines for stacking glass bottles, cans in transport containers: pneumatic, vacuum and electromagnetic gripping devices. References: [bases 1-5].	4
7	Flow lines for forming and fastening transport packages. Layout schemes of lines. References: [bases 1-5].	2
8	Equipment for transshipment, orientation of transport packages and formation of ledges. References: [bases 1-5].	2
9	Robots and manipulators in the packaging industry. General information. Classification. Packaging of small-piece and piece products. References: [bases 1-5]. Tasks on CPS: Typical design schemes of robots and manipulators for the formation of group packages and transport packages. References: [bases 1-5].	4
10	MCW	2
	Just	30

Practical classes

In the system of professional training of applicants for this educational component, practical classes occupy 32% of the classroom load. As a supplement to the lecture course, they lay and form the foundations of a master's qualification in packaging. The content of these classes and the methodology of their conduct should ensure the development of creative activity of the individual. They develop scientific thinking and the ability to use special terminology, allow you to test knowledge, therefore, this type of work acts as an important means of prompt feedback. Practical classes should perform not only cognitive

and educational functions, but also contribute to the growth of applicants as creative workers in the field of machines and packaging technology.

The main tasks of the cycle of practical classes:

- to help applicants systematize, consolidate and deepen theoretical knowledge in the field of modern methods and technologies of packaging;
- to teach applicants techniques for solving practical problems, to promote the acquisition of skills and abilities in performing calculations, graphic and other tasks;
- to teach them to work with technical and reference literature and diagrams.

No. s/p	Title of the topic of the practical lesson and a list of main questions (list of didactic support, references to literature and tasks on the SRS)	Hours
1	Calculation of the volumetric dosing process on a semi-automatic packaging. References: [bases 1, 4]. Tasks on the SRS: performing calculations according to an individual task.	2
2	Calculation of the weight dosing process on a semi-automatic packaging. References: [bases 1, 4]. Tasks on the SRS: performing calculations according to an individual task.	2
3	Calculation of the process of weight dosing of viscous products with a worm dispenser. References: [bases 1, 4]. Tasks on the SRS: performing calculations according to an individual task.	2
4	Calculation of dosage error References: [bases 1, 4]. Tasks on the SRS: performing calculations according to an individual task.	2
5	Kinematic calculation of a liquid dispenser References: [bases 1, 4]. Tasks on the SRS: performing calculations according to an individual task.	2
6	Determination of Liquid Filling Time of Bottles in Gravitational Filling References: [bases 1, 4]. Tasks on the SRS: performing calculations according to an individual task.	2
7	Calculation of the performance and throughput of the dosing head. References: [bases 1, 4]. Tasks on the SRS: performing calculations according to an individual task.	2
	Just	14

6. Independent work of a student/postgraduate student

Independent work takes 70% of the time to study the educational component, including preparation for the exam. The main task of independent work of applicants is to master scientific 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 framework of the educational component, the applicant must learn to deeply analyze modern approaches to the development and implementation of the latest packaging technologies, based on the characteristics of water and the requirements for the quality of packaged products. He must be able to create the most effective methods and means of packaging.

No. s/p	Name of the topic submitted for independent study	Number of CPC hours
1	Introduction. Tasks on the SRC: Basic concepts and terminology adopted by DSTU for packaging processes, equipment.	10

	<i>References: [bases 1, 5].</i>	
2	Equipment for packing products in transport containers. <i>Tasks on the CPC: Typical design diagrams of equipment for packaging liquid, viscous and plastic products in transport containers.</i> <i>References: [bases 1, 5].</i>	10
3	Equipment for group packaging. <i>Tasks on the CPS: Typical design diagrams of devices for performing basic operations in the process of group packaging in transport containers: formation of a row, layer, foot and capture devices. Typical design diagrams of equipment for stacking soft packages with products in transport containers.</i> <i>References: [bases 1, 2, 5].</i>	10
4	Equipment for forming, fastening transport packages and their dismantling. <i>Tasks on the CPC: Typical design schemes of equipment for the formation of transport packages from consumer packages; from bags with bulk products; without pallets. Typical design diagrams of devices and machines for fastening bags with metal and polymer tape.</i> <i>References: [bases 1, 2, 5].</i>	10
5	Equipment for packaging products in containers. <i>Tasks on the CPC: Technological processes of packaging bulk, liquid products in universal containers.</i> <i>References: [bases 1, 2].</i>	16
6	Robots and manipulators in the packaging industry. <i>Tasks on CPS: Typical design schemes of robots and manipulators for the formation of group packages and transport packages.</i> <i>References: [bases 1, 2].</i>	16
7	<i>Preparation for the MCR</i>	4
8	<i>Exam preparation</i>	30
	Just	106

7. Individual lessons

Individual classes are not provided for by the working curriculum.

Policy and control

8. Educational Component Policy

Rules for attending classes and behavior in the classroom

Attendance at classes is a mandatory component of assessment. Applicants 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.

Rules for assigning incentive and penalty points

Incentive points are not provided within the educational component

Penalty points (1 for each) are issued for untimely (later than before the nearest calendar control) delivery of a practical task.

Deadline and retake policy

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

Academic Integrity Policy

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the absence of references when using printed and electronic materials, quotes, opinions of other authors. Hints and cheating are unacceptable when writing tests, conducting classes; passing the test for another applicant; 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

Applicants should be tolerant, respect the opinion of others, formulate objections in the correct form, and constructively support 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>

9. 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 curriculum:

Semester	Study time		Distribution of training hours				Control measures		
	Loans	Acad. H.	Lecture	Practical	Lab. Rob.	SRS	MCW	RR	Semester control
2	5	150	30	14	-	106	1	–	Exam

The student's rating in the educational component consists of the points that he receives for working in practical classes and writing the MCW and passing the exam.

Semester control is an exam.

System of rating (weight) points and evaluation criteria

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

- 1) performance and defense of 8 practical works;
- 2) performance of tasks at the MCW;
- 3) passing the exam.

System of rating (weight) points and evaluation criteria

1. Practical work

Each practical work is evaluated at 5 points:

The correctness of the calculations made is 3 points.

Preparation of the report and defense of the work: weight score - 2.

The maximum points are given subject to the timely defense of the work, a full response to the defense and impeccable execution.

- "excellent" – 5 points;
- "good" – 4 points;
- "satisfactory" – 3 points;
- "unsatisfactory" – 0 points

The maximum number of points for all tasks is 5 points x 8 tasks = 40 points.

2. Tasks on the modular test work

Each task is evaluated at 5 points:

- "excellent" – 5 points;
- "good" – 4 points;
- "satisfactory" – 3 points;
- "unsatisfactory" – 0 points

The maximum number of points for 2 tasks is 10 points.

Incentive points are not provided within the educational component

Penalty points (1 for each) are issued for untimely (later than before the nearest calendar control) delivery of a practical task.

Calculation of the rating scale (R):

The sum of the weight points of control measures during the semester is:

$$R_c = 40 + 10 = 50 \text{ points.}$$

The maximum amount of points is 100. The exam component $R_{instance}$ is 50 points.

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.

Thus, the rating scale from the educational component is:

$$R = R_c + R_{specimen} = 50 + 50 = 100 \text{ points}$$

Two questions are submitted for the exam in each ticket, each is valued at 25 points.

- "excellent" – 25-24 points;
- "good" – 23-20 points;
- "satisfactory" – 19-15 points;
- "unsatisfactory" – 0 points

The list of exam questions is given in Section 10.

To obtain the final grade, the sum of all rating points R received during the semester 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

10. Additional information on the educational component

Approximate list of tasks for the MCW

CONTROL TASK No. 1

1. To determine the general characteristics of consumer containers and auxiliary packaging means.
2. Draw typical design diagrams and classification of machines for banding cardboard boxes.

CONTROL TASK No. 2

1. To classify equipment for packaging products in consumer containers. Give an analysis of the main and auxiliary packaging operations.
2. To draw the main layout schemes of flow lines for group packaging of products in transport containers.

CONTROL TASK No. 3

1. To define the general concept of the operation of dosing products. Classification of dosing devices.
2. To provide typical design schemes and equipment for group packaging of products in wrapping paper and polymer film. Features.

CONTROL TASK No. 4

1. Describe the device for dosing bulk products. Dosage methods: accuracy. Classification of dosing devices. Features of volumetric and weight dosage. Typical design diagrams of devices for volumetric, weight and combined.
2. To provide a classification and analysis of technological schemes and modern equipment for stacking rigid and semi-rigid consumer containers with products in transport.

CONTROL TASK No. 5

1. Provide devices for dispensing liquid products. Classification of dosing devices and typical designs of barometric packaging devices by volume and level, vacuum packaging, suprabarometric packaging. Features of the design of devices for dosing liquid products into soft and semi-rigid consumer containers.
2. Draw typical design diagrams of devices and machines for stacking glass bottles, cans in transport containers: pneumatic, vacuum and electromagnetic gripping devices.

CONTROL TASK No. 6

1. To give a classification and typical design diagrams of devices for dosing viscous products.
2. To give a classification and design diagrams of devices and machines for the formation, positioning and fastening of transport containers. Typical design schemes of machines for forming cardboard boxes from a flat-folded workpiece.

CONTROL TASK No. 7

1. To provide a classification and typical design schemes of devices for dosing plastic products into consumer containers. Features of the execution of dosing devices for vacuum, aseptic and packaging in a modified gas environment.
2. Draw typical design diagrams of equipment for packaging liquid, viscous and plastic products in transport containers.

CONTROL TASK No. 8

1. To characterize devices for performing auxiliary operations of packing products in consumer containers. Typical design schemes for the formation of consumer containers.
2. To provide a classification and analysis of technological schemes and modern equipment for stacking rigid and semi-rigid consumer containers with products in transport.

CONTROL TASK No. 9

1. To give a classification and typical design diagrams of devices and machines for capping glass, polymer and metal consumer containers.

2. Draw typical design schemes for performing basic operations in the process of group packaging in transport containers: formation of a row, layer, stack and gripping devices.

CONTROL TASK No. 10

1. To provide a classification and typical design diagrams of devices and machines for labeling and labeling consumer containers.
2. To give a classification and design diagrams of devices and machines for the formation, positioning and fastening of transport containers. Typical design schemes of machines for forming cardboard boxes from a flat-folded workpiece.

CONTROL TASK No. 11

1. To give a classification and typical design schemes of machines for packaging piece and small-piece products.
2. Draw typical design diagrams of devices and machines for stacking glass bottles, cans in transport containers: pneumatic, vacuum and electromagnetic gripping devices.

CONTROL TASK No. 12

1. To give layout and design diagrams of machines and lines for packaging products in consumer containers. Advantages and disadvantages. Field of application.
2. Draw typical design diagrams of equipment for stacking soft packages with products in transport containers.

CONTROL TASK No. 13

1. To give a general description of the main and auxiliary technological operations of packaging products in transport containers. Typical design diagrams of equipment for packing bulk products in soft and semi-rigid transport containers.
2. To classify equipment for packaging products in consumer containers. Analysis of the main and auxiliary packaging operations

CONTROL TASK No. 14

1. Draw typical design diagrams of equipment for packaging liquid, viscous and plastic products in transport containers.
2. To give a classification and typical design schemes of devices for dosing viscous products.

CONTROL TASK No. 15

1. To characterize the methods of group packaging. Classification of equipment for group packaging.
2. To give a classification and typical design schemes of machines for packaging piece and small-piece products.

List of exam tasks

EXAM TICKET No. 1

1. To give typical design diagrams of devices for the formation of consumer containers.
2. Give ways to fasten transport packages. Typical design diagrams of devices and machines for fastening packages with polymer tape.

EXAM TICKET No. 2

1. To give a classification and typical design diagrams of devices and machines for capping glass, polymer and metal consumer containers.
2. How is the bags fastened with a stretch polymer film? Equipment classification. Typical design diagrams of machines and equipment.

EXAM TICKET No. 3

1. To provide a classification and typical design schemes of devices and machines for labeling and labeling consumer containers.
2. How is the bags fastened with shrink polymer film? Equipment classification. Typical design diagrams of machines and equipment.

EXAM TICKET No. 4

1. What is the heat shrink film heat treatment equipment?
2. To give a classification and typical design schemes of machines for packaging piece and small-piece products.

EXAM TICKET No. 5

1. To give layout and design diagrams of machines for packaging products in consumer containers. Advantages and disadvantages. Field of application.
2. What equipment exists for transshipment, orientation of transport packages?

EXAM TICKET No. 6

1. To give layout and design diagrams of lines for packaging products in consumer containers. Advantages and disadvantages. Field of application.
2. What equipment is there for the formation of ledges?

EXAM TICKET No. 7

1. To give a general description of the main and auxiliary technological operations of packaging products in transport containers.
2. What are the flow lines for forming and fastening transport packages? Classification.

EXAM TICKET No. 8

1. To give typical design diagrams of equipment for packaging bulk products in soft and semi-rigid transport containers.

2. What are the flow lines for forming and fastening transport packages? Layout schemes of lines. Advantages and disadvantages.

EXAM TICKET No. 9

1. Give typical design diagrams of equipment for packaging liquid, viscous products in transport containers.
2. What equipment and machines exist for dismantling transport packages with bulk packs?

EXAM TICKET No. 10

1. To give typical design diagrams of equipment for packaging plastic products in transport containers.
2. What equipment and machines exist for dismantling transport packages with transport and consumer containers?

EXAM TICKET No. 11

1. What are the methods of group packing?
2. To characterize the technological processes of packaging bulk, liquid products in special containers (soft, hard).

EXAM TICKET No. 12

1. Give a classification of equipment for group packaging.
2. To characterize the technological processes of packaging bulk, liquid products in special containers (soft, hard).

EXAM TICKET No. 13

1. To classify and analyze technological schemes and modern equipment for stacking rigid consumer containers with products in transport.
2. How is the packaging of small-piece products performed? General information. Classification.

EXAM TICKET No. 14

1. What are the ways to improve packaging equipment? Cost-effectiveness from the introduction of packaging equipment.
2. How is the packaging of piece products performed? General information. Classification.

EXAM TICKET No. 15

1. To give typical design schemes for performing the main operations in the process of group packaging in transport containers: the formation of a row, a layer.
2. Give typical design diagrams of robots and manipulators for the formation of group packages and transport packages.

Work program of the educational component (syllabus):

Compiled by Assoc. Prof., Doctor of Technical Sciences, Sokolsky O.L.

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