



Forming Tool

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	G11 Mechanical Engineering
Educational program	OPP Engineering of Innovative Industry Equipment
Status of the educational component	Custom
Form of study	Full-time (daytime)
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 (1 hour of lectures and 2 hours 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 "Formative Tool" is compiled in accordance with the educational and scientific program for training masters of the specialty G11 Mechanical Engineering under the educational program "Engineering of Innovative Industry Equipment".

The educational component belongs to the cycle of professional and practical training (selective educational components).

The subject of the educational component is the forming equipment for the manufacture of packaging products, its design and calculations.

The purpose of the educational component "Formative tool"

The purpose of the educational component is to provide applicants with knowledge about the design features of forming equipment for the manufacture of polymer products.

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 the field of mechanical engineering, which involves conducting research on processes, equipment and/or innovations in this field and is characterized by uncertainty of conditions and requirements.

- Ability to learn and master modern knowledge (GC 02);

- Ability to generate new ideas (creativity) (GC 06);
- Ability to identify, ask and solve problems (GC 07).
- Ability to create new equipment and technologies in the field of mechanical engineering, protect intellectual property (SC 03);

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

knowledge:

- Knowledge and understanding of the principles of technological, fundamental and engineering sciences that underlie the branch mechanical engineering of the relevant industry (PRN 01);
- Knowledge and understanding of mechanics and mechanical engineering and prospects for their development (PRN 02).

Skill:

- Carry out engineering calculations to solve complex problems and practical problems in industrial engineering (PRN 04);
- Prepare, manufacture and operate equipment and products of industrial engineering during the life cycle (PRN 07).

Also, the study of the educational component "Formative Tool" will also allow students to strengthen the ability to perform research using modern design systems, including computational, to process and analyze the results obtained.

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)

Interdisciplinary relations: the educational component "Forming Tool" is preceded by educational components, such as: "Physics", "Materials Science", "Resistance of Materials", "Design Design of Equipment", "Engineering of Innovative Technologies and Equipment".

3. Content of the educational component

Classification of the forming tool. Methodological foundations of the design of the forming tool.

Design and calculation of formatting elements of molds for pressing. Design and calculation of centering, moving, ejection and fastening systems. Design and calculation of mold heating systems.

Design and calculation of injection molds. Classification, design features and principle of operation. Design and calculation of design elements and spout systems. Design and calculation of auxiliary mold systems. Design and calculation of mold temperature control systems.

Design and calculation of extrusion heads. Classification and design principles of extrusion heads. Design of ring heads. Design of profile heads. Filters, calibration devices. Calculations of head elements.

Design and calculation of molds for blow molding. Classification, design features and principle of operation. Design and calculation of structural elements.

Design and calculation of a tool for pneumatic vacuum forming. Classification, design features and principle of operation. Design and calculation of structural elements.

4. Training materials and resources

Basic literature

1. Design of molding devices of equipment for processing plastics : [Electronic resource] : study. Manual. for applicants for a master's degree in education. programs "Engineering of Packaging and Packaging Equipment" special 131 "Applied Mechanics" and "Engineering and Computer-Integrated Technologies for the Design of Innovative Industry Equipment" special. 133 "Branch Engineering" / O. L. Sokolskyi, V. I. Sivetskyi, I. O. Mikulonok; KPI. Igor Sikorsky. – 2nd ed., reworked. and supplements. – Electronic text data. Kyiv: KPI. Igor Sikorsky, 2023. 159 c.

2. Sokolsky O.L., Sivetskyi V.I. Design and calculation of forming tools and equipment for processing plastics. Kyiv: SPD Sichkar, 2010. 104 p. (in Russian)

3. Mikulonok I.O., Sokolskyi O.L. *Polymeric materials and products from them (obtaining, processing, properties): terminological dictionary*. Kyiv: NTUU "KPI", 2015. 208 p. (stamp of NTUU "KPI").
4. *Equipment for processing composite materials by injection molding: Methodical instructions for laboratory work* / Sivetsky V.I., Sidorov D.E., Prystylelov S.O., Sokolsky O.L., Gladkyi V.M. Kyiv: IVC "Publishing House "Polytechnic", 2003.
5. *Design of Machines for Processing Polymers and Composite Materials* / Sivetsky V.I., Sidorov D.E., Nasonkin G.O., Shcherbyna V.Yu., Sokolsky O.L., Prystylelov S.O. Kyiv: IVC "Publishing House "Polytechnic", 2003.
6. *Design of molding devices of equipment for processing plastics: study. manual* / O.L. Sokolskyi, V.I. Sivetskyi, I.O. Mikulonok. Kyiv: NTUU "KPI", 2014. 130 c.

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, 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;

reflection of methodological processing of the material (highlighting the main ideas and provisions, emphasizing conclusions, repeating them in different formulations);

teaching in clear and clear language, explaining 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	Entry. Lecture 1. Classification of the forming tool. Methodological foundations of the design of the forming tool. Classification, design features and principle of operation of molds for pressing. References: [1-4].	2
2	Topic 1. Design and calculation of molds for pressing. Lecture 2. Design and calculation of the design elements of forms. Design and calculation of centering, moving, ejection and fastening systems. References: [1, 4, 6] Lecture 3. Design and calculation of mold heating systems. Design features and principle of operation of molds for injection molding.	4

	References: [1-4]. Tasks on CPS: Design features of modular forms. References: [1, 4].	
3	Topic 2. Design and calculation of injection molds. Lecture 4. Classification, design features and principle of operation. Design and calculation of design elements and sprue systems. References: [bases 1-4]. Lecture 5. Design and calculation of auxiliary mold systems. Design features of point, tunnel and hot channel sprue systems. Design and calculation of mold temperature control systems. References: [1-4]. Tasks on CPS: Design features and principle of operation of molds for threaded parts. Design features of plate-pushing molds. References: [2, 3].	4
4	Topic 3. Design and calculation of extrusion heads. Lecture 6. Classification and design principles of extrusion heads. Design of ring heads. References: [1, 3, 6]. Lecture 7. Design of flat-slot and profile heads. Calculations of head elements. References: [1, 3, 6]. Tasks on the SRS: Design features of heads with rotating elements. References: [1, 6].	4
5	Topic 4. Design and calculation of molds for blowing and pneumatic vacuum molding. Lecture 8. Classification, design features and principle of operation of molds for blow and pneumatic vacuum molding. Design and calculation of structural elements. References: [1, 3, 6]. Tasks on the SRS: Design features of auxiliary systems. Features of the manufacture of cooling systems. References: [1, 6].	2
	Just	16

Practical classes

The main purpose of practical classes in the educational component is to consolidate theoretical knowledge and form skills in the calculations of formative tools.

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	Practical lesson 1. Calculation of the mold matrix for rigidity. References: [1, 4]. Tasks on the SRS: performing calculations according to an individual task.	2
2	Practical lesson 2. Calculation of the mold heating system. References: [1, 4]. Tasks on the SRS: performing calculations according to an individual task.	2
3	Practical lesson 3. Calculation of the mold temperature control system. References: [1, 4]. Tasks on the SRS: performing calculations according to an individual task.	4
4	Practical lesson 4. Calculation of executive dimensions of the design elements of forms. References: [1, 4, 6]. Tasks on the SRS: performing calculations according to an individual task.	4
5	Colloquium on the delivery of practical papers	2

6	Practical lesson 5. Calculation of the sprue system. References: [1, 4, 6]. Tasks on the SRS: performing calculations according to an individual task.	4
7	Practical lesson 6. Calculation of ring head elements for strength and rigidity. References: [1, 6]. Tasks on the SRS: performing calculations according to an individual task.	2
8	Practical lesson 7. Hydraulic balancing of the channels of the profile extrusion head. References: [1, 6]. Tasks on the SRS: performing calculations according to an individual task.	2
9	Practical lesson 8. Simulation of polymer flow in the head channel. References: [1, 5, 6]. Tasks on the SRS: performing calculations according to an individual task.	4
10	Modular control work	2
11	Colloquium on the delivery of practical papers	2
	Just	30

6. Independent work of a student/postgraduate student

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. In the process of independent work within the framework of the educational component, the student must learn to deeply analyze the task and, based on the analysis of the information received, come to his own reasonable conclusions and draw up an abstract in accordance with the individual task.

No. s/p	Name of the topic submitted for independent study	Number of CPC hours
1	Topic 1. Design and calculation of molds for pressing. Tasks on CPS: Design features of modular forms. References: [1, 4]. Design features and principle of operation of molds for injection molding. References: [3, 1, 2].	16
2	Topic 2. Design and calculation of injection molds. Tasks on the CPC: Design features and the principle of operation of molds for threaded parts. References: [2, 3].	18
3	Topic 3. Design and calculation of extrusion heads. Tasks on the SRS: Design features of heads with rotating elements. References: [1, 4].	16
4	Topic 4. Design and calculation of molds for blowing and pneumatic vacuum molding. References: [1, 4]. Features of the manufacture of cooling systems. References: [1, 4].	18
5	Preparation for the MCW	4
6	Exam preparation	30
	Total hours	104

7. Individual lessons

Individual tasks are not provided for in the work curriculum.

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 (ALO)

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	Indus	SRS	MCW	RR	Semester control
2	5	150	16	30		104	1	–	Exam

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

Semester control is an exam.

System of rating (weight) points and evaluation criteria

The student's rating in the credit module consists of the points that he receives for:

- 1) *performance and defense of 8 practical works;*
- 2) *writing 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:

Preparation and execution of work: weight score – 3:

Impeccable design of work – 1 point;

The correctness of the calculations made is 2 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 practical tasks is 5 points x 8 tasks = 40 points.

2. Modular control work

Weight score – 10. The maximum number of points for the test is 5 points × 2 questions = 10 points.

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

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

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

Score 2 is given if 60% of questions are answered;

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

Incentive points are not provided 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.

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.

Semester control: exam.

A prerequisite for admission to the exam is a rating of at least 20 points. The weight score of the exam work is 50 points. The ticket contains two questions of 25 points each.

Criteria for evaluating the performance of the exam work

<i>Completeness and signs of task completion</i>	<i>Points</i>
<i>The work is done in full</i>	<i>25</i>
<i>Minor deficiencies in paragraph 1</i>	<i>24-22</i>
<i>Significant deficiencies in paragraph 1</i>	<i>21-19</i>
<i>Incomplete completion of the task</i>	<i>18-15</i>
<i>Failure to complete the task</i>	<i>0</i>

Thus, the rating semester scale from the educational component is:

$$R = 40 + 10 + 50 = 100 \text{ points}$$

To obtain the final grade, the sum of all rating points R received during the semester is converted according to the table:

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

10. Additional information on the educational component

List of issues at the MCW

1. To give a classification of the forming tool and factors taken into account when designing it
2. Classify and indicate the design features of molds
3. Specify the requirements for the manufacturability of plastic products
4. Indicate the design features of the forming signs
5. Specify the design features of mold ejection systems
6. Indicate the design features of the centering and lateral movement systems in the molds
7. Specify the design features of mold dies and punches
8. Specify the design features of mold forming sockets
9. Indicate the design features of mold heating systems and provide a method for their calculation
10. To give the basic principles of designing molds for LPT
11. Indicate the design features of the design details of the molds for LPT
12. Indicate the design features of the central and adjustable sprue channels
13. Specify the design features of the intake sprue channels
14. Specify the design features of point sprue systems
15. Indicate the design features of ventilation ducts in LPT molds
16. Give a classification of hot-runner forms. Indicate their advantages and disadvantages
17. Indicate the design features of ACS with external heating
18. Specify the design features of heat-insulated ACS
19. Specify the design features of the thermostating systems for LPT molds
20. Specify the design features of ACS nozzles
21. Specify the features of cold and hot granulation methods
22. Specify the design features of molds for blow molding
23. Give a classification of extrusion heads
24. List and characterize factors taken into account in the design of extrusion heads
25. To list and characterize the requirements for the manufacturability of plastic extrusion products
26. To give a classification and features of pneumatic vacuum forming methods
27. List and characterize the basic principles of extrusion head design
28. Specify the design features of the pipe heads
29. Specify the design features of direct-flow pelletizing heads
30. To list and characterize constructive means of preventing the formation of welding lines
31. Specify the principles of calculating the calibration tool
32. Specify the principles of approximate hydraulic calculation of extrusion heads
33. Specify the classification and design features of the calibration tool
34. Specify the principles of refined hydraulic calculation of extrusion heads
35. Specify the design features of the profile heads
36. Specify the design features of the heads for blowing pipe blanks
37. Specify the design features of the cable heads
38. Specify the design features of the collector flat-slit heads
39. Specify the design features of corner film heads
40. List and characterize the means of balancing the flow in flat-slotted heads

Approximate list of questions submitted for semester control

1. *To give a classification of the forming tool and factors taken into account when designing it*
2. *Classify and indicate the design features of molds*
3. *Specify the requirements for the manufacturability of plastic products*
4. *Indicate the design features of the forming signs*
5. *Specify the design features of mold ejection systems*
6. *Indicate the design features of the centering and lateral movement systems in the form*
7. *Specify the design features of mold dies and punches*
8. *Specify the design features of mold forming sockets*
9. *Indicate the design features of mold heating systems and provide a method for their calculation*
10. *To give the basic principles of designing molds for LPT*
11. *Indicate the design features of the design details of the molds for LPT*
12. *Indicate the design features of the central and adjustable sprue channels*
13. *Specify the design features of the intake sprue channels*
14. *Specify the design features of point sprue systems*
15. *Indicate the design features of ventilation ducts in LPT molds*
16. *Give a classification of hot-runner forms. Indicate their advantages and disadvantages*
17. *Indicate the design features of ACS with external heating*
18. *Specify the design features of heat-insulated ACS*
19. *Specify the design features of the thermostating systems for LPT molds*
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24. *List and characterize factors taken into account in the design of extrusion heads*
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26. *To give a classification and features of pneumatic vacuum forming methods*
27. *List and characterize the basic principles of extrusion head design*
28. *Specify the design features of the pipe heads*
29. *Specify the design features of direct-flow pelletizing heads*
30. *To list and characterize constructive means of preventing the formation of welding lines*
31. *Specify the principles of calculating the calibration tool*
32. *Specify the principles of approximate hydraulic calculation of extrusion heads*
33. *Specify the classification and design features of the calibration tool*
34. *Specify the principles of refined hydraulic calculation of extrusion heads*
35. *Specify the design features of the profile heads*
36. *Specify the design features of the heads for blowing pipe blanks*
37. *Specify the design features of the cable heads*
38. *Specify the design features of the collector flat-slit heads*
39. *Specify the design features of corner film heads*
40. *List and characterize the means of balancing the flow in flat-slotted heads*

Work program of the educational component (syllabus):

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

Approved by the Department of ____CPSM____ (Prot. No. 17 of 04.06.2025)

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