



3D Graphics

Educational Component Work Program (Syllabus)

Educational component details

Higher education level	<i>First (bachelor's)</i>
Field of knowledge	<i>13 Mechanical Engineering</i>
Specialty	<i>133 Industrial engineering</i>
Educational program	<i>Packaging and Packaging Equipment Engineering</i>
Status of educational component	<i>elective</i>
Form of study	<i>full-time</i>
Year of preparation, semester	<i>3rd year, fall semester</i>
Volume of educational component	<i>4(120)</i>
Semester control/control measures	<i>credits</i>
Class schedule	<i>3 hours per week (2 hours of lectures, 1 hour of practical classes)</i>
Language of instruction	<i>Ukrainian</i>
Information about course leader/teachers	<i>Lecturer: Asst., Oleksyshen Vitalii Oleksandrovyh Practical/Seminar: Asst., Oleksyshen Vitalii Oleksandrovyh</i>

Educational component program

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

The syllabus "3D Graphics" is compiled in accordance with the educational and professional program for the training of bachelors in the specialty 133 - Industrial engineering under the educational program "Packaging and Packaging Equipment Engineering".

The educational component belongs to the cycle of professional training.

The subject of the educational component is the development of software for creating three-dimensional graphics.

The purpose of the educational component "3D Graphics"

The purpose of the educational component is to build 3D objects, including those of complex geometric shape, and establish their properties.

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

Integral competence: The ability to solve complex specialized tasks and practical problems in applied mechanics or in the process of learning, which involves the application of certain theories and methods of mechanical engineering and is characterized by the complexity and uncertainty of the conditions.

1.1. According to the requirements of the educational component program "3D Graphics", after mastering it, students must strengthen the following program learning outcomes:

- the ability to use computer-aided design (CAD), manufacturing (CAM), engineering research (CAE) systems and specialized application software to solve engineering problems in applied mechanics (FC7);

- the ability to think spatially and reproduce spatial objects, structures and mechanisms in the form of projection drawings and three-dimensional geometric models (FC8).

And also form additional provisions:

- use software to build 3D objects and 3D structures, set the properties of 3D objects and perform motion modeling.

1.2. According to the requirements of the educational and professional program, students, after mastering the educational component, must demonstrate the following learning outcomes.

Knowledge:

- the basics of information technology, programming, practical use of application software for performing engineering calculations, processing information and results of experimental research (PH8);

Skills:

- practical use of computer-aided design (CAD), manufacturing preparation (CAM) and engineering studies (CAE) systems (PH12).

Additional learning outcomes will also contribute to:

- based on modern calculation methods, analyze existing technical solutions of structures and optimize the design process.

2. Prerequisites and postrequisites of the educational component (place in the structural and logical scheme of training according to the relevant educational program)

This educational component is an applied development of theoretical courses that were taught to students: "Informatics", "Engineering and Computer Graphics", "Engineering Calculations on PCs".

3. Content of the educational component

Concept of computer modeling and introduction to design in CATIA. Creation of basic solid objects: interface and basic commands of the Part Design module. Drawing: preparation of documentation according to basic world standards in the Drafting module. Assembly models: work with parts and libraries of standard products in Assembly Design. Visualization: presentation of the developed model in Photo Studio.

4. Educational materials and resources

Basic literature

1. Sham Tickoo. CATIA V5-6R2015 for Designers – CAD/CIM Technologies, 2011. - 856 c.
2. Kaushik Kumar, Chikesh Ranjan, J. Paulo Davim. Understanding CATIA – CRC Press, 2021, DOI:10.1201/9781003121657, ISBN: 9781000370805.

Additional literature

3. Richard Cozzens. CATIA V5 Workbook Release V5-6R2013 – SDC Publications, 1994. – 629 c.
4. ДСТУ ГОСТ 2.051:2006 Єдина система конструкторської документації. Електронні документи. Загальні положення (ГОСТ 2.051-2006, IDT) К. : Держспоживстандарт України, 2007. - 19 с.
5. О.П. Мельник, А.В. Шевченко, М.П. Боцула Інженерна та комп'ютерна графіка. Навчальний посібник, Вінницький національний технічний університет, 2017. – 134 с.

Educational content

5. Methods of learning the educational component

Lecture classes

Lectures are aimed at:

- providing modern, holistic, interdependent knowledge on the educational component 3D graphics, 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;
- educating students in professional and business qualities and developing their independent creative thinking;
- forming the necessary interest in students and providing a direction for independent work;
- determining the current level of development of science and technology in the field of computer graphics, forecasting their development for the coming years;
- reflecting the methodological processing of the material (highlighting the main ideas and provisions, emphasizing conclusions, repeating them in different formulations);
- acquiring visual, combining if possible with the demonstration of audiovisual materials, models, models and samples;
- teaching in a clear and understandable language, explaining all newly introduced terms and concepts;
- accessibility for perception by the given audience.

№	6. Title of the lecture topic and list of main questions (list of didactic aids, references to literature and tasks for the SRS)	Hours
1	Topic 1. The concept of computer modeling and familiarity with design in CATIA. Lecture 1. 3D graphics. Types and principles of three-dimensional modeling. Stages of creation, areas of application and development prospects. Literature: [base. 1, add. 1]. Tasks for the CSE: Principles of modeling depending on the CAD program.	4
2	Topic 2. Creating basic solid objects: interface and basic commands of the Part Design module. Lecture 2. Creating a sketch. Basic operations of solid modeling. Working with the tree of building and editing models. Literature: [bas. 1, add. 1]. Tasks on the VTS: Using basic operations.	12
3	Topic 3. Drawing: documentation design according to the main world standards in the Drafting module. Lecture 3. Creating two-dimensional drawings from three-dimensional models of parts and assemblies. Working with dimensions, symbols and technical inscriptions on the drawing. Literature: [base. 1,2, add. 3]. Tasks on the VTS: Applying symbols.	8
4	Topic 4. Assembly models: working with parts and libraries of standard products in Assembly Design. Lecture 4. Working with a group of parts. Specifying the mutual location of objects. Organizing the design and life cycle of a product. Literature: [base. 1, add. 3]. Tasks on the SRS: Using different types of mating.	8
5	Topic 5. Visualization: presentation of the developed model in Photo Studio. Lecture 5. Concept of texturing and rendering. Creation of photorealistic images of the designed product. Literature: [base 1]. Tasks on the SRS: Creation of renders.	4
	Всего	36

Practical classes

The system of professional training of applicants for the educational component provides for practical classes. Being a supplement to the lecture course, they lay and form the foundations of the bachelor's qualification in the field of packaging. The content of these classes and the methodology for their conduct should provide knowledge of methods, the ability to perform calculations, and allow you to check your knowledge. Therefore, this type of work is an important means of operational 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 computer modeling.

The main tasks of the cycle of practical classes:

- to help applicants systematize, consolidate and deepen theoretical knowledge in the field of modern methods of 3D graphics;
- 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.

№	Title of the topic of the practical lesson and list of main questions (list of didactic material, references to literature and tasks for the CTS)	Hours
1	Safety briefing and familiarization of students with the program of practical work (2 hours).	1
2	Introduction to the CAD system interface. Literature: [basic 1,2]. Tasks for the SRS: Preparation and study of the protocol for laboratory work.	1
3	Creating a three-dimensional model of a typical part. Literature: [base 1,2]. Tasks for the SRS: Preparation and study of the protocol for laboratory work.	4
4	Creating a two-dimensional drawing from three-dimensional models. Literature: [base 1,2]. Tasks for the SRS: Preparation and study of the protocol for laboratory work.	2
5	Creation of a three-dimensional assembled model. Literature: [base 1,2]. Tasks for the SRS: Preparation and study of the protocol for laboratory work.	4
6	Creating renders of the designed part. Literature: [base 1,2]. Tasks for the SRS: Preparation and study of the protocol for laboratory work.	2
7	Classes on taking and defending practical assignments	2
8	MCR	2
	Total	18

Laboratory classes

Laboratory classes are not provided for in the working curriculum.

7. Independent work of a student/postgraduate student

Independent work takes up 55% of the time of studying the educational component, including preparation for the test. 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 to 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 requirements for the quality of packaged products. He must be able to create the most effective methods and means of packaging.

<i>No з/п</i>	<i>Title of the topic to be studied independently</i>	<i>Hours</i>
1	Topic 1. Concept of computer design <i>Literature: [base. 1, add. 4, 5].</i> <i>Tasks for the SRS: Characteristics of CAD systems by field of use.</i>	7
2	Topic 2. Creating basic solid objects <i>Literature: [bas. 1, add. 4, 5].</i> <i>Tasks for the SRS: Ways to create sketches and basic operations.</i>	14
3	Topic 3. Drawings <i>Literature: [base 1, add. 1, 2].</i> <i>Tasks for the SRS: Creating a drawing based on a 3D model.</i>	12
4	Topic 4. Prefabricated models <i>Literature: [base 1, add. 3].</i> <i>Task on the SRS: Using different types of conjugations.</i>	12
5	Topic 5. Visualization <i>Literature: [base 2, add. 6].</i> <i>Task on the SRS: Render a 3D object.</i>	11
6	<i>Preparation for the ICW</i>	4
7	<i>Preparation for the test</i>	6
	Total	66

8. Individual lessons

According to the working curriculum, no individual tasks are provided.

Policy and control

9. Policy of academic discipline (educational component)

Rules for class attendance and behavior in class

Attendance at classes is a mandatory component of assessment. Applicants are required to actively participate in the learning process, not be late for classes or miss them without a valid reason, not interfere with the teacher conducting classes, and not be distracted by activities unrelated to the learning process.

Rules for assigning incentive and penalty points

- No incentive points are provided..*
- penalty points are not provided within the educational component.*

Deadline and Rescheduling Policy

In the event of arrears for the educational component or any force majeure circumstances, applicants must contact the teacher via the available (provided by the teacher) communication channels to resolve 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 lack of references when using printed and electronic materials, quotes, opinions of other authors. Hints and copying when writing tests, conducting classes are unacceptable; taking a 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". More: <https://kpi.ua/code>

Academic Conduct and Ethics Policy

Applicants must be tolerant, respect the opinions of others, formulate objections in a correct form, and constructively support feedback in classes. 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". More: <https://kpi.ua/code>

10. Types of control and rating system for assessing learning outcomes (RSA)

Distribution of study time by types of classes and tasks in the discipline according to the working curriculum:

Semester	Study time		Distribution of study hours					Control measures		
	Credits	academic h.	Lectures	Practical	Lab work	SRS	Ind	MKW	PP	Semester Control
5	4	120	36	18	0	66	0	1	–	test

A student's rating for the educational component consists of the points he receives for work in practical classes and modular test work.

Semester control is a test.

Current control: Reports from practical classes, modular tests.

Calendar control: conducted twice a semester as a monitoring of the current status of implementation of syllabus requirements.

A student's rating for the educational component consists of the points he receives for:

- 1) completion and defense of practical works (5 works in total);
- 2) completion of modular test work.

Rating (weighting) points system and evaluation criteria

1. Practical classes:

Weighted score – 12. The maximum number of points for all practical classes is: 12 points × 5 = 60 points.

Evaluation criteria:

a score of 12 is awarded if the problem is solved without errors;
scores of 10 and 11 are awarded if the problem is solved with a minor error;
scores of 7, 8 and 9 are awarded if the problem is solved with several errors;
a score of 0 is given if the problem is solved with a significant error or if the student is absent from a practical lesson without a valid reason.

2. Modular test work:

Weighted score – 40. The maximum number of points for the test is 20 points × 2 questions = 40 points.

a score of 40 is awarded if at least 95% of the questions are answered;
a score of 34-39 is awarded if at least 85% of the questions are answered;
a score of 30-33 is awarded if 75% of the questions are answered;
a score of 24-29 is awarded if 60% of the questions are answered;
a score of 0 is awarded if less than 60% of the questions are answered.

No bonus points are provided.

No penalty points are provided..

According to the results of the academic work in the first 7 weeks, the "ideal student" should score 20 points. At the certification (8th week), the student receives "passed" 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 certification (14th week), the student receives "passed" if his current rating is at least 20 points.

The maximum sum of points for the RC semester is 100:

$$RC = R_{pz} + R_{mkr} = 60 + 40 = 100 \text{ points.}$$

Admission requirements for semester examination: Enrollment of all practical work and the starting component of the semester rating of at least 20 points.

Students who have scored $R_c = 60$ points or more per semester can receive a credit automatically based on the points they have scored. Students who have not scored a semester rating of 60 points and have at least 20 points or students who wish to increase their scores in the educational component, complete a written credit work and their semester scores are canceled. At the credit test, students complete a written credit test with 2 credit questions. Each task contains two theoretical questions. The list of questions is given in the methodological recommendations for mastering the educational component. Each theoretical question is estimated at 50 points.

Question evaluation system:

- "excellent", complete answer (at least 95% of the required information) - 48-50 points;
- "good", sufficiently complete answer (at least 75% of the required information or minor inaccuracies) – 40-47 points;
- "satisfactory", incomplete answer (at least 60% of the required information and some errors) – 30-39 points;
- "unsatisfactory", unsatisfactory answer – 0 points.

The maximum rating of the final test is:

$$R_z = R_{T1} + R_{T2} = 50 + 50 = 100 \text{ points.}$$

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

Table of correspondence of rating points to grades according to the university scale:

Number of points	Rating
100-95	Excellent
94-85	Very good
84-75	Good
74-65	Satisfactory
64-60	Sufficient
Less 60	Unsatisfactory
Admission conditions not met	Not allowed

Additional information on the educational component

QUESTIONS FOR THE TEST

1. Define the concept of CAD system.
2. Define the concept of three-dimensional modeling.
3. Define the concept of sketch.
4. Define the concept of part geometry.
5. Define the concept of dimensional grid.
6. Define the concept of object array.
7. Define the concept of element trajectory.

8. Define the concept of element intersection.
9. Define the concept of model parameter.
10. Define the concept of element conjugation.
11. Define the concept of part orientation.
12. Define the concept of motion restriction.
13. Define the concept of assembly.
14. Define the concept of 3D model.
15. Define the concept of model properties.
16. Give the method for constructing an arc on a sketch.
17. Give the method for constructing a rounding on a sketch.
18. Give the method for constructing a chamfer on a sketch.
19. Give the method for constructing a spline on a sketch.
20. Give the method for constructing a circle on a sketch.
21. Give the method for constructing a rectangle on a sketch.
22. Give the method for constructing a polyhedron on a sketch.
23. Give the method for constructing a line parallel to the one given on a sketch.
24. Give the method for constructing a line perpendicular to the one given on a sketch.
25. Give the method for constructing a line at an angle to the one given on a sketch.
26. Give the method for constructing an equidistant curve on a sketch.
27. Give the method for constructing auxiliary geometry on a sketch.
28. Give the method for setting dimensions for elements in a sketch.
29. Give the method for setting absolute location constraints in a sketch.
30. Give the method for setting relative location constraints in a sketch.
31. Explain the principles of using the sketch extrude function.
32. Explain the principles of using the sketch rotation surface construction function.
33. Explain the principles of using the trajectory surface construction function.
34. Explain the principles of using the sketch cut function.
35. Explain the principles of using the model element rounding function.
36. Explain the principles of using the sketch transfer function.
37. Explain the principles of using the sketch duplication function.
38. Explain the principles of using the sketch deletion function.
39. Explain the principles of using the sketch to surface conversion function.
40. Explain the principles of using the thin-walled element creation function.
41. Explain the principles of using the element bending function.
42. Explain the principles of using the element mass determination function.
43. Explain the principles of using the sketch-to-surface function.
44. Explain the principles of using the surface creation function from a series of sketches.
45. Explain the principles of using the sketch closure function.
46. Give examples of using different types of mating.
47. Give examples of using different types of dimensions.
48. Give examples of using different types of symbols.
49. Give examples of using different types of sketches.
50. Give examples of using different types of animation.
51. Give examples of using different types of freedom constraints.
52. Give examples of using different types of element movement.
53. Give examples of using different types of surfaces.
54. Give examples of using different types of material addition.
55. Give examples of using different types of material removal.
56. Give examples of using different types of parts.
57. Give examples of using different types of sections.
58. Give examples of using different types of sections.
59. Give examples of using different types of parameters.

60. Give examples of using different types of sketch operations

SET OF TASKS FOR MODULAR CONTROL WORK

TASK 1

1. Define the concept of CAD system.
2. Give examples of the use of different types of conjugations

TASK 2

1. Define the concept of three-dimensional modeling.
2. Explain the principles of using the function of constructing a surface by rotating a sketch.

TASK 3

1. Explain the principles of using the sketch extrude function.
2. Give examples of using different types of dimensions.

TASK 4

1. Explain the principles of using the function of constructing a surface by trajectory.
2. Give examples of the use of different types of symbols.

TASK 5

1. Define the concept of sketch.
2. Give the method for constructing a chamfer on a sketch.

TASK 6

1. Define the concept of part geometry.
2. Give the method for constructing a spline in a sketch.

TASK 7

1. Explain the principles of using the sketch cut function.
2. Give examples of using different types of sketches.

TASK 8

1. Define the concept of dimensional grid.
2. Give the method for constructing a circle in a sketch.

TASK 9

- 1. Explain the principles of using the rounding function for model elements.*
- 2. Give examples of using different types of animation.*

TASK 10

- 1. Define the concept of an array of objects.*
- 2. Give the method for constructing a rectangle in a sketch.*

TASK 11

- 1. Define the concept of an array of objects.*
- 2. Give the method for constructing a rectangle in a sketch.*

TASK 12

- 1. Define the concept of the trajectory of an element.*
- 2. Give the method for constructing a polyhedron on a sketch.*

TASK 13

- 1. Give a method for constructing a line parallel to the one given in the sketch.*
- 2. Give examples of using different types of surfaces.*

TASK 14

- 1. Define the concept of model parameter.*
- 2. Give a method for constructing a line perpendicular to the one given in the sketch.*

TASK 15

- 1. Give the method for constructing a straight line at an angle to the one given in the sketch.*
- 2. Explain the principles of using the function for creating a thin-walled element.*

TASK 16

- 1. Give the method for constructing an equidistant curve on a sketch.*
- 2. Give the method for constructing auxiliary geometry on a sketch.*

TASK 17

- 1. Define the concept of assembly.*
- 2. Give the method for assigning dimensions to elements in a sketch.*

TASK 18

1. Define the concept of a 3D model.
2. Describe the method for setting absolute location constraints on a sketch.

TASK 19

1. Explain the principles of using the surface creation function from a series of sketches.
2. Give examples of using different types of parameters.

TASK 20

1. Describe the method for setting relative location constraints on a sketch.
2. Explain the principles of using the sketch locking function.

List of questions for the modular test

1. Define the concept of CAD system.
2. Define the concept of three-dimensional modeling.
3. Define the concept of sketch.
4. Define the concept of part geometry.
5. Define the concept of dimensional grid.
6. Define the concept of object array.
7. Define the concept of element trajectory.
8. Define the concept of element intersection.
9. Define the concept of model parameter.
10. Define the concept of element conjugation.
11. Define the concept of part orientation.
12. Define the concept of motion restriction.
13. Define the concept of assembly.
14. Define the concept of 3D model.
15. Define the concept of model properties.
16. Give the method for constructing an arc on a sketch.
17. Give the method for constructing a rounding on a sketch.
18. Give the method for constructing a chamfer on a sketch.
19. Give the method for constructing a spline on a sketch.
20. Give the method for constructing a circle on a sketch.
21. Give the method for constructing a rectangle on a sketch.
22. Give the method for constructing a polyhedron on a sketch.
23. Give the method for constructing a line parallel to the one given on a sketch.
24. Give the method for constructing a line perpendicular to the one given on a sketch.
25. Give the method for constructing a line at an angle to the one given on a sketch.
26. Give the method for constructing an equidistant curve on a sketch.
27. Give the method for constructing auxiliary geometry on a sketch.

28. Give a method for setting dimensions for elements in a sketch.
29. Give a method for setting absolute location constraints in a sketch.
30. Give a method for setting relative location constraints in a sketch.

The work program of the educational component (syllabus):

Compiled assistant., PhD Oleksyshen V.O.

Approved department CPSM (protocol No. 17 dated 06/04/2025)

Approved by the Methodological Committee of the Faculty of Chemical Engineering (protocol № 11 від 27.06.2025)