



National Technical University of  
Ukraine "Igor Sikorsky Kyiv  
Polytechnic Institute"



Department of machines and  
devices of chemical and oil  
refining industries

# Engineering of Three-Dimensional Objects

## Working program of the academic discipline (Syllabus)

### Details of the academic discipline

Level of higher education	<i>First (undergraduate)</i>
Branch of knowledge	<i>13 Mechanical engineering</i>
Specialty	<i>133 Industrial engineering</i>
Educational program	<i>Computer-integrated technologies of chemical engineering equipment design</i>
Discipline status	<i>selective</i>
Form of education	<i>daytime</i>
Year of training, semester	<i>3rd year, spring semester</i>
Scope of the discipline	<i>4 ECTS credits / 120 hours</i>
Semester control/ control measures	<i>assessment, modular control work</i>
Lessons schedule	<i>3 hours per week (1 hour of lectures and 2 hours of computer workshop)</i> <i><a href="https://rozkklad.kpi.ua/">https://rozkklad.kpi.ua/</a></i>
Language of teaching	<i>Ukrainian</i>
Information about the course leader / teachers	<b>Lecturer:</b> <i>associate professor of the Department of the National Academy of Sciences of the Russian Academy of Sciences, candidate of technical sciences</i> <i>Novokhat Oleg Anatoliyovych,</i> <i>email: novokhatoleh@gmail.com , telegram: @Novokhat_Oleh</i> <b>Practical:</b> <i>assistant of the department of the MAHNV Byshko Mykyta Andriyovych,</i> <i>email: m.byshko@kpi.ua , telegram: @potatosoge</i>
Placement of the course	<i><a href="https://ci.kpi.ua/синабусы/silabus-24-25/">https://ci.kpi.ua/синабусы/silabus-24-25/</a></i>

### Program of educational discipline

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

The purpose of the educational discipline is the formation of students' competencies.

ABILITY:

- Ability to design 3D models with specified characteristics, using the modern SolidWorks CAD system.
- Ability to automatically create 2D drawings based on designed 3D models with specified characteristics, application using the modern SolidWorks CAD system.

The main tasks of the academic discipline.

After mastering the academic discipline, students must demonstrate the following learning outcomes:

KNOWLEDGE:

- general principles of modeling and design three-dimensional models, in particular hydromechanical, heat and mass exchange equipment of chemical, oil refining, biotechnological and refrigeration industries;
- modern information technologies and modern application software packages;

SKILLS:

- design three-dimensional models using the SolidWorks automated design system;
- 2D drawings and specifications to 3D models.

The knowledge, skills and experience gained while studying this discipline will be useful for further professional activities.

## **Pre-requisites and post-requisites of the discipline (place in the structural and logical scheme of training according to the relevant educational program)**

This academic discipline is optional. To successfully master this discipline, a student must meet all of the following criteria:

- have the ability and skills to work with a personal computer at the level of a confident user;
- know and understand the basic principles of information organization in computer systems;
- understand the basic principles of engineering graphics.

## **2. Content of the academic discipline**

The educational discipline "Engineering of Three-Dimensional Objects" consists of the following topics:

1. Solidworks automated design system interface.
2. Creating sketches.
3. Construction of 3D models of parts.
4. Construction of 3D models of assemblies.
5. Creation of 2D drawings.
6. Creating a realistic image of three-dimensional models.

## **3. Educational materials and resources**

### ***Basic literature***

1. SOLIDWORKS Online Help:  
[https://help.solidworks.com/2023/English/SolidWorks/sldworks/r\\_welcome\\_sw\\_online\\_help.htm](https://help.solidworks.com/2023/English/SolidWorks/sldworks/r_welcome_sw_online_help.htm)
2. Козяр М.М. Комп'ютерна графіка. SolidWorks: навчальний посібник. / М.М. Козяр, Ю.В. Фещук, О.В. Парфенюк. – Херсон: ОЛДІ-ПЛЮС, 2018. – 251 с.
3. Пустюльга С., Самостян В., Клак В. Інженерна графіка в SolidWorks. ЛНТУ, Луцьк 2018.– 174 с.

### ***Additional literature***

1. Gaurav Verma, Matt Weber. SolidWorks Simulation 2017 Black Book (Colored). CAD/CAM/CAE Works; 4th edition (December 14, 2016). – 362 p.
2. Solidworks у завданнях 3D моделювання та інжинірингу технічних систем. Навч. посібник / В.Я. Ворошук, Т.М. Вітенько. Тернопіль: ФОП Паляниця В.А., 2021. 164 с.
3. Холодняк Ю. В. Комп'ютерне проектування промислових виробів: навчально-методичний посібник з виконання практичних робіт / Ю. В. Холодняк; ТДАТУ. – Мелітополь: ТДАТУ, 2020. – 152 с.
4. Білецький В.С. Моделювання у нафтогазовій інженерії: навчальний посібник. / В.С. Білецький – Львів: Видавництво "Новий Світ – 2000", – Харків: НТУ «ХПІ», 2021. – 306 с. ISBN 978-617-7519-90-3
5. Марчевський В.М. Конструкторська документація курсових і дипломних проектів: навч. посібн. для студ. вищ. навч. закладів. / В.М. Марчевський. – К.: Норіта-плюс, 2006. – 352 с.
6. Tran P. SOLIDWORKS 2024 Basic Tools: Getting Started with Parts, Assemblies and Drawings. / P. Tran. – SDC Publications, 2024. – 706 p.
7. Shih R.H., Schilling P.J. Parametric Modeling with SOLIDWORKS 2022. / R.H. Shih, P.J. Schilling. – SDC Publications, 2022. – 600 p.
8. Planchard D.C. SOLIDWORKS 2020 Quick Start. / D.C. Planchard. – SDC Publications, 2020. – 280 p.
9. Параметричне моделювання технологічних процесів. Розділ 1. Основи твердотілого параметричного моделювання в системі SolidWorks [Електронний ресурс] : навчальний посібник для здобувачів ступеня бакалавра, за освітньою програмою «Технічні та програмні засоби автоматизації» спеціальності 151 Автоматизація та комп'ютерно-інтегровані технології / КПІ ім. Ігоря Сікорського ; уклад.: С. В. Плашихін, Д. М. Складанний, Ю. А. Запорожець, С. Л. Мердуч. – Електронні текстові дані – Київ : КПІ ім. Ігоря Сікорського, 2022. – 83 с.

10. Основи геометричного моделювання в програмі SolidWorks. Частина 1 [Електронний ресурс]: навчальний посібник для здобувачів ступеня магістра за освітньою програмою «Інжиніринг інтелектуальних електротехнічних та мехатронних комплексів» спеціальності 141 «Електроенергетика, електротехніка та електромеханіка» / КПІ ім. Ігоря Сікорського ; уклад.: Л. К. Лістовщик. - Електронні текстові дані - Київ: КПІ ім. Ігоря Сікорського, 2023. - 71 с.
11. Системи автоматизованого проєктування. Конспект лекцій [Електронний ресурс] : навчальний посібник для здобувачів ступеня бакалавра за освітньою програмою «Комп'ютерно-інтегровані технології виробництва приладів» спеціальності 151 «Автоматизація та комп'ютерно-інтегровані технології» / КПІ ім. Ігоря Сікорського ; уклад. К. С. Барандич, О. О. Подолян, М. М. Гладський. – Електронні текстові дані. – Київ : КПІ ім. Ігоря Сікорського, 2021. – 97 с.

## Educational content

### 4. Methods of mastering an educational discipline (educational component)

#### *The structure of the credit module*

Names of sections, topics	In total	Number of hours		
		including		
		Lectures	Practical training	SRS
Solidworks automated design system interface	10	2	4	4
Creating sketches	22	4	8	10
Construction of 3D models of parts	26	4	10	12
Construction of 3D models of assemblies	8	2	2	4
Creation of 2D drawings	24	4	10	10
Creating a realistic image of three-dimensional models	8	2	2	4
Term Paper	14			14
<i>MKR</i>	2			2
<i>Test</i>	6			6
<b>Hours in general</b>	<b>120</b>	<b>18</b>	<b>36</b>	<b>66</b>

#### *Lecture classes*

No. z/p	The name of the topic of the lecture and a list of main questions (a list of didactic tools, references to the literature and tasks on the SRS)
<b>Topic 1</b>	
1	SolidWorks: installation, interface, navigation, settings. <b>Literature 1, 2, 3</b> Assignment on SRS: Comparison of design capabilities in SolidWorks with other CAD programs
<b>Topic 2</b>	
2	Creation of sketches: construction of geometric primitives, bindings, arrays, editing of elements. <b>Literature 1, 2, 3</b> Tasks on SRS: Construction of a spiral and a three-dimensional sketch
3	Creation of sketches: measurement system, dimensioning, relationships, states of certainty. <b>Literature 1, 2, 3</b> Tasks on SRS: Variety of measurement systems
<b>Topic 3</b>	

4	3D design: creating details. Commands of the type "Bobishka", "Cutting", reference geometry. <b>Literature 1, 2, 3</b> Task on SRS: Determining the coordinates of the center of mass of a three-dimensional part
5	Modeling of sheet metal parts. <b>literature</b> Task on SRS: Creating inscriptions on the surface
<b>Topic 4</b>	
6	3D design: creating assemblies. <b>Literature 1, 2, 3</b> Task on SRS: Configuration of a three-dimensional model
<b>Topic 5</b>	
7	Creation of 2D drawings based on a 3D model. <b>Literature 1, 2, 3</b> Task on SRS: Creation of standard formats with multiplicity. Printing output
8	Attributes of a three-dimensional model. The main inscription. Positions on the drawing. Specifications <b>Literature 1, 2, 3</b> Tasks on SRS: Opening drawings from other programs
<b>Topic 6</b>	
9	Creating a realistic image of a solid model. <b>Literature 1, 2, 3</b> Task on SRS: Ways to increase the quality of the saved image of a three-dimensional model

### **Practical training**

No. z/p	Title of the topic and list of main questions (a list of didactic tools, references to the literature and tasks on the SRS)
<b>Topic 1</b>	
1	Program installation, interface settings, mouse navigation, creation of various types of documents. Saving documents <b>Literature 1, 2, 3</b> Task on SRS: Adaptation of the interface to ultra-widescreen monitors
2	Construction of contours from geometric primitives. Ways to set sizes <b>Literature 1, 2, 3</b> Task on SRS: Using the graphics area grid to facilitate construction: advantages and disadvantages
<b>Topic 2</b>	
3	Construction of figures of complicated configuration. Application of single binding <b>Literature 1, 2, 3</b> Task on SRS: Construction of lines and arcs by one team
4	Construction of figures with elements of conjugation and hatching. Editing of the built figure <b>Literature 1, 2, 3</b> Task on SRS: Solid and gradient fill
5	Construction of shapes with elements of arrays. Ensuring the state of certainty of the sketch <b>Literature 1, 2, 3</b> Task on SRS: Filling with a texture from a picture
6	Construction of figures according to projections with the addition of dimensions. <b>Literature 1, 2, 3</b> Task on SRS: Application of sheet layers
<b>Topic 3</b>	
7	Construction of 3D parts of a simple configuration with holes <b>Literature 1, 2, 3</b> Task on SRS: Construction of bodies of rotation
8	Construction of 3D body-type parts of complicated configuration <b>Literature 1, 2, 3</b> Tasks at SRS: Construction of pipelines
9	Construction of 3D parts based on projection images

	<b>Literature 1, 2, 3</b> Task on SRS: Construction of bodies of variable cross-section
10	Construction of 3D parts of complicated configuration with threads <b>Literature 1, 2, 3</b> Task on SRS: Building a three-dimensional thread in manual mode
11	Construction of a sheet metal part based on its sweep <b>Literature 1, 2, 3</b> Task on SRS: Construction of blind holes in the sheet body
<b>Topic 4</b>	
12	Build an assembly of a welded structure <b>Literature 1, 2, 3</b> Task on SRS: Recording information in a document as a comment
<b>Topic 5</b>	
13	Create a 2D drawing based on a 3D model <b>Literature 1, 2, 3</b> Tasks on SRS: Local section: features of construction
14	Create a 2D drawing based on a 3D model with stamp filling and dimensioning <b>Literature 1, 3</b> Tasks on SRS: Placing signs of roughness: features
15	Create a 2D drawing based on a 3D model with sections according to the scheme <b>Literature 1, 2, 3</b> Task on SRS: Placing bases to surfaces
16	Create a 2D drawing based on the built assembly with positioning, filling in the main inscription and creating a specification on the drawing <b>Literature 1, 2, 3</b> Task on SRS: Setting tolerances
17	Creating a document template of standard formats of vertical and horizontal orientation and specification <b>Literature 1, 3</b> Task on SRS: Adaptation of AutoCAD files
<b>Topic 6</b>	
18	Creating an image of a 3D model by rendering it and typically saving it as a drawing <b>Literature 1</b> Task on SRS: Choosing the optimal configuration of a personal computer for working with SolidWorks

### **Laboratory classes**

According to the curriculum, laboratory classes are not provided.

### **Term Paper**

It involves designing a 3D model of the device according to the task.

Approximate types of devices: heat exchanger, cyclone, absorber, rectification column. The task is given by the teacher.

## **5. Independent work of student**

Independent work of students within this course involves:

- preparation for the lecture, which includes familiarization with the provided text of the lecture, identification of poorly understood fragments and theses, identification of questions that, in the student's opinion, need more extensive coverage, preparation of questions to the teacher that are planned to be asked during the lecture (up to 1-2 hours for each lecture) ;
- preparation for practical classes, which includes familiarization with the topic and purpose of the class, task, familiarization with control questions and formation of answers to them (up to 30-60 minutes for each practical work);

- preparation of reports based on the results of work carried out in practical classes (up to 30-60 minutes for each practical class);
- development of the device according to the task of performing Term Paper (14 hours).
- preparation for the modular control work (2 hours);
- preparation for the test (6 hours).

## Policy and control

### 6. Policy of educational discipline

The system of requirements that the teacher sets before the student:

#### **6.1. Attendance and behavior in classes.**

- the student must come to class prepared;
- turning off mobile phones or switching them to silent mode in all classes and during consultations is mandatory;
- attendance at lectures on the discipline is welcome and will contribute to better learning of the discipline;
- the student's activity in lectures and the ability to ask questions about the topic of the lecture to the teacher are welcome;
- attending laboratory classes and completing tasks during practical classes is mandatory;
- the use of information search tools is allowed (except for control classes);
- free movement of the audience is allowed during practical (but not lecture) classes.

#### **6.2. Issuance of penalty and incentive points.**

- incentive points are awarded to students who completed additional work tasks or tasks of increased complexity during the class;
- incentive points are awarded to students who proposed a different way of completing the task, not provided for in the work plan;
- skipping practical classes without a good reason leads to the issuance of zero points according to its results, but it is absolutely necessary to complete the work tasks;
- skipping the modular test without a good reason leads to the issuance of zero points based on its results.

#### **6.3. Policy of deadlines and rescheduling.**

- at the beginning of the next practical session, the student must submit a completed report based on the results of the previous session;
- repeated execution of modular control work is not allowed;
- writing a modular test by students who did not write it on time without a good reason is not allowed;
- retaking the test is allowed only in the manner prescribed by the regulatory documents on the organization of the educational process of KPI named after Igor Sikorsky.

#### **6.4. Academic Integrity Policy.**

- students studying the discipline must adhere to the rules and norms of academic integrity when performing all types of work;
- calculation and Term Paper performed in gross violation of the rules and norms of academic integrity is evaluated with a score of 0 points, in addition, the student is awarded 4 penalty points when issuing a repeated assignment.

### 7. Types of control and rating system for evaluating learning outcomes (RSO)

The student's credit module rating consists of points obtained for:

- 1) performance of 18 practical works in classroom classes;

- 2) execution of modular control work;
- 3) execution of Term Paper.

### **7.1. Performance of practical works.**

A total of 18 practical works are provided during the semester. The weighted point is 3. The maximum number of points for all works is  $3 \times 18 = 54$  points. Points are awarded as follows:

- work tasks were completed correctly and on time, within the set time of the lesson, correct answers were received - 3 points;
- the task of the work was completed partially correctly during the set time of the lesson, and it was not completed completely, in a time exceeding the time of the practical lesson, a part of the correct answers was obtained - 1-2 points;
- the work task was not completed or was completed completely incorrectly - 0 points.

*Note:* if the student was absent from class for a valid reason, which is documented and presented at the next class the completed task of the missed work, the work is considered completed on time.

### **7.2. Modular control work.**

The weighted score is 6. The evaluation of the work task is carried out according to the following scale:

- data analysis is correct, the answer is correct - 6 points;
- the data analysis is correct, the answer is correct, there are minor inaccuracies - 4-5 points;
- the process of data analysis is generally correct, but there are errors that do not make it possible to get a correct answer, only the analysis algorithm is given, but the analysis itself is missing or completely incorrect - 2-3 points;
- incorrectly selected data analysis method, incorrectly selected analysis algorithm or missing task - 0 points.

### **7.3. Term Paper**

The weighted score is 40. The calculation work consists of a complex task.

Evaluation of the work task is carried out according to the following scale:

- performing the task correctly and without errors - 40 points;
- the execution of the task is correct and without errors, there are minor inaccuracies or irrationally chosen solutions for the execution of the task, but which allowed to obtain the correct result - 35-39;
- the progress of the task is generally correct, but there are non-critical errors, the prompt correction of which will allow you to get a correct answer - from 20 to 29 points;
- the progress of the task is generally correct, but there are sufficiently gross errors that do not make it possible to get a correct answer - from 10 to 19 points;
- only certain fragments are given correctly, but the task itself is not completed, or is completed completely incorrectly - from 1 to 9 points;
- the method of performing the task is incorrectly chosen, the calculation formulas are incorrectly specified or the task is missing, work performed in gross violation of the rules and norms of academic integrity is evaluated with a score of 0 points.

The maximum number of points during the semester is:  $R = 54 + 6 + 40 = 100$  points.

Calendar control: is carried out twice a semester as a monitoring of the current state of fulfillment of the syllabus requirements.

According to the results of the educational work in the first 7 weeks, the "ideal achiever" should score 21 points. At the first attestation (8th week), the applicant receives "credited" if his current rating is at least 10 points.

According to the results of the educational work in 13 weeks of training, the "ideal achiever" should score 45 points. At the second attestation (14th week), the applicant receives "passed" if his current rating is at least 22 points.

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

Semester control: assessment.

If the student receives less than 60 points or if he wishes to increase the total score, all points received for practical tasks and modular control work are canceled (with no possibility of cancellation if the student receives a lower score for credit work than for the total score for practical classes and modular control work). Points for Term Paper are saved. The student is given a credit assignment for 60 points. The task contains elements of building a three-dimensional model of the assembly type and creating a specification for it and a two-dimensional drawing.

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

<b>Scores</b>	<b>Rating</b>
100 ... 95	<i>perfectly</i>
94 ... 85	<i>very good</i>
84 ... 75	<i>fine</i>
74 ... 65	<i>satisfactorily</i>
64 ... 60	<i>enough</i>
0 ... 60	<i>unsatisfactorily</i>
0 ... 22	<i>not allowed</i>

## **8. Additional information on the discipline (educational component)**

### **8.1. Completion of credit work.**

Students who scored a rating of less than 60 points during the semester or decided to increase their score perform credit work.

In case of completion of credit work, points for practical classes and modular control work are canceled. Points for Term Paper are saved.

A "hard" evaluation system is used. Therefore, if a student has a total score that is lower than before taking the test, the points for the test are not canceled and the previous points for practical classes and MKR are not returned.

The weighted score of the credit work is 60 points. The work consists of three practical tasks. The weighted score of the tasks is 20 points. The practical task requires the student to solve typical problems from the credit module (construction of parts, three-dimensional assembly and two-dimensional drawing with specification). The practical task is evaluated according to the following scale:

- the approach to the solution is correct, the answer is correct - from 19 to 20 points;
- the approach to the solution is correct, but the answer is incorrect due to the presence of minor errors - from 15 to 18 points depending on the number of indicated errors;
- the approach to the solution is generally correct, but there are sufficiently gross errors that do not make it possible to get a correct answer - from 10 to 14 points, depending on the number and severity of errors;
- only fragments of the task are correct, but the task itself is missing or completely incorrect - from 1 to 9 points depending on the number and correctness of the available elements;
- the calculation method is incorrectly chosen, the solution strategy is incorrectly chosen or the task is missing - 0 points.

### **8.2. Enrollment of distance or online course certificates.**

For students who have completed distance learning or online courses on the relevant subject, this training can be counted as studying this academic discipline if all the following conditions are met:

- the student provided a certificate or other document that confirms his completion of a distance or online course and provided an opportunity to verify its authenticity;



- a distance or online course posted on the platform or conducted by an organization that is recommended or recognized by KPI named after Igor Sikorskyi;
- the volume of the distance or online course is at least 108 study hours;
- the list of topics studied in the distance or online course contains at least four topics specified in the content of the academic discipline (item 3 of the syllabus); in the case of a difference in titles, the correspondence of the content of the topics is established on the basis of a comparative analysis with the distance or online course program;
- the student's success rate based on the results of studying a distance or online course is at least 75% of the maximum.

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**Working program of the academic discipline (syllabus):**

- ***Composed*** associate professor of the Department of the National Academy of Sciences of the Russian Academy of Sciences, candidate technical Science Oleh NOVOKHAT
- ***approved*** department of machines and devices of chemical and oil refining industries  
(protocol No. 20 dated June 12, 2025)
- ***agreed*** Methodical Commission of the Faculty of Engineering and Chemistry  
(protocol No. 11 dated June 27, 2025)