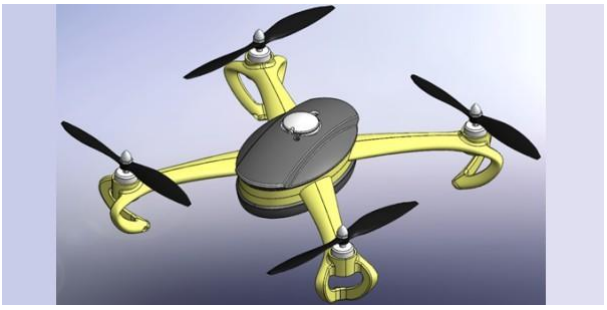
Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Department of Applied Radio Electronics

[RE-23] THREE-DIMENSIONAL MODELING OF RADIOELECTRONIC EQUIPMENT



Curriculum of the academic discipline (Syllabus)

Course details

Level of higher education	First (bachelor's)
Field of knowledge	17 - Electronics, Automation, and Electronic Communications
Specialization	172 - Electronic Communications and Radio Engineering
Educational program	All educational programs
Discipline status	Elective (F-catalog)
Form of higher education	Full-time
Year of training, semester	Available for selection starting from the 2nd year, spring semester
Scope of the discipline	4 credits (Lectures 18 hours, Practical classes 36 hours, Laboratory work 36 hours, Independent work 66 hours)
Semester Control/control measures	Credit
Class schedule	https://schedule.kpi.ua
Language of instruction	Ukrainian
Information about the course coordinator/teacher s	Lecturer: Shulga A. V., Lab: Shulga A. V.,
Course placement	https://do.ipo.kpi.ua/course/view.php?id=456

Curriculum

- **Description of the course, its purpose, subject matter, and learning outcomes**

3D modeling plays an important role in modern society. Today, it is widely used in various fields, namely in marketing, architectural design, cinematography, not to mention industry. 3D modeling allows you to create a prototype of a future part, device, structure, etc. in a three-dimensional format. 3D modeling plays an important role in presentations and demonstrations of any product or service. The course " Three-dimensional modeling of radio-electronic equipment" will introduce you to the capabilities of SolidWorks software, teach you how to create parts of varying

complexity, going from the idea to preparing files for production and visualizing them for demonstration.

The aim of the course is to provide students with theoretical and practical skills in working with the SolidWorks three-dimensional modeling environment.

The discipline provides the formation of the following professional competencies:

- The ability to perform computer modeling of devices, systems, and processes using universal application packages (PC 04);

- Ability to participate in design and technological preparation, implementation in production, and support of radio-electronic equipment production (PC 17);

- Ability to select and apply specialized software tools for simulation modeling and design of radio-electronic equipment (PC 23).

Program learning outcomes:

- Apply a comprehensive approach to the design of telecommunications and radio-electronic equipment (PLO 30);
- Apply the basics of designing radio-electronic equipment for intelligent systems and the latest component base and materials when designing radio-electronic equipment for intelligent systems (PLO 31).

- **Prerequisites and post-requisites of the discipline (place in the structural-logical scheme of training under the relevant educational program)**

Students must ***master*** such disciplines as "Engineering and Computer Graphics," "Informatics," "Fundamentals of Metrology," and "Introduction to the Specialty," since TMPEA is a logical continuation of all the subjects studied and provides further study of disciplines in the training profile.

- **Contents of the academic discipline**

Section 1 *Three-dimensional modeling in SolidWorks and requirements for technical documentation*

Topic 1.1 *SolidWorks as CAD. Basic functional capabilities* Topic 1.2

Building sketches and 3D models in SolidWorks Topic 1.3 *General rules*

and symbols in documents

Topic 1.4 *Design documentation*

Section 2 *From designing a three-dimensional product to manufacturing it, taking into account ergonomics and aesthetics*

Topic 2.1 *Product appearance and manufacturing materials*

Topic 2.2 *Animation and visualization in SolidWorks.*

Topic 2.3 *3D printers and 3D printing*

- **Training materials and resources**

Basic literature

1. New features in SOLIDWORKS 2021 [Electronic resource] // solidworks.com – 2022. – Access mode Access to resource: https://files.solidworks.com/Supportfiles/Whats_new/2021/Engsian/whatsnew.pdf.
2. LEARN ONLINE [Electronic resource] // edu.3ds.com – 2022. – Access mode to the resource: https://edu.3ds.com/en/learn.
3. 3. DSTU 3008:2015

4. 4. Technical documentation: methodological guidelines for studying the course for students majoring in 7.02010501, 8.02010501 "Documentation and Information Activities." – Kirovograd: KNTU, 2015. – 52 p.
5. Morozhenko O.P., Malyshko G.V. Rules for the execution and design of drawings: Tutorial. – Dnipropetrovsk: NMETAU, 2012. – 49 p.
6. Tolerances, fits, and technical measurements: Textbook for students of vocational (vocational- technical) education / V. Z. Nabrodov. — Kyiv: Litera LTD, 2019. — 224 p.
7. Brusentsov V.G., Brusentsov O.V., Bugaychenko I.I., Kiselova S.O. Fundamentals of Ergonomics: Textbook. – Kharkiv: UkrDAZT, 2011. – 141 p.
8. Ergonomics and Fundamentals of Ergonomic Design: Methodological Recommendations for Coursework / Compiled by: L.R. Gnatyuk, V.M. Zaplatynsky. — Kyiv: NAU, 2011. — 40 p.
9. Solovyova O.V. 3D printing technologies. State University of Infrastructure and Technologies. URL: http://ageg.knuba.edu.ua/article/view/195097/pdf_25
10. Lazebny V.M. Modeling mechanical parts using AutoCAD and SolidWorks for printing on 3D printers / V.M. Lazebny // Scientific Notes of V.I. Vernadsky Ternopil National University. Series: Technical Sciences Volume 32 (71) No. 3 2021 – pp. 105–110.
11. Gibson I., Rosen D., Stucker B. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing. 2nd ed. Springer; 2015: 498 p. DOI: 10.1007/978-1-4939-2113-3.
12. Larson H., Kurman M. Fabricated: The New World of 3D-Printing. Wiley. 2013. 280 p

Supplementary

1. Three-dimensional modeling of radio-electronic equipment in SolidWorks [Electronic resource]: textbook for students majoring in 172 "Telecommunications and Radio Engineering" / A. V. Shulga, Ya. L. Zinger; Igor Sikorsky KPI. – Electronic text data (1 file: 14.33 MB). – Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2022. – 112 p.

Information resources

https://www.solidworks.com

https://edu.3ds.com/en/get-software

Educational content

- **Methodology for mastering the academic discipline (educational component)**

Lectures

No No	Lecture topic and list of key questions (list of teaching aids, references to literature, and assignments for independent study)

1	*Section 1. "Three-dimensional modeling in SolidWorks and requirements for technical documentation"* *References* Sources 1-6 from the list of teaching materials
2	*Topic 1.1: "SolidWorks as CAD. Basic functional capabilities"* • *CAD* • *CAD classes* • *Types of CAD* • *CAD classification* *Basic tasks of SolidWorks* *Literature:* 1-2 sources from the list of educational materials *Assignments for independent study:* Review lecture materials
3	*Topic 1.2: "Creating sketches and 3D models in SolidWorks"* • *Stages of manufacturing a part in SolidWorks* • *Creating sketches and other SolidWorks features* • *From sketch to 3D model* *SolidWorks libraries* *References:* 1-2 sources from the list of educational materials *Assignments for independent study:* Review lecture materials
4	*Topic 1.3: "General rules and symbols on documents"* • *Assembly drawing and requirements for it* • *Designations of products and design documents* • *Hatching* • *Roughness.* • *Tolerances, fits.* • *Quality* *Diagrams and their* *classification Literature:* 3-6 sources from the list of educational materials *Assignments for independent study:* Review lecture materials
5	*Topic 1.4: "Design documentation"* • *Design documentation* • *Graphic documents* • *Text documents* *Specifications and requirements for formatting* *References:* 3-6 sources from the list of educational materials *Assignments for independent study:* Review lecture materials
6	*Section 2. From designing a three-dimensional product to manufacturing it, taking into account ergonomics and aesthetics* *References:* 7-12 sources from the list of educational materials
7	*Topic 2.1: "Appearance of the product and materials for its manufacture"* • *Color, contrast, and color models* • *Basics of composition in three-dimensional modeling* • *Stages of product development* • *Material and product specifics* • *Material characteristics* • *Types of materials in design* • *Properties of polymer materials Literature:* 7-8 sources from the list of educational materials *Assignments for independent study:* Review lecture materials

8	*Topic 2.2: "Animation and visualization in SolidWorks"* • *Vector and raster graphics* • *Creating photorealistic models.* • *Rendering.* • *Texture.* • *Visualization methods.* *References:* 1-2 sources from the list of educational materials *Assignment for independent study:* Review lecture materials
9	*Topic 2.3: "3D printers and 3D printing"* • *3D printing technologies* • *Types of 3D printers* • *Recommendations for developing a 3D model for 3D printing* • *How to obtain the G-code for a 3D model* • *How to obtain STL in SolidWorks* • *Basic types of part filling References:* 9-12 sources from the list of educational materials *Assignments for independent study:* Review lecture materials

Laboratory work

No No	**Name of laboratory work**
1	*Laboratory work No. 1* "Creating a three-dimensional model of the TDA1558Q microcircuit in *SolidWorks*"
2	*Laboratory work No. 2* "Basic principles of drawing design in *SolidWorks*"
3	*Laboratory work No. 3* "Creating your own 3D model and drawing from a real part/device in *SolidWorks*"
4	*Lab work No. 4* "Part from a colleague's drawing"
5	*Lab work No. 5* "Creating a three-dimensional assembly from parts. Animation and visualization"
6	*Laboratory work No. 6* "Teamwork. Part 1 (Assembly, animation, visualization)" "Teamwork. Part 2 (Design documentation)" "Teamwork. Presentation of work"
7	*Laboratory work No. 7* "Creating a three-dimensional model of a printed assembly, editing elements. Working with sheet metal. Thermal analysis"

- **Independent work by students**

Planned calculation and graphic work, in which it is necessary to develop a device body for a given printed circuit board

Policy and control

- **Policy of the academic discipline (educational component)**

Rules for attending classes (both lectures and labs)

Attendance and completion of laboratory work are mandatory. If these classes are missed,

they must be made up during consultations or with other groups, if available. If lectures are missed, the material must be studied independently. Lecture materials are posted on the Sikorsky platform.

Defense of laboratory work

Laboratory work is defended at the beginning of the next class. The student receives one grade.

Defense of computational and graphic work

The calculation and graphic work is performed by each student independently, and the assignment is received according to the variant. The student receives one grade.

Modular test

The modular test is completed independently by each student after completing the entire lecture course. Students receive a grade after taking the test on the Sikorsky platform.

Incentive and penalty points and academic integrity policy

The most active students and students who complete individual assignments in an exemplary manner can receive up to 10 points towards their semester rating.

Penalty points are applied in cases of passing off someone else's work as one's own, with mandatory subsequent reworking.

Deadline and resit policy

If the deadlines for submitting assignments are missed, the maximum score for the assignments is reduced by 10%.

- **Types of assessment and the learning outcomes assessment rating system (LOAS)**

The curriculum for RE-23 provides for the following grading system:

- Laboratory work — 9 points for each, 7x9=63 points; •
Modular test — 18 points, 18x1=18 points;
- Calculation and graphic work — 19 points, 19x1=19.

Admission requirements:

- Completion of all laboratory work (minimum 5 points); •
Completion of the modular test (minimum 12 points);
- Calculation and graphic work (minimum 13 points).

Table of correspondence between rating points and grades on the university scale

Number of points	**Grade**
100-95	Excellent
94	Very good
84	Good
74-65	Satisfactory
64-60	Sufficient
Less than 60	Unsatisfactory
Admission requirements not met	Not admitted

- **Additional information on the discipline (educational component)**

List of questions for semester assessment:

- What is SolidWorks?
- List the classes of CAD
- List the types of CAD
- What CAD classifications do you know?
- What are the main tasks of SolidWorks?
- Describe the step-by-step creation of sketches.
- From sketch to three-dimensional model, basic principles
- Building complex solid models
- Basic symbols on assembly drawings.
- General rules and symbols on documents.
- What are the tolerances?
- What fits do you know?
- What types of roughness are there?
- What types of diagrams are there?
- What are the main sections of the specification?
- Requirements for drawing up specifications
- The concept of composition, its categories, properties, and means.
- Spatial structure and tectonics.
- The concept of composition. Tectonics.
- Means of composition. Types of repetition. Contrast, nuance.
- Properties of composition. Staticity, dynamism. Symmetry.
- Properties of composition. Unity of form and content. Imagery.
- Types of colors. Characteristics of color. Types and features of color models.
- Additive color models. RGB model.
- Subtractive color models. CMY(K) model.
- Perceptual color models. HSB models.
- Perceptual color models. Lab model.
- Types and characteristics of color models.
- Raster and vector graphics. Features, advantages, disadvantages.

Description of material, technical, and informational support for the discipline

The course "Three-dimensional modeling of radio-electronic equipment" is fully equipped with lecture halls with modern technology for conducting lectures in the form of presentations, as well as computer classrooms with the necessary software, namely SolidWorks.

Work program of the academic discipline (syllabus):
Compiled by Shulga A. V.;
Approved by the PRE Department (Minutes No. 06/2024 dated 06/27/2024)
Approved by the methodological commission of the faculty/research institute (protocol No. 06/2024 dated 28.06.2024)