

# Engineering & CoComputer Graphics

## Work program of the discipline (Syllabus)

### – Details of the discipline

<b>Level of higher education</b>	<i>First (bachelor's)</i>
<b>Field of knowledge</b>	<i>17 Electronics and Telecommunications</i>
<b>Speciality</b>	<i>172 Telecommunications and Radio Engineering</i>
<b>Educational program</b>	<i>Information and Computing Facilities of Radio-Electronic Systems</i>
<b>Discipline status</b>	<i>Compulsory (orative) (cycle of general training)</i>
<b>Form of study</b>	<i>full-time (full-time)</i>
<b>Year of preparation, semester</b>	<i>I course,  OSandNISemester</i>
<b>Scope of discipline</b>	<i>5 (150)</i>
<b>Semester control / control measures</b>	<i>Exam</i>
<b>Timetable</b>	<i>Lecture – every week (36 hours) Practical classes - once every two weeks (18 hours) Computer workshop – biweekly (18 hours)</i>
<b>Language of instruction</b>	<i>English</i>
<b>Information about Course Leader / Instructors</b>	<i>Department of Descriptive Geometry, Engineering and Computer Graphics (building 7, room 815), e-mail: <a href="http://geometry.kpi.ua/">http://geometry.kpi.ua/</a> Phone: +380 44 204 94 46  Nadkernychna Tetyana Mykolayivna e-mail: <a href="mailto:t_nadker@ukr.net">t_nadker@ukr.net</a>, mobile phone 0953340464</i>
<b>Course Placement</b>	<i><a href="https://drive.google.com/drive/folders/12mcri85VsWw0ApfTKa3EysweOuGrHk75?usp=drive_link">https://drive.google.com/drive/folders/12mcri85VsWw0ApfTKa3EysweOuGrHk75?usp=drive_link</a></i>

### – The program of the discipline

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

The academic discipline belongs to the cycle of general training.

Subject of subject: methods of geometric modeling; graphic (projection) methods for solving engineering and geometric problems; methods of simplifying the solution of engineering graphics problems; requirements of standards for the design of design documentation, computer graphics systems.

Interdisciplinary relations: The discipline "Engineering and Computer Graphics" refers to the cycle of general training, which is based on the preliminary training of students in geometry, stereometry, physics, drawing and computer science within the programs of secondary education institutions, as well as knowledge of the basics of fundamental sections of the disciplines of

higher mathematics, general physics, computer science and others in volumes that meet the requirements of the chosen profession.

The discipline "Engineering and Computer Graphics" lays the foundations for the development of electronic equipment products, which are studied in senior courses; in course and diploma design.

### **1. Purpose and objectives of the discipline**

The purpose of the discipline is to form students' abilities to model electronic equipment products by geometric and computer methods, build and design their technical drawings and diagrams in accordance with existing standards; use of information and design systems in their professional activities.

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

#### **knowledge:**

- basic principles of geometric modeling of objects;
- projection methods of construction and study of spatial objects based on their flat images in drawings;
- requirements of existing state, interstate and world standards that operate on the territory of Ukraine and are used in the construction of technical documentation in the field of electronic industry;
- capabilities of modern graphic editors for modeling objects, making and editing their images and drawings, as well as preparing design and technological documentation;
- fundamental graphic and information training with a focus on the professional profile of the Faculty of Electronics.

#### **Skill:**

- perform and read projection images of any geometric and technical objects;
- use the drawing as a flat geometric model of the object, on which you can examine the same geometric parameters as on the real product;
- draw up design documents in accordance with the requirements of current standards;
- carry out design and technological documents using computer-aided design systems;
- apply knowledge of computer graphics, modern information technologies and the Internet;
- Use drawings at different stages of design.

#### **experience:**

- making a freehand sketch and drawing with the help of drawing tools;
- work with information and design tools;
- information management;
- knowledge of appropriate terminology and use of reference literature;

According to the requirements of the educational and scientific program, students after mastering the discipline "Computer Graphics" must demonstrate the following learning outcomes:

The main tasks of the discipline.

According to the requirements of the program of the discipline, students after mastering the credit module must demonstrate the following learning outcomes:

#### **General Competencies**

GC2 Ability to apply knowledge in practical situations.

GC3 Ability to plan and manage time.

GC7 Ability to learn and master modern knowledge.

GC8 Ability to identify, pose, and solve problems.

#### **Professional competencies**

FC 4 Ability to carry out computer simulation of devices, systems and processes using universal application packages

FC 5 Ability to use regulatory and legal documentation that refers to information and telecommunication networks, telecommunications and radio engineering systems (laws of Ukraine, technical regulations, international and

national standards, recommendations of the International Telecommunication Union, etc.) to solve professional problems.  
 FC 8 Willingness to promote the implementation of promising technologies and standards.  
 FC 9 Ability to accept and master new equipment in accordance with current regulations  
 FC 10 Ability to install, adjust, adjust, adjust, Proof-of-service, testing and commissioning  
 Facilities, Facilities and Equipment of Telecommunications and Radio Engineering

### Programmatic Learning Outcomes

PRN 19 explain the principles of construction and operation of hardware and software complexes of control and maintenance systems for the development, analysis and operation of information and telecommunication networks, telecommunication and radio engineering systems;  
 PRN 27 Independently make the right engineering and technical decisions, apply modern system and information technologies, to justify the choice rational variants of EOS construction, as well as radio-electronic systems different functional purpose and principle of operation.

### 2. Prerequisites and post-requisites of the discipline (place in the structural and logical scheme of training in the relevant educational program)

The discipline "Engineering and Computer Graphics" forms the engineering and technical component in the training program of the future specialist.  
 Students will be able to apply the obtained learning outcomes in the preparation of the following subjects: REA materials, the basics of metrology

### 3. The content of the discipline

A list of sections and topics of the entire *discipline* is provided.

Form of study	Semester (credit) modules	Total credits/hours	Distribution of study time by types of classes				Semester Certification
			Lecture	Practical classes	Computer Practicum	SRS	
Day	Just	5/150	36	18	18	78	
	1	5/150	36	18	18	78	Exam

The course material is divided into two sections:

#### Chapter 1. Engineering Graphics

The main goals of engineering graphics are to master the methods of development and implementation of design documentation by students.

#### Chapter 2. Computer Graphics

The main goals of computer workshops are: mastering specific typical construction techniques, acquiring practical skills in constructing a drawing and solid mode.

As a result of studying the course, the student should gain knowledge, work experience and conscious application of the methods of geometric modeling of spatial forms, the use of standards for the execution of working drawings.

### 4. Training Materials & Resources

Basic literature:

1. Vanin V.V., Perevertun V.V., Nadkernychna T.M., Vlasiuk A.G. *Engineering graphics*. – K. BHV Publishing Group. 2009.– 400 p.: ill. [http://ng-kg.kpi.ua/files/Inz\\_graf\\_Vanin.pdf](http://ng-kg.kpi.ua/files/Inz_graf_Vanin.pdf)

2. *Methodical instructions for geometric and projection drawing/ Compiled by G.M. Koval.-k.: NTU "KPI", 2014 – 36 p. [http://geometry.kpi.ua/files/metod\\_kovalj.pdf](http://geometry.kpi.ua/files/metod_kovalj.pdf)*
3. *Computer Graphics Course in AUTOCAD Environment. THEORY EXAMPLES. TASKS [Electronic resource]: study. Helps. for students. specialty 105 "Applied Physics and Nanotechnology", specialization "Applied Physics" / T.M. Nadkernichna, O.A. Lebedeva; KPI them. Igor Sikorsky. – Kyiv : KPI them. Igor Sikorsky, 2020. – 191 p. [http://geometry.kpi.ua/files/Literature/Autocad\\_2020\\_Nadkernichnaya\\_Lebedeva.pdf](http://geometry.kpi.ua/files/Literature/Autocad_2020_Nadkernichnaya_Lebedeva.pdf)*

*Further reading:*

1. *Vanin V.V., Blyok A.V., Gnitetska G.O. Design of design documentation. Manual. 4th ed., ed. And additional. – K.: Karavela, 2012.-200 p. [http://geometry.kpi.ua/files/Vanin\\_Gniteckaja\\_kd1\\_2.pdf](http://geometry.kpi.ua/files/Vanin_Gniteckaja_kd1_2.pdf)*
2. *GOST 2.001-70 - 2.121-73 ESKD. Osnovnye polozheniya.- M., 1985.*
3. *GOST 2.301-68 - 2.319.81 ESKD. General rules for the execution of drawings.-M., 1985.*
4. *Mikhailenko V.E., Kislookiy V.I., Lyashchenko A.A. Geometric Modeling and Machine Graphics in CAD.-Higher School, 1991.*

*All this literature is available in sufficient volume in the library of NTUU "KPI".*

*Information Resources*

1. *Short Lecture Course on Engineering Graphics <http://ela.kpi.ua/handle/123456789\6764>*
2. *Campus <http://login.kpi.ua/>.*
3. *Library <ftp://77.47.180.135/>.*
4. *Methodical documentation of the website of the Department of [http://ng-kg.kpi.ua/index.php?option=com\\_content&view=article&id=37:2010-06-05-04-40-02&catid=71:narisnauch1&Itemid=13](http://ng-kg.kpi.ua/index.php?option=com_content&view=article&id=37:2010-06-05-04-40-02&catid=71:narisnauch1&Itemid=13)*

## – Educational content

### 5. Methods of mastering the discipline (educational component)

*The program of the discipline provides for lectures, practical and computer workshops. In the case of distance learning mode, it is possible to use courses posted on the Sikorsky platform: problem-based, visualized lectures on the Zoom platform*

**Chapter 1.** *Engineering graphics.*

**Lecture 1.** *Introduction. Projection of a point and a line.*

*Subject and objectives of the course. Projection methods. Complex point drawing. Ways to construct the third projection of a point. The position of points relative to the planes of projections. Direct and inverse problems. Complex drawing of a straight line. Straight lines and projections, their properties. Determination of the natural value of a segment of a line of general position by the method of replacing projection planes. The first and second typical tasks.*

**Lecture 2.** *Projection of a plane and a circle.*

*Define a plane on a diagram. Planes of special position: projection and level. Trace-projection of the plane of special position. Planes of general position. Zero traces of the plane. Belonging to a line and a point to a plane. Conversion of the plane of general position into projection and level.*

**Lecture 3.** *Curved lines and surfaces.*

*Classification of curved lines. Methods of specifying surfaces, their classification, surface determinants. Top-down spins. Plotting points and lines on surfaces.*

**Lecture 4.** *Intersection of surfaces by a plane. Sweeps.*

A general technique for crossing surfaces with a plane. Four types of adach on the intersection of surfaces of the area. Construction of a line (figure) of the intersection of second-order surfaces by planes of separate and general position.

**Practical lesson 1. Introduction. Projection of a point and a line. The problems of constructing a complex drawing of a point, the position of points relative to the planes of projections and relative to the geometric elements of the figures are considered. The problems of constructing a complex drawing of a line are considered; determination of the natural value of the segment of the line of general position by the method of replacing the planes of projections; construction of spatial geometric shapes.**

**Practical lesson 2. Projection of a plane and a circle.** The problems of constructing the membership of a line and a point of area are considered; transformation of the plane of the general position into the projection and level; projection of a circle, which is located in the planes of special and general position.

**Practical lesson 3. Curved lines and surfaces.** Problems for constructing points and lines on surfaces of rotation are considered. Projection drawings of rotation surfaces are constructed.

**Practical lesson 4. Intersection of surfaces by plane. Sweeps.** Tasks are performed to construct a line (figure) of intersection of second-order surfaces by planes of separate and general position.

**Lecture 5. Images: views, sections, sections. Dimensioning**

Species (primary, additional, local). Simple and complex cuts. Sections. Examples of execution.

**Lecture 6. Working drawings of parts obtained by machining. Threading.**

Classification of slices. Image and notation of the thread on the drawing. Surface cleanliness of the part. On the basis of surface roughness. Conventions for designating roughness in drawings.

**Lecture 7, 8. Structural elements of assembly units. Threaded connections. One-piece joints.**

Connection with screws, studs, and bolts. Calculation of the lengths of fasteners by options. Connection by welding, soldering and gluing. Designation of welding, soldering and gluing. Drawing up a specification for an assembly unit. Compilation of symbols.

**Lecture 9. Reading general drawings.**

Purpose, features and principles of execution and designation of general drawings. Features of detailing drawings of a general view. Selection of the main view and number of images of the part. Dimensioning, taking into account technological and design bases. Determination of the roughness of the surfaces of parts according to general drawings.

**Practical lesson 5. Images: views, sections, sections.. Dimensioning. Single and double penetration.**

**Practical lesson 6. Working drawings of parts obtained by machining. Rifling. Classification of rifling. Images and notations of the thread on the drawing. Surface cleanliness of the part. Surface roughness parameters. Conventions for designating roughness in drawings.**

**Practical lesson 7. Structural elements of assembly units. Threaded connections.**

Connection with screws, studs, and bolts. Calculation of the lengths of fasteners according to the we option. Compilation of symbols. Drawing up a specification for an assembly unit.

**Practical lesson 8. One-piece joints. Joints by welding, soldering and gluing. Designation of welding, soldering and gluing.**

**Practical lesson 9. Overview of the lesson.**

**Chapter 2. Computer graphics.**

**Lecture 1. General requirements for the execution of design documents. Formats, main inscription, lines on drawings. Introduction to AutoCAD. ACAD window. The boundaries of the drawing and its display on the screen. Create and install layers. Specify the coordinates of points in the drawing. The Line drawing**

command and the Erase, Copy editing command, Commands for generating textual information in the drawing. Create text styles.

**Lecture 2.** Drawing generation commands using graphic primitives Xline, Circle, Ellipse, Polygon, Rectang, Spline. Image editing commands Trim, Extend, Move, Offset. Dimensions in drawings. Create dimension styles. Dimensioning in the ASAD system. Examples of execution.

**Lecture 3, 4. Blocks.** Create and use blocks. Create and edit block attributes. Work with the Design Center module and tool palettes. Rules for executing the scheme and list of elements of digital computing.

**Lecture 5.** Organization of work in ACAD when constructing a projection drawing. Use object snaps and Polar Tracking mode to build three types of models. . Graphic designations of materials. Use the B hatch command to apply hatching. Dimensioning.

**Lecture 6. Fundamentals of working in three-dimensional space.** Means of navigation and identification of species. Coordinate systems. Coordinate filters. User's coordinate system. Working with view screens in three-dimensional space. Three-dimensional primitives. Building a model using basic three-dimensional primitives (box, sphere, cylinder, cone, wedge, torus). Creation of a projection drawing from a 3D image.

**Lecture 7.** Creation of three-dimensional objects by ejection (extrusion) and the Presspull command. Modeling of objects of complex shape using Boolean operations. Examples of execution.

**Lecture 8.** Create three-dimensional objects by rotating. Editing the shape of solids. Chamfering and conjugation of faces of solids.

**Lecture 9.** Review lecture. Preparation for the exam.

**Computer Practicum 1.** Graphical interface of the program. Configuring drawing parameters in AutoCAD. Set the drawing boundary and display it on the screen. Create and install layers. Specifies the coordinates of points in the drawing. Setting coordinates in AutoCAD. Building a frame and a main inscription.

**Computer Practicum 2.** Execution of a geometric drawing – conjugation according to an individual task. Drawing design.

**Computer Practicum 3, 4.** Creation of blocks. In the implementation of the scheme of the principal and the list of elements of digital computing technology.

**Computer Practicum 5.** Execution of a drawing of a geometric model (construction of views, sections) according to an individual task. Drawing design.

**Computer Practicum 6.** Work in three-dimensional space. Three-dimensional primitives.

User's coordinate system. Working with view screens in three-dimensional space. Commands for constructing three-dimensional primitives.. Construction of three-dimensional primitives according to an individual task.

**Computer Practicum 7. Construction of a three-dimensional model of a complex shape according to an individual task** Creation of a three-dimensional model by ejection and Boolean operations Construction of a three-dimensional model of a complex shape according to an individual task

**Computer Practicum 8.9** Creation of three-dimensional objects by rotation. Editing the shape of solids. Construction of chamfers and conjugation of faces of solids. Building a three-dimensional model – shaft. Creation of a shaft drawing with cross-sections from a 3D image.

*The student's independent work involves the preparation of the student for practical classes and computer practicum, exam.*

## – Policy & Control

### 6. Academic discipline policy (educational component)

*The system of requirements that the teacher sets for the student/graduate student is indicated:*

- rules for attending classes (both lectures and computer workshops);

- *rules of conduct in the classroom (activity, preparation of short reports or texts, disconnection of phones, use of communication tools to search for information on the teacher's Google Drive or on the Internet, etc.);*
- *rules for the protection of practical classes;*
- *rules for the protection of computer workshops;*
- *rules for the protection of individual tasks;*
- *rules for assigning incentive and penalty points;*
- *deadline and retake policy;*
- *academic integrity policy;*
- *other requirements that do not contradict the legislation of Ukraine and regulatory documents of the University.*

### *Academic Integrity*

*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>*

### *Standards of Ethical Conduct*

*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>*

### *Procedure for appealing the results of control measures*

*Students have the opportunity to raise any issue that relates to the control procedure and expect it to be dealt with according to predetermined procedures.*

## **7. Types of control and rating system for assessing learning outcomes (CRO)**

*Current control: express control, defense of practical classes and computer workshops.*

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

*Conditions for admission to semester control: enrollment of all practical tasks and computer workshops.*

*Graphic works.*

*1. Workbook on engineering graphics with solved exercises and problems on the topics of lectures.*

*2. Diagram No. 1 "geometric model" - f.A3.*

*3. Threaded part – f.A3.*

*4. Construction of a drawing of threaded connections and permanent connections. Drawing up a specification.*

*5. Execution of the detailing drawing.*

*Tasks for a computer workshop.*

*1. Execution of a geometric drawing – conjugation according to an individual task.*

*2. Execution of the circuit of the principal electrical with the help of blocks.*

*3. Drawing a geometric model (views, sections)*

*4. Construction of three-dimensional primitives and creation of a projection drawing based on a 3D image.*

*5. Building a three-dimensional model of a complex shape.*

*6. Construction of bodies of rotation and creation of a shaft drawing with cross-sections from a 3D image.*

*Express tests are carried out in the form of a programmable control of students' knowledge at the end of each topic at the beginning of the practical lesson for 15 minutes. Individual tasks of programmable control over the subject and complexity correspond to the exercises that students perform at the computer workshop. The results of the test are communicated to students in the same practical lesson. Such a schedule of tests ensures the systematic work of students during the study of this discipline and, as experience shows, significantly affects the improvement of the quality of education. Individual tasks are selected in such a way that their implementation requires updating the knowledge of students both from the lecture course and obtained in the process of completing tasks for each section of the computer workshop. The topics of individual tasks are provided on the website of the department, and are also attached to the work program. Calendar control: it is carried out twice a semester as a monitoring of the current state of fulfillment of the requirements of the syllabus.*

*Semester control: exam.*

*Conditions for admission to semester control: minimum positive mark for an individual assignment / enrollment of all laboratory work / semester rating of more than 36 points.*

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

<i>Score</i>	<i>Score</i>
100-95	Perfectly
94-85	Very good
84-75	Well
74-65	Satisfactory
64-60	Enough
Less than 60	Disappointing
Admission conditions are not met	Not allowed

– **Criteria for awarding points based on the results of the student's work:**

*Engineering Graphics Workbook – 4 points*

*Graphic works on engineering graphics (5 works in total (5x4 = 20 points)).*

*Computer workshop (6 papers in total (6x4=24 points)).*

*Express control work (3 works in total (4x3=12 points)).*

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

The exam is passed by tickets. The ticket consists of three tasks. The condition of the first and second tasks includes the educational material that is studied in the theoretical part of the course on engineering graphics. Knowledge of projection methods and methods of simplifying the solution of course problems is tested. The second task is complex. The acquired competencies of modeling geometric objects, the ability to apply the requirements of standards in the design of design documentation are checked. The condition of the third part includes the educational material that is studied in the theoretical part of the course on computer graphics.

**Work program of the discipline (syllabus):**

Compiled by Senior Lecturer Nadkernychna Tetyana Mykolayivna.

**Approved** by the Department of \_NGIKG\_ (Minutes No. \_6\_ of \_25.0 5.2023)

**Approved by the** Methodological Council of the Faculty Of Electronics

(Minutes No. 06/2023 dated 29.06.2023)



