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

Department of Descriptive Geometry, Engineering and Computer Graphics

ENGINEERING AND COMPUTER GRAPHICS

Curriculum of the academic discipline (Syllabus)

Course details

Level of higher education ***First (bachelor's)***

Field of knowledge	*17 Electronics, Automation, and Electronic Communications*
Special	*172 Electronic communications and radio engineering*
Educational program	*1.Intelligent technologies of radio electronics* *2.Information and Communication Radio Engineering* *3.Radio Engineering Computerized Systems* *4.Radio Electronic Warfare Technologies*
Status of the discipline	*Regulatory*
Form of study	*Full-time (day)/distance/blended*
Year of training, semester	*1st year, fall*
Scope of the discipline	5 credits/150 hours (lectures: 18 hours, practical lessons: 36 hours, laboratory works – 36 hours, independent work: 60 hours)
Semester assessment/assessment measures	*Fall semester – credit*
lesson schedule	*Fall semester: lecture – once a week (18 hours); practical lessons – every week (36 hours); computer workshop every week (36 hours).*
Language of instruction	*Ukrainian*
Information about the course coordinator/teachers	*Department of Descriptive Geometry, Engineering and Computer Graphics (building 7, room 815), e-mail: http://geometry.kpi.ua/ Phone:+380 44 204 94* Lecturer: *Ph.D., Associate Professor, Galina Gnitetskaya Омелянівна,gnitetsk@ukr.net, 050 710 41 87*[1] Practical lessons: *according to schedule* Computer workshop: *according to schedule* [2]
Course location	Link to remote resource (Moodle) Engineering and Computer Graphics (RTF) https://do.ipo.kpi.ua/course/view.php?id=1995 https://do.ipo.kpi.ua/course/view.php?id=3362

Curriculum

1. Description of the academic discipline, its purpose, subject matter, and learning outcomes

The main objective of teaching the discipline "Engineering and Computer Graphics" is to provide higher education students with a system of basic knowledge of the main sections of the course, to give them experience in applying methods of geometric modeling of spatial forms, and to create and design construction documentation using modern CAD systems in accordance with standard requirements.

The syllabus is structured in such a way that in order to complete each subsequent task, students must apply the skills and knowledge they have acquired in previous course topics. The content of the practical tasks is selected so that they are as close as possible to the future practical professional activities of higher education students. Particular attention is paid to encouraging students to engage in active learning. This is facilitated by the organization of independent work by students using a set of methodological materials posted on the Sikorsky distance learning platform. In addition, the following are used during training:

- *active and collective learning strategies;*
- *personality-oriented developmental technologies based on active forms and teaching methods (independent lesson room and extracurricular work on course; independent study of individual topics of the discipline, using a set of teaching materials posted on the Sikorsky distance learning platform, etc.).*

As a result of studying the discipline "Engineering and Computer Graphics," students acquire the following competencies:

***general**:*

1. *Ability to apply knowledge in practical situations (GC 2);*
2. *Knowledge and understanding of the subject area and understanding of professional activities (PC 4)*
3. *Ability to learn and acquire modern knowledge (PC 7);*

Program learning outcomes:

1. *Application of understanding of means of automation of design and technical operation of telecommunications and radio engineering systems in professional activities (PRN15).*
2. *Understanding and compliance with domestic and international regulatory documents on the development, implementation, and technical operation of information and telecommunications networks, telecommunications, and radio engineering systems.*

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

The discipline lays the foundation for the study of other disciplines: design of radio-electronic equipment; higher mathematics; virtual device technology; course and diploma design, etc., as well as disciplines that require the ability to create and design traditional projection and electronic drawings of products using modern CAD, geometric and computer 3D modeling of radio-electronic equipment objects from a cycle of disciplines for the professional and practical training of students in their senior years. OK, which is a prerequisite for this discipline – "Circuitry."

3. Contents of the academic discipline "Engineering and Computer Graphics."

4. Section 1. Representation of point, line, and plane models in the projection plane system.

Topic 1.1. Projection methods: central and parallel. Orthogonal projection is the main method for constructing technical drawings. Setting the position of a point model in a system of projection planes. Creating a complex drawing of a point. The position of points in space relative to projection planes. Direct and inverse problems (construction and reading of a projection drawing).

Topic 1.2. Modeling a straight line in a system of projection planes. Specifying a straight line on a drawing. Straight lines of a specific position: level and projecting. Straight lines of a general position. Traces of a straight line. Belonging of a point to a straight line. Division of a straight line segment in a given ratio. Modeling the mutual position of straight lines in space: parallelism, intersection, skewness.

Topic 1.3. Modeling a plane in a system of projection planes. Specifying a plane on a diagram. Planes of a specific position: level and projecting. Trace-projection of a plane of a specific position. Planes of a general position. Belonging of a line and a point to a plane. Modeling the mutual position of planes in space: parallelism, intersection (special cases).

Section 2. Methods for simplifying the solution of problems for modeling geometric objects in the space of the system of projection planes.

Topic 2.1. Method of replacing projection planes. Main tasks of the method of replacing projection planes using the example of a line segment of general position and a plane of general position. Determining the natural value of a dihedral angle. Constructing the natural value of a flat figure.

Section 3. Modeling curved lines and surfaces.

Topic 3.1. Flat and spatial curved lines. lesson and order of a curve. Methods of modeling second-order curved lines. Projection of a circle.

Topic 3.2. Surfaces. Methods of modeling surfaces. Determinants of surfaces. Linear surfaces that unfold and do not unfold. Surfaces of revolution. Construction of points and lines on surfaces.

Section 4. Intersection of geometric elements.

Topic 4.1. Modeling the intersection of surfaces with a plane. General method for the intersection of surfaces with a plane.

Four lessons of problems. Construction of a line (figure) of intersection of second-order surfaces with planes of separate and general position. Determination of the natural size of the intersection figure. Developments.

Topic 4.2. Single and double penetration. General method for solving problems of penetration of surfaces by symmetric and asymmetric horizontal "windows." The concept of a view and a simple section.

Topic 4.3. Intersection of surfaces. Method of intermediaries. Special cases of intersection of second-order surfaces. Use of intermediaries - planes of separate position. Method of spherical intermediaries. Monge's theorem. Conclusions from the theorem.

Section 5. General requirements of standards for the design of engineering documentation Part 1.

System of standards for the design of engineering documentation.

Topic 5.1. Basic provisions. Types of design documentation. Formats and basic inscriptions. Scales. Lines. Fonts. Basic requirements for dimensioning on drawings. Conjugation of geometric elements.

Part 2. Using the AutoCAD graphics editor for design documentation

Topic 5.2. Purpose of the AutoCAD graphics editor and its capabilities. Graphics editor interface. Basic commands for constructing and editing graphic primitives. Model space. Sheet space. Ways to set coordinates in AutoCAD. Object snaps. Image control.

Topic 5.3. Configuring object properties. Creating layers. Configuring text, dimension styles, and units of measurement. Specifying blocks with attributes. Creating A3 and A4 templates using blocks with attributes.

Topic 5.4. Performing conjugations in a graphics editor. Creating arrays of objects. Constructing flat parts of complex configuration using conjugations on an A3 template. Formatting drawings in accordance with standard requirements. Printing drawings.

Section 6. Modeling 3D objects, constructing projection drawings in AutoCAD.

Part 1. Building images of objects on projection drawings. Axonometric projection.

Topic 6.1. Images: views, sections, cross-sections. Simple and complex sections. Methodology for applying dimensions taking into account the geometry of the part.

Topic 6.2. Axonometry. Methods of constructing axonometric images. Standard types of axonometry.

Part 2. Modeling 3D objects in AutoCAD.

Topic 6.3. Using basic geometric shapes. Methods of extrusion, rotation, offset, loft. Using the user coordinate system. Using logical operations. Commands for editing 3D objects.

Topic 6.4. Layout of projection drawing images in AutoCAD. Construction of a drawing
"Simple sections" based on a previously created 3D model. The model is based on a wooden model or an axonometric image of the object. Designing a drawing of a detail in accordance with standard requirements.

Topic 6.5. Construction of a drawing "Complex sections" based on a previously created 3D model. The model is made according to the projection drawing of the detail, where the views of the detail are shown. Design of the detail drawing in accordance with the requirements of the standards.

Chapter 7. Parameterization.

Topic 7.1. Using parameterization capabilities in geometric modeling. Imposing geometric and dimensional dependencies. Parameter manager. Creating a drawing of a parameterized flat contour.

Section 8. Sketches and working drawings of parts.

Part 1. Standard requirements for working drawings and sketches of parts.

Topic 8.1. Features of images of parts in a drawing depending on the method of their manufacture. Applying dimensions from technological bases. Surface cleanliness. Surface roughness marks. Technical conditions. Structure of material recording.

Topic 8.2. Threads. personification of threads. Thread parameters. Thread grooves. Depiction of threads on a working drawing of a part. Thread designations.

Topic 8.3. Features of drawing parts manufactured by turning. Sketches of parts of the
"Shaft" and "Bushing".

Part 2. Application of parameterization as a means of solving 3D computer geometric modeling problems of technical objects in AutoCAD.

Topic 8.4. Construction of a 3D model of a part with a "cap nut" thread using AutoCAD and parameterization. Use of the created 3D model to construct a working drawing of the part in accordance with current standards.

Topic 8.5. Building a 3D model of a part that is machined by turning. Creating a working drawing of the "Shaft" part in the AutoCAD graphics editor by creating its 3D model using parameterization and in accordance with current standards.

Section 9. Assembly drawing.

Part 1. Designing drawings of assembled units.

Topic 9.1. Contents of assembly drawings. Standard requirements for creating assembly drawings. Conventions and simplifications in drawings of assembly units.

Topic 9.2. Threaded connections. Depiction of threaded connections in assembly drawings. Calculation of simplified depictions of fasteners in connections.

Topic 9.3. Permanent joints (soldering, gluing, welding). Welding methods. Images and designations of permanent joints. Features of assembly drawings for reinforced, soldered, and welded products. Specifications.

Use of conventional symbols. Technical conditions.

Part 2. Application of parameterization and dynamic blocks when creating assembly drawings in AutoCAD.

Topic 9.4. Creating electronic libraries of fastener images using dynamic blocks in the AutoCAD graphics editor.

Topic 9.5. Creating an assembly drawing of a parameterized model of an assembled unit using an electronic library of images of fasteners created using dynamic blocks. Specification.

Section 10. Detailing.

Part 1. General drawing.

Topic 10.1. Purpose of a general assembly drawing. Requirements for a general assembly drawing of an assembled unit. Conventions and simplifications. Detailing a general assembly drawing. Features of creating working drawings of parts manufactured using different technological operations.

Part 2. Detailing in the AutoCAD graphics editor environment.

Topic 10.2. Analysis of general drawings and selected parts. Creating a 3D model of a part. Creating a working drawing of a part based on a previously constructed 3D model.

Section 11. Schemes.

Part 1. Electrical schematic diagram.

Topic 11.1. Types and kinds of diagrams. Electrical schematic diagram. Conventional graphic symbols of diagram elements. Alphanumeric code of an element. Characteristics of input and output circuits. Drawing up a list of elements.

Part 2. Electronic drawing of an electrical schematic diagram.

Topic 11.2. Construction of an electrical schematic diagram in the AutoCAD graphics editor using a created library of blocks with attributes. Creation of a list of elements.

Section 12. Additional features of AutoCAD.

Topic 12.1. Interconnection with other graphic editors (SolidWorks, 3D Max Studio, etc.): exporting and importing files with other formats.

5. Training materials and resources

Basic literature

1. Engineering Graphics: Textbook for Students of Higher Education Institutions of I-II Levels of Accreditation/ V.E. Mikhailenko, V.V. Vanin, S.M. Kovalyov; Edited by V.E. Mikhailenko. -Lviv: Picha Yu.V.; Kyiv: Karavela; Lviv: Novyi Svit - 2000. - 284.
2. Vanin V.V., Bliook A.V., Gnitetskaya G.O. Design documentation: Textbook. 3rd edition. Kyiv: Karavela, 2012. 200 p. http://geometry.kpi.ua/files/Vanin_Gniteckaja_kd1_2.pdf
3. Vanin V.V., Perevertun V.V., Nadkernichna T.M. et al. Engineering and computer graphics. Kyiv: BHV Publishing Group, 2009. — 400 p.

Additional literature

5 Mykhailenko V.E., Vanin V.V., Kovalov S.M. Engineering and computer graphics. — Kyiv: Karavela, 2012. — 363 p.

6 Khaskin A.M. Drawing. — Kyiv: Vyshcha shkola, 1985. — 440 p.

7 Engineering Graphics Development of Sketches and Working Drawings of Details Tutorial/ Compiled by: V.V. Vanin, O.M. Vorobyov, A.E. Izvolenskaya, N.A. Parakhina, - Kyiv: Igor Sikorsky KPI, 2016. — 106 p.

8 DSTU GOST 2.702:2013 Unified system of design documentation. Rules for the execution of electrical diagrams.

All of the above literature is available in sufficient quantities in the library of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute."

Information resource

9 Set of methodological materials. Distance learning platform "Sikorsky":https://do.ipo.kpi.ua/course/view.php?id=1995

Set of methodological materials. Distance learning platform "Sikorsky": https://do.ipo.kpi.ua/course/view.php?id=3362

10 *ftp://77.47.180.135/* Library.

11 5. G.V. Baskova, G.M. Koval. Methodological guidelines for completing the assignment on the topic "Connections" – K: NTUU "Igor Sikorsky KPI", 2017. – 42 p. http://ng-kg.kpi.ua/files/147.pdf

12 Methodological documentation of the department's website page Educational and methodological literature*: 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

6. Methods of mastering the academic discipline (educational component)

The program of the academic discipline includes lectures, practical lessons, and computer workshops. The course is supported by an information resource that provides a set of methodological materials: a lecture course with references to the relevant sections of the textbook; video lessons, options for assignments on the course topics, and methodological guidelines for their completion, posted on the Sikorsky educational platform. In the case of distance learning, all these materials can be used for lectures and practical lessons on the Zoom and In platforms, as well as being available for students' independent work within the framework of remote access to information resources at a time convenient for them.

Lectures

No.	Lecture topics
1	Projection methods. Central and parallel projection. Geometric modeling of spatial objects. Projection of a point onto three mutually perpendicular projection planes. Complex drawing of a point. Methods for constructing the third projection of a point. Position of points relative to projection planes. Direct and inverse problems. Determining the distance from a point to planes and projection axes. Competing points. ***Teaching aids:*** https://do.ipo.kpi.ua/course/view.php?id=1995; https://do.ipo.kpi.ua/course/view.php?id=3362; course workbook. ***Recommended reading:*** *[1].* ***Independent work:*** *Review of lecture material. Completion of homework assignments in the workbook on this topic. Review of materials from the video lesson "Creating Templates."*
2	System of standards. Types of design documentation. Formats. Scales. Lines. Fonts. Images: types, sections, cross-sections. Simple sections. Complex sections. Dimensioning. ***Teaching aids:*** https://do.ipo.kpi.ua/course/view.php?id=3362. ***Recommended reading:*** *[2], section 2, pp. 19-25.* ***SRC:*** *Review of lecture materials. Review of video lessons "Building a 3D model in AutoCAD," "Laying out drawings in AutoCAD. Making sections."*

3	Projecting a straight line. Assigning a straight line on a diagram. Straight lines of special position: horizontal and projecting. Straight lines of general position. Determining the actual length of a segment of a straight line of general position and the angles of inclination of the straight line to the projection planes. Belonging of a point to a straight line. Dividing a segment of a straight line in a given ratio. Traces of a straight line. Mutual position of two straight lines. ***Teaching aids:*** https://do.ipo.kpi.ua/course/view.php?id=1995; https://do.ipo.kpi.ua/course/view.php?id=3362; course workbook. ***Recommended reading:*** *[1].* ***Independent work:*** *Study the lecture material. Complete the homework assignments in the workbook according to* *this topic. Review of the video lesson "Parameterization in the AutoCAD graphics editor."*
4	Projection of a plane. Setting a plane on a diagram. Planes of special position. Trace projection of a plane of special position. Planes of general position. Belonging of a line and a point to a plane. Mutual position of two planes. Curved lines Parallelism of planes. Intersection of planes of special position. Intersection of planes of general and special position. ***Teaching aids:*** https://do.ipo.kpi.ua/course/view.php?id=1995; https://do.ipo.kpi.ua/course/view.php?id=3362; course workbook. ***Recommended reading:*** *[1].* ***Independent work:*** *Study the lecture material. Complete the homework assignments in the workbook on this topic. Study the materials of the video lesson "Working drawings and sketches of parts. Threading. Construction of a working drawing of a cap nut based on a 3D model created* *the AutoCAD graphics editor environment."*
5	Methods for simplifying the solution of course problems. Method of replacing projection planes.
	Teaching aids: https://do.ipo.kpi.ua/course/view.php?id=1995; https://do.ipo.kpi.ua/course/view.php?id=3362; course workbook. ***Recommended reading:*** *[1].* ***SRC:*** *Review of lecture material. Completion of homework assignments in the workbook on this topic. Review of video lesson materials "Working drawings and sketches of parts. Threads. Construction of a working drawing of the "Shaft" part based on a 3D model created in* *the AutoCAD graphics editor environment."*
6	Curved lines. lessonification of curved lines. Projection of a circle. Methods of specifying surfaces, their definition, lessonification. Linear surfaces that unfold and do not unfold. Surfaces of revolution. Construction of points and lines on a surface, conditions for their belonging to the surface. ***Teaching aids:*** https://do.ipo.kpi.ua/course/view.php?id=1995; https://do.ipo.kpi.ua/course/view.php?id=3362; course workbook. ***Recommended reading:*** *[1].* ***Independent work:*** *Study the lecture material. Complete the homework assignments in the workbook on this topic. Study the video lesson "Assembly drawing. Conventions and simplifications. Using dynamic blocks when creating electronic libraries* *simplified images of fasteners in the AutoCAD graphics editor."*

7	Intersection of surfaces with a plane. General method for intersecting surfaces with a plane. Constructing a line (figure) of intersection of second-order surfaces with planes of separate and general position. Determining the actual size of the intersection figure. ***Teaching aids:*** https://do.ipo.kpi.ua/course/view.php?id=1995; https://do.ipo.kpi.ua/course/view.php?id=3362; course workbook. ***Recommended reading:*** *[1]..* ***Independent work:*** *Study the lecture material. Complete the homework assignments in the workbook on the given topic. Study of video lesson materials "Permanent joints. Standard requirements for the design of permanent joints in assembly drawings."*
8	Intersection of body surfaces. Single and double penetration. General problem-solving methodology. ***Teaching aids:*** https://do.ipo.kpi.ua/course/view.php?id=1995; https://do.ipo.kpi.ua/course/view.php?id=3362; course workbook. ***Recommended reading:*** *[1], GOST 2.305-68.* ***Independent work:*** *Study the lecture material. Complete the homework assignments in the workbook on the given topic. Study of the video lesson "Detailing general-purpose drawings."*
9	Intersection of surfaces. Special cases of surface intersection, use of intermediaries - planes of a separate position, spheres. Theorems for simplifying the solution of surface intersection problems (Monge's theorem, double touch theorem, etc.). ***Teaching aids:*** https://do.ipo.kpi.ua/course/view.php?id=1995; https://do.ipo.kpi.ua/course/view.php?id=3362; course workbook. ***Recommended reading:*** *[1].* ***Independent work:*** *Review of lecture material. Completion of homework assignments in the workbook on this topic. Review of video lesson materials "Schemes. Using blocks with attributes in the AutoCAD graphics editor environment."*

Practical lessons

Practical session title
Practical lesson 1. Projecting a point. Solving problems on a complex drawing. ***Teaching aids:*** https://do.ipo.kpi.ua/course/view.php?id=1995; *workbook (theoretical information on the lecture topic and conditions for homework and lessonroom tasks).* ***Recommended reading:*** *[1].* ***SRC:*** *Review of lecture material. Completion of homework assignments in the workbook on this topic.*
Practical lesson *2*. System of standards. Types of design documentation. Formats. Scales. Lines. Fonts. Dimensioning. ***Teaching aids:*** https://do.ipo.kpi.ua/course/view.php?id=3362 ***Recommended reading:*** *[2], section 2, pp. 19-25.* ***Independent work:*** *Review of lecture materials and video lessons.*

Practical lesson 3. Setting a straight line on a diagram. Solving problems on a complex drawing.
Test "Topic: Point, line. Reading a complex drawing."
Teaching aids: https://do.ipo.kpi.ua/course/view.php?id=1995;
workbook (theoretical information on the lecture topic and conditions for homework and lessonroom tasks).

Recommended reading: *[1].*

SRC: *Review of lecture material. Completion of homework assignments in the workbook on this topic.*

Practical lesson 4. Images: types, sections, cross-sections. Main, basic, auxiliary, local types. Analysis of the geometric structure of models given in the form of axonometric images.

Teaching aids: https://do.ipo.kpi.ua/course/view.php?id=3362;
reference tables.

Recommended reading: *[2], section 2, pp. 12-18, 19-30;.*

Independent work: *Study of the video lesson material. Analysis of the geometric structure of a model specified according to your own version.*

Practical lesson 5. Setting the plane on the diagram. Solving problems on a complex drawing.
Test "Topic: Plane. Intersection of planes."
Teaching aids: https://do.ipo.kpi.ua/course/view.php?id=1995;
workbook (theoretical information on the lecture topic and conditions for homework and lessonroom tasks).

Recommended reading: *[1].*

SRC: *Review of lecture material. Completion of homework assignments in the workbook on this topic.*

Practical lesson 6. Images: types, sections, cross-sections. Simple sections. Construction of a projection drawing of a detail. Applying dimensions.

Teaching aids: https://do.ipo.kpi.ua/course/view.php?id=3362; *reference tables*

Recommended reading: *[2], section 2, pp. 12-18, 19-30.*

Independent work: *Review of the video lesson material. Finalizing the projection drawing of the part according to your own version using simple sections.*

Practical lesson 7. Method of replacing projection planes. Solving problems using the method of replacing projection planes using the example of a line segment of general position and a plane of general position.
Test "Topic: Construction of the actual size of a triangle using the method of replacing projection planes."
Teaching aids: https://do.ipo.kpi.ua/course/view.php?id=1995;
workbook (theoretical information on the lecture topic and conditions for homework and lessonroom assignments).

Recommended reading: *[1].*

Self-study: *Review of lecture material. Completion of homework assignments in the workbook on the given topic.*

Practical lesson *8.* Images: views, sections, cross-sections. Complex sections. Analysis of the geometric structure of a model given by two views.

Teaching aids: https://do.ipo.kpi.ua/course/view.php?id=3362; *reference tables, task options.*

Recommended reading: *[2], section 2, pp. 12-18, 19-30.*

SRS: *Review of video lesson material. Analysis of the geometric structure of a model specified according to your own option.*

Practical lesson 9. Curved lines. Solving problems on the topic.
Teaching aids: https://do.ipo.kpi.ua/course/view.php?id=1995;
workbook (theoretical information on the lecture topic and conditions for homework and lessonroom assignments).
Recommended reading: *[1].*
Independent work: *Study of lecture material. Completion of homework assignments in the workbook on the given topic.*

Practical lesson 10. Images: types, sections, cross-sections. Complex sections. Construction of a projection drawing of a detail with a complex section on the main view and simple sections on the top and left views. Dimensioning. Checking the work.
Teaching aids: https://do.ipo.kpi.ua/course/view.php?id=3362; *reference tables, task options.*
Recommended reading: *[2], section 2, pp. 12-18, 19-30.*
SRS: *Review of video lesson material. Finalization of the projection drawing of a detail with a complex cut.*

Practical lesson 11. Surfaces. Solving problems on constructing points and lines on surfaces. Checking work.
Test: "Topic: Construction of points on surfaces of revolution."
Teaching aids: https://do.ipo.kpi.ua/course/view.php?id=1995;
workbook (theoretical information on the lecture topic and conditions for homework and lessonroom assignments).
Recommended reading: *[1].*
Independent work: *Study of lecture material. Completion of homework assignments in the workbook on the given topic.*

Practical lesson 12. Intersection of surfaces by a plane. Solving problems on the intersection of surfaces by a plane. Construction of the actual size of the intersection figure.
Teaching aids: https://do.ipo.kpi.ua/course/view.php?id=1995;
workbook (theoretical information on the lecture topic and conditions for homework and lessonroom tasks).
Recommended reading: *[1].*
Independent work: *Review of lecture material. Completion of homework assignments in the workbook on this topic.*

Practical lesson 13. Intersection of surfaces by a plane. Solving problems involving the intersection of surfaces by a plane. Construction of unfoldings.
Teaching aids: https://do.ipo.kpi.ua/course/view.php?id=1995;
workbook (theoretical information on the lecture topic and conditions for homework and lessonroom tasks).
Recommended reading: *[1].*
Independent work: *Study of lecture material. Completion of homework assignments in the workbook on this topic.*

Practical lesson 14. Solving problems on the construction of single and double penetration of bodies through horizontal "windows." Formatting work according to standards.
Teaching aids: https://do.ipo.kpi.ua/course/view.php?id=1995;
workbook (theoretical information on the lecture topic and conditions for homework and lessonroom tasks).
Recommended reading: *[2].*
SRC: *Review of lecture material. Completion of homework assignments in the workbook on this topic in accordance with the relevant standards.*

Practical lesson 15. Solving problems on the construction of single and double penetration of bodies through horizontal "windows" according to your own version. Formatting the work according to the requirements of the standards. ***Teaching aids:*** https://do.ipo.kpi.ua/course/view.php?id=1995; *workbook (theoretical information on the lecture topic and conditions for homework and lessonroom tasks).* ***Recommended reading:*** *[2].* ***Independent work:*** *Study the lecture material. Complete the graphic work "Single penetration" according to your own version. Format the work according to the requirements of the standards.*
Practical lesson 16. Intersection of surfaces. Solving problems on the intersection of surfaces. ***Teaching aids:*** https://do.ipo.kpi.ua/course/view.php?id=1995; *workbook (theoretical information on the lecture topic and conditions for homework and lessonroom assignments).* ***Recommended reading:*** *[2], GOST 2.305-68.* ***SRC:*** *Study of lecture material. Completion of homework assignments in the workbook on this topic.*
Practical lesson 17. Intersection of surfaces. Solving problems on the intersection of surfaces. ***Teaching aids:*** https://do.ipo.kpi.ua/course/view.php?id=1995; *workbook (theoretical information on the lecture topic and conditions for homework and lessonroom tasks).* ***Recommended reading:*** *[2], GOST 2.305-68.* ***SRC:*** *Study of lecture material. Completion of homework assignments in the workbook on this topic.*
Practical lesson 18. Submission of work.

Computer workshop

Name of computer workshop
Computer workshop 1. Graphic editor interface. Basic commands for constructing and editing graphic primitives. Model space. Sheet space. Methods for specifying coordinates in AutoCAD. Object references. Image control . Setting object properties. Creating layers. Setting up text, dimension styles, measurement units
. Setting blocks with attributes. Creating A3 and A4 templates using blocks with attributes . ***Recommended teaching aids for independent study:*** https://do.ipo.kpi.ua/course/view.php?id=3362. ***Independent work:*** *Reviewing the video lesson material. Creating templates.*
Computer workshop 2. Conjugation. Applying dimensions. Constructing a flat part of complex shape. Completing the graphic work "Conjugation." ***Recommended teaching aids for independent study:*** https://do.ipo.kpi.ua/course/view.php?id=3362 ***Independent work:*** *Reviewing the video lesson material. Completing the graphic work "Conjugation."*
Computer workshop 3. 3D modeling in the AutoCAD graphics editor environment. Using basic geometric shapes. Methods of extrusion, rotation, offset, and loft. Using the user coordinate system. Using logical operations. Creating a 3D model of a part in the AutoCAD graphics editor based on its axonometric image. ***Recommended teaching aids for independent study:*** https://do.ipo.kpi.ua/course/view.php?id=3362; ***Independent work:*** *Reviewing the video lesson material. Building a 3D model of a part according to the option.*

Computer workshop 4 3D modeling in the AutoCAD graphics editor environment. Layout of the part drawing based on its 3D model using simple and complex sections. Creation of an axonometric image of the part with a cutout of its fourth part. Hatching.

Recommended teaching aids for independent study: https://do.ipo.kpi.ua/course/view.php?id=3362;

Independent work: *Review of the video lesson material. Construction of a projection drawing of a part based on the created 3D model.*

Computer workshop 5. Parameterization. Using parameterization in AutoCAD. Applying geometric and dimensional constraints. Parameter manager. Creating a drawing of a parameterized flat contour.

Recommended teaching aids for independent study: https://do.ipo.kpi.ua/course/view.php?id=3362;

Independent work: *Reviewing the video lesson material. Constructing a parameterized flat contour of a part according to the option.*

Computer workshop 6. Modular test work. Construction a drawing of a parameterized flat part of complex configuration using AutoCAD.

Recommended teaching aids for independent study: https://do.ipo.kpi.ua/course/view.php?id=3362;

Computer workshop 7. Working drawings and sketches of parts.

Thread. Images and markings on the drawing. Surface roughness of the part. Material. Creation of a 3D model of a typical part with a thread (cap nut) using parameterization and in accordance with the requirements of current standards.

Recommended teaching aids for independent study: https://do.ipo.kpi.ua/course/view.php?id=3362;

reference tables.

Recommended reading: *[2], sections 3, 4, 5, pp. 33-52.*

Independent work: *Study the video lesson material. Build a 3D model of a cap nut according to the option.*

Computer workshop 8. Working drawings and sketches of parts. Construction of a working drawing of a cap nut.

Recommended teaching aids for independent study: https://do.ipo.kpi.ua/course/view.php?id=3362;

reference tables.

Recommended reading: *[2], sections 3, 4, 5, pp. 33-52.*

Independent work: *Review of the video lesson material. Construction of a working drawing of a cap nut according to the option.*

Computer workshop 9. Working drawings and sketches of parts.

Features of drawing parts manufactured by turning. Parts such as "Shaft" and "Bushing" type parts. Applying dimensions from technological bases. Creating a parameterized 3D model of a "Shaft" part in accordance with the requirements of current standards. Checking the working drawing "Cap nut" drawing created using AutoCAD.

Recommended teaching aids for independent study: https://do.ipo.kpi.ua/course/view.php?id=3362;

reference tables.

Recommended reading: *[2], sections 3, 4, 5. pp. 33-57, 67-73, 92.*

Independent work: *Study the video lesson material. Build a 3D model of the "Shaft" part according to the option.*

Computer workshop 10. Building cross-sections in AutoCAD. Layout of the drawing based on the created parameterized 3D model. Building a working drawing of the part. Formatting the drawing of the part in accordance with the requirements of the standards.

Recommended teaching aids for independent study: https://do.ipo.kpi.ua/course/view.php?id=3362;

reference tables.

Recommended reading: *[2], sections 3, 4, 5, pp. 33-52.*

SRC: *Review of video lesson material. Construction of a working drawing of the "Shaft" detail according to the option.*

Computer workshop 11. Assembly drawing. Specification. Threaded connections. Conventions and simplifications in the assembly drawing. Calculation of simplified images of fasteners in connections. Checking the working drawing of the "Shaft" made using AutoCAD.
Recommended teaching aids for independent study: https://do.ipo.kpi.ua/course/view.php?id=3362; *reference tables.*
Recommended reading: *[2], section 6, pp. 104-106.*
Independent work: *Study of the video lesson material. Performing calculations of simplified images of fasteners in the assembly drawing of the topic "Threaded connections." Creating dynamic blocks.*

Computer workshop 12. Creating electronic libraries of simplified images of fasteners made using dynamic blocks in the AutoCAD graphics editor environment.
Creating an assembly drawing of a composite unit with parameterization elements using the created electronic library of images of fasteners. Specification. ***Recommended teaching aids for independent study:*** https://do.ipo.kpi.ua/course/view.php?id=3362; *reference tables.*
Recommended reading: *[2], section 6, pp. 104-106.*
Independent work: *Study of the video lesson material. Preparation of an assembly drawing of a folding unit with parameterization elements using the created electronic library of images of fasteners according to the task option. Completing the specification.*

Computer workshop 13. Assembly drawing. Non-detachable connections. Connections by welding, soldering, gluing, etc. Conventions and simplifications in the assembly drawing. Completing the specification. Checking the assembly drawing on the topic "Threaded connections" created using AutoCAD.
Recommended teaching aids for independent study: https://do.ipo.kpi.ua/course/view.php?id=3362; *reference tables.*
Recommended reading: *[2], section 6, pp. 114-116.*
Independent work: *Study the video lesson material. Create a 3D model of an assembled unit according to the option and specifications.*

Computer workshop 14. Creating an assembly drawing of a folding unit based on a previously created 3D model, individual parts of which are connected by soldering, gluing, and welding. Specification.
Defense of the design and graphic work.
Recommended teaching aids for independent study: https://do.ipo.kpi.ua/course/view.php?id=3362
Recommended reading: *[2], section 6, pp. 114-116.*
Independent work: *Study of the video lesson material. Preparation of an assembly drawing of a composite unit according to the option and specifications.*

Computer workshop 15. Detailing. Features of detailing a general assembly drawing of an assembled unit. Creating a 3D model of a detail corresponding to the position of the general assembly drawing according to the device option in the atlas in the AutoCAD graphics editor environment. ***Recommended teaching aids for independent study:*** https://do.ipo.kpi.ua/course/view.php?id=3362; *atlases of general assembly drawings of assembled units.*
Recommended reading: *[2], section 6, pp. 118-120.*
SRS: *Review of video lesson material. Creation of a 3D model of a part.*

Computer workshop 16. Detailing. Layout of a drawing in the AutoCAD graphics editor. Creation of a working drawing of a part. ***Recommended teaching aids for independent study:*** https://do.ipo.kpi.ua/course/view.php?id=3362; *atlases of composite units.* ***Recommended reading:*** *[2], section 6, pp. 118-120.* ***Independent work:*** *Review of video lesson material. Creation of a working drawing of a detail.*
Computer workshop 17. Schematics. Electrical schematics. List of elements. Creating a drawing of an electrical schematic and a list of elements. Using blocks with attributes in the AutoCAD graphics editor. ***Recommended teaching aids for independent study:*** https://do.ipo.kpi.ua/course/view.php?id=3362; ***Recommended reading:*** *[2], section 8, pp. 148-152.* ***Independent work:*** *Study the video lesson material. Draw an electrical schematic diagram using blocks with attributes and a list of elements.*
Computer workshop 18. Printing the chair design. Acceptance of work. Passing the exam

Individual assignments

In order to study the course material in depth and acquire practical skills, individual assignments based on individual source data are provided. The main objective of these tasks is to reinforce the theoretical principles of the topics and sections of the discipline; to check the level of knowledge acquired by higher education students in lectures, practical lessons, computer workshops, and during independent work on the course. The curriculum provides for 12 graphic works, which are performed using a mixed system (in practical lessons, computer workshops, and during independent work on the course):

1. single penetration;
2. construction of a flat figure using the AutoCAD graphics editor;
3. construction of a projection drawing "Simple sections" using a 3D model of a detail using the AutoCAD graphics editor;
4. construction of a projection drawing "Complex sections" using a 3D model of a detail using the AutoCAD graphics editor;
5. construction of a parameterized drawing of a flat part of complex configuration using AutoCAD (Module test);construction of a working drawing "Cap nuts" based on a previously created parameterized 3D model using AutoCAD;
6. construction of a working drawing of the "Shaft" detail based on a previously created parameterized 3D model using AutoCAD;
7. construction of an assembly drawing of an assembled unit with parameterization elements using a created electronic library of images of fasteners made with dynamic blocks. Specification (GCW);
8. creating an assembly drawing of an assembled unit based on a previously created 3D model, individual parts of which are connected by soldering, gluing, and welding. Specification.
9. Execution of a working drawing of a typical part based on a previously created 3D model with a general view drawing.
10. Preparation of an electrical schematic diagram in accordance with the option. List of elements.

7. Independent work of the student

Hours allocated for independent work by the student are specified in paragraph 5. Mastery of the academic discipline in the process of independent work on the course occurs when completing homework assignments in the workbook, preparing for practical lessons and computer workshops, completing individual assignments, performing calculation and graphic work, as well as preparing for Module test s and exams.

Policy and control

8. Policy of the academic discipline (educational component)

Studying the academic discipline "Engineering and Computer Graphics" requires higher education seekers to:
- adherence to academic ethics;

- adherence to the academic schedule;
- be thoughtful and attentive in lesson;
- systematically study theoretical material;
- adherence to the schedule for the defense of computational and graphic work. The applicant's response should demonstrate signs of independent completion of the assigned task, with no signs of repetition or plagiarism.

Bonus points are awarded by the lecturer for active participation in lectures (answers to the lecturer's questions), participation in the engineering and computer graphics competition, and early defense of individual assignments.

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" (https://kpi.ua/code).

Standards of ethical behavior The standards of ethical behavior for higher education 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" (https://kpi.ua/code).

Procedure for appealing the results of control measures Higher education students have the opportunity to raise any issue related to the control measures procedure and expect it to be considered in accordance with predefined procedures.

9. Types of assessment and the learning outcomes assessment rating system (LOAS)

Student ratings are calculated on a 100-point scale.

1. A student's rating for a credit module consists of points awarded for:
   - homework and lesson room assignments (HA) on the lecture topic in the workbook (7 assignments);
   - programmed control (PC) (4 PCs);completion of a Module test (MT);
   - completion and defense of individual graphic works (GW) (9 works);
   - completion and defense of graphic and calculation work (GCW).

2. Criteria for scoring:

2.1. Completion of tasks in the workbook is assessed at 2 points according to the following criteria:
- flawlessly completed work, excellent graphics, work submitted on time – 2 points;
- there are certain shortcomings in the execution, good graphics, violation of the submission schedule by up to 2 weeks –
  1.5 points;
- significant shortcomings in execution, satisfactory graphics, late submission – 1 point;

2.2. Programmed control (PC) (4 PC);
- flawlessly executed work – 5 points;
- there are certain shortcomings in the execution – 3 points;
- significant shortcomings in execution – 2 points;

2.3. The performance of the modular control work is assessed in 6 points:
- flawless work – 6 points;
- minor shortcomings in the work – 5 points;
- significant shortcomings in the performance of the work – 3 points;
- work performed incorrectly or not performed at all - 0 points.

2.4. The execution and defense of graphic works are evaluated on a 5-point scale:
- flawlessly executed work, excellent graphics - 5 points;
- there are certain shortcomings in the execution, good graphics, violation of the submission schedule by up to 2-0 weeks -
  1 points;
- significant flaws in execution, satisfactory graphics – 3 points;

2.5. The execution of computational and graphic work is evaluated on a 15-point scale:
- flawless work – 15 points;
- there are minor shortcomings in the execution of the work - 13 points;
- there are significant shortcomings in the performance of the work – 10 points;
- the work is done incorrectly or not done at all – 0 points.

Calendar control: conducted twice per semester as monitoring of the current status of syllabus requirements fulfillment. The condition for the first calendar control is to receive at least 18 points and complete and defend three topics in the workbook, one graphic work, and receive a positive grade on two programmed tests. The condition for the second calendar control is to receive at least 45 points and complete and defend three topics in the notebook, one graphic work, receive a positive grade on two programmed tests, and complete a calculation and graphic work. The requirement for receiving a credit is to complete and defend a calculation and graphic work, tasks in the workbook on 7 topics of the course, 11 graphic works, receive positive grades on four programmed tests and a Module test .

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

10. Additional information on the discipline (educational component)

The exam is based on test papers. Each test paper consists of two tasks. The first task covers the material studied in the theoretical part of the course. It tests the student's knowledge of projection methods and methods for simplifying the solution of course problems. The second task is comprehensive. It tests the competencies acquired by the higher education student in both engineering and computer graphics: 3D modeling of geometric objects using AutoCAD, layout of drawings, and the ability to apply standards requirements when preparing design documentation.

The working program of the academic discipline (syllabus):

Compiled by: Associate Professor of the Department of Descriptive Geometry, Engineering and Computer Graphics, Candidate of Pedagogical Sciences G.O. Gnitetskaya, Candidate of Technical Sciences T.V. Gnitetskaya.

Approved by the Department of _NGIKG (Minutes No. 10 of 11.06.2024)

Approved by the Methodological Council of the Radio Engineering Faculty (Minutes No. 06/2024 dated 28.06.2024)