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

Department of sketch geometry, engineering and computer graphics

ENGINEERING GRAPHICS

Working program of the academic discipline (Syllabus)

Details of the academic discipline

Level of higher education	*First (undergraduate)*
Field of	*141 Power engineering, electrical engineering and electromechanics*
knowledge	*141 Power engineering, electrical engineering and electromechanics*
Specialty	*141 Power engineering, electrical engineering and electromechanics*
Educational program	*Normative full-*
Discipline status	*time/ correspondence/ distance/ mixed*
Form of study Year of	*1st year, autumn / spring semester*
training, semester Scope of the discipline	*discipline (SC)*
Semester control/ control measures	*Test*
Class schedule	*Lecture - every week (36 hours)* *Practical class - once every two weeks (18 hours)*
Language of teaching	*Ukrainian*
Information about the course leader / teachers	*Department of sketch geometry, engineering and computer graphics (building 7, room 815), e-mail: http:// geometry.kpi.ua/ Phone: +380 44 204 94 46* *lecturer: Ph.D., Assoc. Tetyana Vitalyivna Gnitetska, 066 735 7541, gnitetsk@ukr.net;* *lecturer: Ph.D., Assoc. Galina Omelanivna Gnitetska, 050 710 41 87, gnitetsk@ukr.net;* *practical classes:: Ph.D., Assoc. Tetyana Vitalyivna Gnitetska, 066 735 7541, gnitetsk@ukr.net;* *Ph.D., Assoc. Galina Omelanivna Gnitetska, 050 710 41 87, gnitetsk@ukr.net;*
Placement of the course	https://do.ipo.kpi.ua/course/view.php?id=3361

Program of educational discipline

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

The main goal of teaching the discipline "Engineering and computer graphics." is the formation of students' competences of the system of basic knowledge from the main sections of the course, gaining work experience and applying methods of geometric modeling of spatial forms, creation and design of design and construction documentation using CAD AutoCAD with the application of the requirements of standards. The syllabus is structured in such a way that to complete each

subsequent task, students need to apply the skills and knowledge acquired in the previous one. Special attention is paid to the principle of encouraging students to study actively. This is facilitated by the organization of independent work of students with the help of sets of methodical materials presented on the Sikorsky distance learning platform, including video lessons that are

effective in organizing distance learning. At the same time, students must perform practical tasks that will allow them to solve real tasks in their professional activities in the future. During training, the following are used:

- *active and collective learning strategies;*
- *personality-oriented developing technologies based on active forms and methods of learning (team-based learning, independent work and independent study of individual topics of the discipline).*

As a result of studying the discipline "Engineering and computer graphics" students receive the following competencies:

general:

1. *ability to abstract thinking, analysis and synthesis (K01);*
2. *ability to apply knowledge in practical situations (K02);*
3. *the ability to communicate in the state language both orally and in writing (K03);*
4. *the ability to search, process and analyze information from various sources (K05);*
5. *the ability to realize one's rights and responsibilities as a member of society, to realize the values of civil (free democratic) society and the need for its sustainable development, the rule of law, the rights and freedoms of a person and a citizen in Ukraine (K09);*
6. *the ability to preserve and increase the moral, cultural, scientific values and achievements of society based on an understanding of the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technology, to use various types of motor activity for active recreation and leading a healthy lifestyle (K10).*

professionals:

1. *the ability to solve practical problems with the involvement of automated design and calculation systems (CAD) (K11);*
2. *the ability to develop projects of electric power, electrotechnical and electromechanical equipment in compliance with the requirements of legislation, standards and specifications (K17);*
3. *awareness of the need to constantly expand one's own knowledge of new technologies electrical power and electromechanics (K20).*

program learning outcomes:

1. *find the necessary information in scientific and technical literature, databases and other sources of information, evaluate its relevance and reliability (PR10);*
2. *communicate freely about professional problems in national and foreign languages orally and in writing, discuss the results of professional activity with specialists and non-specialists, argue one's position on debatable issues (PR11);*
3. *know modern methods, algorithms and software tools for calculation, design, manufacture, installation, operation, fault diagnosis and repair of electrical machines and devices (PR13);*
4. *understand the principles of European democracy and respect for the rights of citizens, take them into account when making decisions (PR14);*
5. *understand and demonstrate good professional, social and emotional behavior, to follow a healthy lifestyle (PR15).*

The above-mentioned competencies and program learning outcomes of the discipline "Engineering and computer graphics" are ensured thanks to the knowledge of students:

- *basics of sketch geometry and engineering graphics;*
- *basics of geometric modeling;*
- *trends in the development of modern information technologies;*
- *AutoCAD universal automated design system;*
- *methods of developing design and construction documentation in accordance with the requirements of standards using modern CAD.*

2. Pre-requisites and post-requisites of the discipline (place in the structural and logical scheme of training according to corresponding educational program)

The discipline forms the engineering and technical component in the training program of the future specialist, lays the foundations for studying disciplines by profession, such as production technology, electrical machines, electrical devices, technical mechanics, design basics, synthesis of logical systems, computer graphics, as well as disciplines , which involve the ability to create and design
traditional projection and electronic drawings of products with the help of modern CAD, geometric and computer 3d modeling of objects of electrical equipment from the cycle of disciplines of professional and practical training of students studying in senior courses, in course and diploma design.

3. Content of the academic discipline

Chapter 1. Projection methods

Topic 1.1. **Introduction. Point and straight line projection.** Projection method. Central and parallel projection. Projection of a point on three mutually perpendicular projection planes. Orthogonal projection is the main method of construction of technical drawings.
Complex point drawing. Position of points relative to projection planes. Direct and inverse problems. Specifying a straight line on the plot. Lines of a special position: level and projecting. The line of general position. Determination of the natural value of the line segment of the general position and the angles of inclination of the line to the projection planes. Belonging of a point to a straight line. Division of a straight line segment in a given ratio. Traces of a straight line. Modeling the relative position of two straight lines -
parallelism, intersection, transience.

Topic 1.2. **Projection of the plane.** Modeling the plane in the system of projection planes. Areas of special position. Trace-projection of the plane of a special position. Planes of general position. Traces of the plane. Belonging to a line and a point in a plane.

Topic 1.3. **The relative position of two planes.** Parallelism of planes. Intersection of planes of a special position. Intersection of planes of general and special position. The method of intermediary planes. General technique and algorithm for constructing a line of intersection of two planes of general position. The method of determining the visibility of individual geometric elements at the intersection of planes on a complex drawing.

Topic 1.4. **The relative position of a straight line and a plane.** Signs of parallelism of a straight line and a plane on a complex drawing. General technique and algorithm for constructing the point of intersection of a straight line and a plane. Determination of the visibility of individual geometric elements at the intersection of a straight line and a plane on a complex drawing.

Topic 1.5. **Perpendicularity of geometric elements.** Right angle projection. Perpendicularity of a line and a plane. Determination of the distance from a point to a plane. Typical tasks. Perpendicularity of planes. Perpendicularity of lines. Determination of the distance from a point to a straight line. Typical tasks.

Topic 1.6. **The method of geometric places.** Examples of geometric locations of points and lines. Typical tasks. Generalization of methods of solving complex problems using the method of geometric locations. Topic 1.7.

The method of replacing projection planes. The method of rotation around the level line The main provisions of the method of replacing projection planes. Transformation of a line of general position into a level line and into a projecting line. Transformation of the general position plane into a projecting and level plane. Typical tasks. A class of problems solved using the rotation method. Elements of rotation. Combination Typical tasks.

Chapter 2. Geometric modeling of curved lines and surfaces

Topic 2.1. **Curved lines and surfaces.** Classification of curved lines. Circle projection. Methods of assignment of surfaces, their definition, classification. Expandable and non-expandable linear surfaces. Surfaces of rotation. Construction of points and lines on surfaces.

Topic 2.2 **Intersection of surfaces by a plane.** General method of crossing surfaces with a plane. Four types of problems on the intersection of surfaces with a plane. Construction of the line of intersection of second-order surfaces by planes of general and special positions. Determination of the natural size of the cross-sectional figure. Topic 2.3.

Intersection of surfaces of bodies. .General method of solving problems for single and double penetration of surfaces by horizontal "windows". Topic 2.5. **Intersection of**

surfaces. General method of solving problems on the intersection of surfaces. The use of mediators - planes of general and separate position, spheres. Special cases of intersection of surfaces. Monge's theorem.

Section 3. **General requirements of the standards for design documentation. Application of AutoCAD graphics editor for creating electronic drawings**

Topic 3.1. Basic provisions. Types of design documentation. Formats and basic inscriptions. Scales of the Line. Fonts. Basic requirements for drawing dimensions on drawings. Conjugation of geometric elements.

Topic 3.2. Purpose of the graphic editor AutoCad and its capabilities. Graphical editor interface. Basic commands for building graphic primitives and their editing. Model space. Letter space. Methods of specifying coordinates in AutoCAD. Object bindings. Image management. Setting properties of objects. Creating layers. Text settings,

dimensional styles, units of measurement. Specifying blocks with attributes. Creation of A3 and A4 format templates using blocks with attributes.

Topic 3.3. Execution of conjugations in the graphic editor. Creation of arrays of objects. Building flat parts of a complex configuration using conjugations on an A3 format template. Drafting in accordance with the requirements of the standards. Output of drawings for printing.

Chapter 4. Modeling of 3D objects, construction of projection drawings in AutoCAD.

Topic 4.1. Images: views, sections, sections. Cuts are simple and complex. The method of applying dimensions taking into account the geometry of the part.

Topic 4.2. Use of basic geometric shapes. Ways of pushing out, rotation, shift, loft. Application of user coordinate system. Use of logical operations. Commands for editing 3D objects.

Topic 4.3. Layout of projection drawing images in AutoCAD. Construction of the drawing "Simple sections" based on a previously created 3D model. **Chapter 5. Parameterization.**

Topic 5.1. Use of parameterization capabilities in geometric modeling. Imposition of geometric and dimensional dependencies. Settings Manager. Construction of the blueprint

parametrized flat contour. **Chapter 6. Sketches**

and working drawings of details.

Topic 6.1. Requirements of the standards for the execution of working drawings and sketches of details. Features of the images of details on the drawing depending on the method of their production. Applying dimensions from technological bases. Cleanliness of surfaces. Signs of surface roughness. Technical conditions. The structure of the recording of the material.

Topic 6.2. Incision. Classification of the thread. Thread parameters. Thread grooves. The image of the thread on the working drawing of the part. Designation of the thread.

Topic 6.3. Construction of a 3D model of a part with a "Cap nut" thread using AutoCAD tools with the use of parameterization. Using the created 3D model to build a working drawing of the part and in accordance with current standards.

Chapter 7. Assembly drawing.

Topic 7.1. Contents of assembly drawing. Standards requirements for creating assembly drawings. Conventions and simplifications on drawings of assembly units. Specification.

Threaded connections. The image of threaded connections on the assembly drawing. Calculation of simplified images of fasteners in joints. Topic 7.2. Creation of electronic image libraries of

fasteners using dynamic blocks of the AutoCAD graphics editor. Execution of the assembly drawing of the parameterized model of the assembly unit using the electronic library of images of fasteners created using

dynamic blocks.

Chapter *8.* Schemes.

Topic 8.1. Types and types of schemes. The electrical scheme is basic. Conventional graphic symbols of scheme elements. Letter code of the element. Characteristics of input and output circles. Drawing up a list of elements.

Topic 8.2. Construction of the electrical schematic diagram in the graphic editor AutoCAD using the created library of blocks with attributes. Execution of the list of elements.

4. Educational materials and resources

Basic literature

1. Engineering graphics: a textbook for students of higher education institutions of the I - II levels of accreditation / V. Ye. Mykhaylenko, V. V. Vanin, S. M. Kovalev; Under the editorship V. E. Mykhaylenko. - Lviv: Yu.V. Picha; K.: Caravel; Lviv: Novy svit - 2000. - 284.

2. Vanin V.V., Bliok A.V., Hnitetska documentation: Educational manual. H.O. Design of the of construction

3rd edition. - *http:// geometry.kpi.ua/ files/ Vanin_Gniteckaja_kd1_2.pdf* K.: Caravel, 2012.-200 with.

3. Vanin V.V., Perevertun V.V., Nadkernychna T.M. etc. Engineering and computer graphics. K.: Vid. gr. BHV, 2009. — 400 p.

Additional literature

5 Mykhaylenko V.E., Vanin V.V., Kovalev S.M. Engineering and computer graphics. — K.: Caravela, 2012. — 363 p.

6 Haskin A.M. Drawing. — K.: Vyshcha Shk., 1985. — 440 p.

All the mentioned literature is available in sufficient quantity in the library of NTUU "KPI".

Information resource

7 Complex of methodical materials. Educational platform of distance learning "Sikorsky": https://do.ipo.kpi.ua/course/view.php?id=3361

8 Complex of methodical materials. Educational platform of distance learning "Sikorsky": https://do.ipo.kpi.ua/course/view.php?id=3187

9 Library *ftp:// 77.47.180.135/.*

10 Methodical documentation of the website of the department page Educational and methodical 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

5. Methods of mastering an educational discipline (educational component)

The program of the academic discipline provides for lectures and practical classes. Methodical support for studying the course is the use of an information resource that presents a methodological set of materials: a lecture course with reference to the relevant sections of the textbook co-authored by the lecturer; video lessons, options for tasks on course topics and methodological instructions for their implementation, posted on the "Sikorsky" Learning Platform. In the case of distance learning, all these materials can be used for lectures, practical classes and computer workshops on the Zoom platform

and others, as well as be available when organizing students' independent work as part of remote access to information resources at a time convenient for them.

Lecture classes

No z/n	Topics of lectures
1	Projection methods. Central and parallel projection.
	Geometric modeling of spatial objects. Projection of a point onto three mutually perpendicular planes. Complex point drawing. Methods of constructing the third projection of a point. Position of points relative to projection planes. Direct and inverse problems. Determination of the distance from a point to the planes and axes of the projections. Competing points. Straight line projection.
	Specifying a straight line on the plot. Lines of a special position: level and projecting. The line of general position. Determination of the natural value of the line segment of the general position and the angles of inclination of the line to the projection planes. Belonging of a point to a straight line. Division of a line segment in a given ratio. Traces of a straight line. The relative position of two straight lines.
	Didactic tools: https://do.ipo.kpi.ua/course/view.php?id=3361;
	https://do.ipo.kpi.ua/course/view.php?id=3187;
	workbook from the course.
	Recommended literature: *[1]*
	SRS: *Doing homework in the workbook on the given topic.*
2	AutoCAD graphic editor.
	Graphical editor interface. Basic commands for building graphic primitives and their editing. Model space. Letter space. Methods of specifying coordinates in AutoCAD. Object bindings. Image control. Setting properties of objects. Creating layers. Setting text, dimension styles, units of measurement. Specifying blocks with attributes. Creation of A3 and A4 format templates using blocks with attributes. Conjugation
	Didactic tools: https://do.ipo.kpi.ua/course/view.php?id=3361;
	https://do.ipo.kpi.ua/course/view.php?id=3187.
	Task by option.
	Recommended literature: *[2,3]*
	SRS. *Elaboration of lecture material.*
3	Projection of the plane.
	Specifying the plane on the epurse. Areas of special position. Trace-projection of the plane of a special position. Planes of general position. Belonging to a line and a point in a plane. Traces of the plane.
	Didactic tools: https://do.ipo.kpi.ua/course/view.php?id=3361;
	https://do.ipo.kpi.ua/course/view.php?id=3187; workbook from the course.

	Recommended literature: *[1].* ***SRS:*** *Doing homework in the workbook on the given topic.*
4	System of standards. Types of design documentation. Images: views, sections, sections. Cuts are simple and complex. The method of applying dimensions taking into account the geometry of the part. Use of basic geometric shapes. Ways of pushing out, rotation, shift, loft. Application of user coordinate system. Use of logical operations. Commands for editing 3D objects. Layout of projection drawing images in AutoCAD. Construction of the drawing "Simple sections" based on a previously created 3D model. ***Didactic tools:*** https://do.ipo.kpi.ua/course/view.php?id=3361 https://do.ipo.kpi.ua/course/view.php?id=3187. Task by option. ***Recommended literature:*** *[2,3]* ***SRS.*** *Elaboration of lecture material.*
5	Relative position of two planes. Parallelism of planes. Intersection of planes of a special position. Intersection of planes of general and special position. The method of intermediary planes. General technique and algorithm for constructing a line of intersection of two planes of general position. The method of determining the visibility of individual geometric elements at the intersection of planes on a complex drawing. ***Didactic tools:*** https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187; workbook from the course. ***Recommended literature:*** *[1]* ***SRS:*** *Doing homework in the workbook on the given topic.*
6	Parameterization. Using AutoCAD parameterization capabilities in geometric modeling. Imposition of geometric and dimensional dependencies. Settings Manager. Construction of a parametrized flat contour drawing. ***Didactic tools:*** https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187; Task by option. ***Recommended literature:*** *[3]* ***SRS:*** *Execution of a parametrized flat contour plotter.*
7	Relative position of a straight line and a plane. Signs of parallelism of a straight line and a plane on a complex drawing. General algorithm and technique for constructing the point of intersection of a straight line and a plane. Determination of the visibility of individual geometric elements at the intersection of a straight line and a plane on a complex drawing. ***Didactic tools:*** https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187. workbook from the course. ***Recommended literature:*** *[1,4,5]* ***SRS:*** *Doing homework in the workbook on the given topic.*
8	Sketches and working drawings of details. Requirements of the standards for the execution of working drawings and sketches of details. Features of the images of details on the drawing depending on the method of their production. Applying dimensions from technological bases. Cleanliness of surfaces. Signs of surface roughness. Technical conditions. The structure of the recording of the material.

	Incision. Classification of the thread. Thread parameters. Thread grooves. The image of the thread on the working drawing of the part. Designation of the thread.
	Application of parameterization as a means of solving problems of 3D computer geometric modeling of technical objects in AutoCAD. Construction of a 3D model of a part with a "Cap nut" thread using AutoCAD tools with the use of parameterization. Using the created 3D model to build a working drawing of the part and in accordance with current standards.
	Didactic tools: https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3189; *reference tables, methodical maps, threaded parts.*
	Task by option.
	Recommended literature: *[2]*
	SRS: *Performing calculations of simplified images of fastening elements of the assembly drawing "Threaded connections".*
9	The method of replacing projection planes. The essence of the method of replacing projection planes. Transformation of a line of general position into a level line and into a projecting line. Transformation of the general position plane into a projecting and level plane.
	Typical tasks. Rotation around the level line. A class of problems that are solved using the method of rotation around the level line. Elements of the method of rotation around the level line. The method of rotation around the zero line of the level is the method of combining. Typical tasks.
	Didactic tools: https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187.
	workbook from the course.
	Recommended literature: *[1]*
	SRS: *Doing homework in the workbook on the given topic.*
10	Assembly drawings. Threaded connections. Specification.
	Creation of electronic image libraries of fasteners using dynamic blocks of the AutoCAD graphics editor. ***Didactic tools:*** https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187.
	Task by option.
	Recommended literature: *[2]*
	SRS: *Processing of lecture materials.* 11
	Curved lines and surfaces. Classification of curved lines. Circle projection. Methods of assignment of surfaces, their definition, classification. Expandable and non-expandable linear surfaces. Surfaces of rotation. Construction of points and lines on surfaces.
	Didactic tools: https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187.
	workbook from the course.
	Recommended literature: *[1]*
	SRS: *Doing homework in the workbook on the given topic*
12	Implementation of the assembly drawing of the parameterized model of the assembly unit with using an electronic library of images of fasteners created using dynamic blocks. ***Didactic tools:*** https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187; *reference tables, methodological maps, task maps.*
	Task by option.

	Recommended literature: [2] *SRS: Performing calculations of simplified images of fastening elements of the assembly drawing "Threaded connections".*
13	Intersection of surfaces by a plane. General method of crossing surfaces with a plane. Construction of the line (figure) of the intersection of second-order surfaces by planes of individual and general position. Determination of the natural size of the cross-sectional figure. *Didactic tools:* https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187; workbook from the course. *Recommended literature: [1]* *SRS: Doing homework in the workbook on the given topic.*
14	Schemes. Types and types of schemes. The electrical scheme is basic. Conventional graphic symbols of scheme elements. Letter code of the element. Characteristics of input and output circuits. Drawing up a list of elements. Construction of the electrical schematic diagram in the graphic editor AutoCAD using the created library of blocks with attributes. Execution of the list of elements. *Didactic tools:* https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3189. Task by option. *Recommended literature: [2,3]* *SRS: Execution of conventional graphic markings of elements of electrical principle schemes in the AutoCAD graphic editor.*
15	Intersection of surfaces of bodies. Single and double penetration. General solution method tasks *Didactic tools:* https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187; workbook from the course. *Recommended reading: [1] SRS:* *Doing homework in a workbook on this topic*
16	Intersection of surfaces. Individual cases of crossing surfaces, use of intermediaries - planes of a separate position, spheres. Monge's theorem. *Didactic tools:* https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187; workbook from the course. *Recommended literature: [1].* *SRS: Doing homework in the workbook on the given topic*
17	Perpendicularity of geometric elements. Right angle projection. Perpendicularity of a line and a plane. Determination of the distance from a point to a plane. Perpendicularity of planes. Perpendicularity of lines. Determination of the distance from a point to a straight line. Lines of greatest inclination of the plane. . *Didactic tools:* https://do.ipo.kpi.ua/course/view.php?id=3361 https://do.ipo.kpi.ua/course/view.php?id=3187; workbook from the course. *Recommended literature:* [1]. *SRS: Doing homework in the workbook on the given topic.* 18 Method of geometric
places.	Two algorithms for solving problems of sketch geometry by the method of geometric places. Examples of geometric places and their application. *Didactic tools:* hhttps://do.ipo.kpi.ua/course/view.php?id=3361;

	https://do.ipo.kpi.ua/course/view.php?id=3187; workbook from the course.
	***Recommended literature:** [1].*
	* **SRS:** Doing homework in the workbook on the given topic.*

Practical classes

The name of the practical session	Number audio hours
Practical lesson 1. Point projection. Specifying a straight line on the plot. Solving problems on a complex drawing. Setting properties of objects. Creating layers. Setting text, dimension styles, units of measurement. Specifying blocks with attributes. Creation of A3 and A4 format templates using blocks with attributes. Conjugation ***Didactic tools:*** https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187; *workbook (theoretical information on the topic of the lecture and conditions for homework and classroom tasks).* ***Recommended literature:*** *[1,2,3].* **SRS:** *Doing homework in the workbook on this topic (tasks 1 - 10). Tasks according to the option on the topic "Conjugation".*	2
Practical lesson 2. Setting the plane on the epurse. Solving problems on a complex drawing. Images: views, sections, sections. The cuts are simple. Use of basic geometric shapes. Ways of pushing out, rotation, shift, loft. Application of user coordinate system. Use of logical operations. Commands for editing 3D objects. Layout of projection drawing images in AutoCAD. Construction of the drawing "Sections are simple" based on a previously created 3D model. **Didactic tools:** https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187; workbook (theoretical information on the topic of the lecture and conditions for homework and classroom tasks; individual tasks of the first chapter). ***Recommended literature:*** *[1,2,3].* **SRS:** *Completion of homework in the workbook on this topic (tasks 22 - 26). Tasks according to the option from the topic "Simple sections".*	2
Practical exercise 3. Relative position of two planes. Parallelism of planes. Intersection of planes of a special position. Intersection of planes of general and special position. The method of intermediary planes. Parameterization. Using AutoCAD parameterization capabilities in geometric modeling. Imposition of geometric and dimensional dependencies. Settings Manager. Construction of a parametrized flat contour drawing. *MKR.* ***Didactic tools:*** https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187; workbook from the course. ***Recommended literature:*** *[1,2,3]* **SRS:** *Doing homework in the workbook on the given topic.*	2
Practical exercise 4. Relative position of a straight line and a plane. Signs of parallelism of a straight line and a plane on a complex drawing. The general algorithm and technique for constructing the point of intersection of a straight line and a plane.	

Sketches and working drawings of details. Requirements of the standards for the execution of working drawings and sketches of details. Features of the images of details on the drawing depending on the method of their production. Applying dimensions from technological bases. Cleanliness of surfaces. Signs of surface roughness. Technical conditions. The structure of the recording of the material. Incision. Classification of the thread. Thread parameters. Thread grooves. The image of the thread on the working drawing of the part. Designation of the thread. Application of parameterization as a means of solving problems of 3D computer geometric modeling of technical objects in AutoCAD. Construction by means of AutoCAD 3D models of parts with a thread "Cap nut" with the use of parameterization. Using the created 3D model to build a working drawing of the part and in accordance with current standards. **Didactic tools:** https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187, workbook from the course. **Recommended literature:** *[1,2].* **SRS:** *Doing homework in the workbook on the given topic. Assignment according to the option on the topic "Cap nut".*	
Practical exercise 5. The method of replacing projection planes. Solving problems of the method of replacing projection planes on the example of a line segment of the general position and planes of general position. Assembly drawings. Threaded connections. Specification. Creation of electronic image libraries of fasteners using dynamic blocks of the AutoCAD graphics editor. **Didactic tools:** https://do.ipo.kpi.ua/course/view.php?id=3361 https://do.ipo.kpi.ua/course/view.php?id=3187; *workbook;* **Recommended literature:** *[1,2].* **SRS:** *Doing homework in the workbook on the given topic.*	2
Practical lesson 6. Curved lines. Solving problems on the projection of a circle. Surfaces. Solving problems on the construction of points and lines on surfaces. Execution of the assembly drawing of the parameterized model of the assembly unit using the electronic library of images of fasteners created using dynamic blocks. **Didactic tools:** https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187; *workbook (theoretical information on the topic of the lecture and conditions for homework and classroom tasks).* **Recommended literature:** *[1].* **SRS:** *Doing homework in the workbook on the given topic. RGR by option.*	2
Practical lesson 7. Intersection of surfaces by a plane. Solving problems on the intersection of surfaces with a plane. Construction of the natural size of the cross-sectional figure. Schemes. Types and types of schemes. The electrical scheme is basic. Conventional graphic symbols of scheme elements. Letter code of the element. Characteristics of input and output circuits. Drawing up a list of elements. Construction of the electrical schematic diagram in the graphic editor AutoCAD using the created library of blocks with attributes. Execution of the list of elements. **Didactic tools:** https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187; *workbook (theoretical information on the topic of the lecture and conditions for homework and classroom tasks).* **Recommended literature:** *[1,2,3].*	2

SRS: *Doing homework in the workbook on the given topic.* *Tasks according to the option on the topic "Basic electrical circuits".*	
Practical lesson 8. Solving problems for the construction of single penetration of bodies through horizontal "windows". Designing the work according to the requirements of the standards. ***Didactic tools:*** https://do.ipo.kpi.ua/course/view.php?id=3361; https://do.ipo.kpi.ua/course/view.php?id=3187; *workbook (theoretical information on the topic of the lecture and conditions for homework and classroom tasks).* ***Recommended literature:*** *[1].* **SRS:** *Doing homework in the workbook on the given topic.*	2
Practical lesson 9. Assessment.	2

6. Independent work of the student

hours assigned to the student's independent work are specified in clause 5. The method of mastering the academic discipline is the performance of homework, preparation for the performance of work in practical classes; execution of calculation and graphic work, as well as preparation for modular control work and assessment.

Policy and control

7. Policy of academic discipline (educational component)

Studying the academic discipline "Engineering and computer graphics. Foundations of geometric modeling" requires a higher education applicant to:
- observance of educational and academic ethics;
- compliance with the schedule of the educational
process; - be balanced, attentive in classes;
- systematically study theoretical material; - compliance with the
schedule for the protection of calculation and graphic work. The applicant's answer must show signs of independent performance of the assigned task, absence of signs of repetition and plagiarism.

If the student of higher education was absent from the lecture, he should practice this lecture at another time (with another group, at a consultation, on his own, using methodical materials presented on the Sikorsky distance learning platform, video recordings, etc.).

If the student of higher education was absent from the practical session, then he should practice the material of this practical session at another time (with another group, at a consultation, independently, using methodical materials presented on the Sikorsky distance learning platform, video recordings, etc.).

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

The student's rating is calculated on a 100-point scale.

1. The student's credit module rating consists of the points he receives for:
- homework and classroom assignments in the workbook (7 assignments);
- homework and classroom tasks according to options (DZ) (4 tasks);
- programmable control (PC) (4 PCs);
- execution of modular control work;
- implementation and protection of graphic and calculation work (RGR).

2. Scoring criteria:

2.1. Completion of tasks in the workbook is evaluated in 2 points according to the following criteria:
- flawlessly executed work, excellent graphics, work submitted on time - 2 points;
- there are certain shortcomings in execution, good schedule, violation of the delivery schedule up to 2-3 weeks - 1 point;

• there are significant shortcomings in execution, satisfactory graphics,late submitted work - 0.5 points;

2.2. Completion of homework according to options is estimated at 8 points:
  • flawlessly executed work, excellent graphics - 8 points;
  • there are certain shortcomings in execution, good schedule, violation of the delivery schedule up to 2-3 weeks - 6 points;
  • there are significant deficiencies in performance ，satisfactory graphics - 4 points;

2.3. Programmable control (PC) (4 PCs);
  • flawlessly performed work – 5 points;
  • there are certain shortcomings in performance – 3 points;
  • there are significant shortcomings in performance - 2 points;

2.4. The performance of the modular control work is assessed at 14 points:
  • flawlessly executed work - 14 points;
  • non-significant shortcomings in the performance of work - 12 points;
  • significant shortcomings in the performance of work - 8 points;
  • work performed incorrectly or not performed at all - 0 points.

 2.5. Completion of calculation and graphic work is estimated at 20 points::
  • flawlessly performed work - 20 points;
  • there are not significant shortcomings in the performance of work - 18 points;
  • there are significant shortcomings in the performance of work - 8 points;
  • work performed incorrectly or not performed at all - 0 points.

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

The condition of the first calendar control is to receive at least 18 points and to complete and defend three topics in the workbook, one optional homework, and to receive a positive grade from two programmed control tasks. The condition of the second calendar control is to obtain at least 45 points and perform and defend three topics in the notebook, two optional homework assignments, receive a positive grade from two programmed control assignments, and perform calculation and graphic work. The condition for obtaining a credit is the completion and protection of calculation and graphic work, tasks in the workbook with 7 course topics, four optional homework assignments, receiving positive grades from four programmed test papers and a modular test paper.

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

Number of points	Rating
100-95	Perfectly
94-85	Very good
84-75	Good
74-65	Satisfactorily
64-60	Enough
Less than 60	Unsatisfactorily
Admission conditions not met	Not allowed

9. Additional information on the discipline (educational component)

Passing of the exam takes place by tickets. The ticket consists of two tasks. The condition of the first task includes the educational material studied in the first theoretical part of the course. Knowledge of projection methods and methods of simplifying the solution of course problems are checked. The second task is complex. The obtained competencies of modeling geometric objects are checked

using AutoCAD tools, the ability to apply the requirements of standards when drawing up design documentation.

Working program of the academic discipline (syllabus):

Compiled by: Associate Professor of the Department of Sketch Geometry, Engineering and Computer Graphics, Ph.D. Hnitetska T.V.

Adopted by the _NGIKG__ department (protocol No. 10 dated June 11, 2024)

Agreed by the Methodical Commission of the Faculty of Electrical Power Engineering and Automation (protocol No. 10 dated June 20, 2024)