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

Logo Department S (if available)

Department of Descriptive Geometry, Engineering and Computer Graphics

Engineering & Computer Graphics

Work program of the discipline (Syllabus)

Details of the discipline

Level of higher education	***First (bachelor's)***
Field of knowledge	*13. Mechanical Engineering*
Speciality	*133. Industrial engineering*
Educational program	*133. Computerized printing systems*
Discipline status	*Normative*
Form of study	*full-time (full-time)/remote/mixed*
Year of preparation, semester	*1st year, autumn*
Scope of discipline	*7 (210)*
Semester control / control measures	*Autumn Semester – Exam*
Timetable	*Autumn semester: lecture – every week (36 hours); practical classes – every week (36 hours); Laboratory classes – once every two weeks.*
Language of instruction	*Ukrainian*
Information about Course Instructor / Teachers	*Department of Descriptive Geometry, Engineering and Computer Graphics (building 7, room 815), e-mail: http://geometry.kpi.ua/ Phone:+380 44 204 94 46* Lecturer: *Senior Lecturer, Natalia Mikhlevskaya, natavikmih@gmail.com, 067 645 97 65*[1] *Telegram: @NataliyaMihlevskaya* Practical classes: *Senior Lecturer, Natalia Mikhlevska, natavikmih@gmail.com, 067 645 97 65*[2]
Course Placement	https://do.ipo.kpi.ua/course/view.php?id=2870

The program of the discipline

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

The main purpose of teaching the discipline "Engineering and Computer Graphics" is to form students' competencies in the system of basic knowledge from the main sections of the course, gain work experience and apply methods of geometric modeling of spatial forms, create and design documentation using AutoCAD CAD using 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 gained in the previous one. Particular attention is paid to the principle of encouraging students to actively learn. This is facilitated by the organization of students' independent work with the help of sets of methodological materials posted on the Sikorsky distance learning platform, including video lessons, which are effective in organizing

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

- *active and collaborative learning strategies;*
- *personality-oriented developmental technologies based on active forms and methods of learning (-* 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 (GC 1);*
2. *ability to apply knowledge in practical situations (GC 2);*
3. the *ability to exercise their rights and duties 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, human and civil rights and freedoms in Ukraine (GC 12);*
4. the *ability to preserve and multiply moral, cultural, scientific values and achievements of society on the basis of understanding 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, equipment and technology, to use various types of physical activity for active recreation and a healthy lifestyle (GC 13).*

Professional:

1. *Ability to apply typical analytical methods and computer software to solve engineering problems of industrial engineering, effective quantitative methods of mathematics, physics, engineering sciences, as well as appropriate computer software for solving engineering problems of industrial engineering. (FC1);*
2. *Ability to apply computerized design systems and specialized application software to solve engineering problems in the field of mechanical engineering. (FC5);*
3. *Ability to realize creative and innovative potential in design developments in the field of industrial engineering. (FC8);*

Program Learning Outcomes:

1. knowledge and understanding of the *principles of technological, fundamental and engineering sciences that underlie industrial engineering in the relevant industry (PH1);*
2. To search for the necessary scientific and technical information in available sources, in particular, in a foreign language, to analyze and evaluate it*. (PH6);*
3. *freely communicate with the engineering community orally and in writing in the state and foreign languages (PH11);*
4. *Knowledge* of regulatory and technical *documentation on engineering and technical support of production and the basics of logistics (PH18).*

The above competencies and program learning outcomes of the discipline "Engineering and Computer Graphics" are provided thanks to the knowledge of students:

- *basics of descriptive geometry and engineering graphics;*
- *Fundamentals of Geometric Modeling;*
- *trends in the development of modern information technologies;*
- *universal computer-aided design system AutoCAD;*

- *methods of development of design documentation in accordance with the requirements of standards.*

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

The discipline lays the foundations for the study of other disciplines: information basics of electronics; fundamentals of design in electronics; computer science; measurement techniques; analytic geometry; higher mathematics; technologies of virtual devices; course and diploma design, etc., as well as in disciplines that involve the ability to create and design traditional projection and electronic drawings of products using modern CAD, geometric and computer 3d modeling of objects from the cycle of disciplines of vocational and practical training of students studying in senior courses.

3. The content of the discipline Engineering and Computer Graphics. Fundamentals of Geometric Modeling.

2. Content of the discipline

Chapter 1. Projection Methods

Topic 1.1. Projection methods. Center and parallel projection. Point projection. Complex point drawing. Ways to construct the third projection of a point. The position of the points relative to the planes of projection. Direct and inverse problems.

Topic 1.2. Define a line on a diagram. Lines of special position: level and projection. Straight line of general position. Belonging of a point to a line. The division of a line segment in a given relation . Method of replacing projection planes. The main problems of the method of replacing projection planes on the example of a segment of a line of general position. The relative position of two straight lines.

Topic 1.3. Plane projection. Define a plane on a diagram. Planes of special position: level and projection. Trace-projection of the plane of special position. Planes of general position. The belonging of a line and a point to a plane. Determination of the natural size of a flat figure. Parallelism of planes. Intersection of planes of special position. Intersection of planes of general and special position. Curved lines. Projection of a circle.

Chapter 2. Geometric Modeling of Surfaces

Topic 2.1.Surfaces. Methods of defining surfaces, their definition, classification. Ruler surfaces that unfold and do not unfold. Surfaces of rotation. Construction of points and lines on the surface, the conditions for their belonging to the surface.

Topic 2.2. Axonometry. Axonometric projection of a point. Rectangular isometrics and dimetry. Axonometric projections of circles that are parallel to the main planes of projections in rectangular isometrics and dimetry and replacing them with four-centered ovals. Hatching of sections in axonometric projections.

Topic 2.3. Intersection of surfaces with a plane.

A general technique for crossing surfaces with a plane. Construction of a line (figure) of intersection of surfaces of the second order by planes of special position. Determination of the natural size of the intersection figure. Sweep.

Topic 2.4. Single penetration. General Method of Solving Problems of Single Penetration of Surfaces by Symmetrical and Asymmetrical Horizontal "Windows".

Topic 2.5. Double penetration. General Method of Solving Problems of Double Penetration of Surfaces by Horizontal Windows.

Topic 2.6. Intersection of surfaces. Some cases of intersection of surfaces, the use of intermediaries – planes of special position. Spherical intermediary method. Monge's theorem. Conclusions.

Chapter 3. Types and rules for the design of technical drawings

Topic 3.1. ESKD Standards System – Basic Provisions. Formats. Scale. Line. Fonts. Geometric drawing. Conjugation of geometric elements. Basic requirements for applying dimensions on the drawing.

Topic 3.2. Projection drawing. Featured Images. Views, sections, sections. Classification of sections. Simple cuts: horizontal, vertical, inclined. Complex cuts: stepped, broken and combined. Features of their implementation. The main provisions of the GOST 2.305-68 standard: Dimensioning.

Topic 3.3. Sketches and working drawings of parts. Slicing. Classification of slices. Image and notation of the thread on the drawing. Threaded part. Cleanliness of the surface of the part. Surface roughness parameters. Conventions for designating roughness in drawings.

Topic 3.4. Sketches and working drawings of parts. Threaded part. Cleanliness of the surface of the part. Surface roughness parameters. Conventions for designating roughness in drawings.

Topic 3.5. Part of the "shaft" type. Features of the choice of the main species. Structural and technological elements.

Topic 3.6. Assembly drawing. Threaded connections: bolt, screw, stud, purpose, types, features, calculation of the length of fasteners, images and designations in the drawing. Drawing up and drawing up a specification.

Chapter 4. AutoCAD computer-aided design system.

Topic 4.1. Graphical interface of the program. The main menu of the program. Context menu. Use dialog boxes. Toolbars. Working with the command line. Program modes. Setting coordinates in AutoCAD. Commands to build graphical primitives. Step-by-step binding. Object snapping. Create a new drawing in AutoCAD. Saving a drawing in AutoCAD. Use templates.

Topic 4.2. Configuring drawing parameters in AutoCAD. Means of organization of the drawing. Working with layers. Layer parameters: color, type, line thickness, etc. On-screen control. Working with text. One-line text. Multi-line text. Adjust the text style. Image editing commands.

Topic 4.3. Drawings of flat objects of complex shape. Conjugation of geometric elements. Working with a polyline. Working with splines. Construction of planar contours. Adjust dimension styles. Dimensioning. Design of the drawing according to the requirements of basic standards (formats, scales, lines, fonts, etc.).

Topic 4.4. Construction of a projection drawing of a part. Specifying points using auxiliary construction methods: tracking, point filters, From operation. Design of a projection drawing of a part (views, sections, dimensioning, designation of sections, etc.).

Topic 4.5. Modeling of three-dimensional objects. Creation of a three-dimensional model by ejection. Apply paths and regions. Use of axonometric images. Ways to cut out the fourth

part of the model. Boolean surgeries. User's coordinate system. Hatching sections of three-dimensional objects.

Topic 4.6. Creation of a three-dimensional model using basic geometric shapes.

Topic 4.7. Modeling of three-dimensional objects by rotation.

Training Materials & Resources

References

1. Engineering graphics: textbook for students of higher educational institutions of I - II levels of accreditation / V.E.Mikhailenko, V.V.Vanin, S.M.Kovalev; Ed. - Lviv: Picha Yu.V.; Kyiv: Karavela; Lviv: Novyi Svit - 2000. - 284.
2. Vanin V.V., Blyok A.V., Gnitetskaya G.O. Formalization of design documentation. 3rd ed.- K.: 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 Publ., 2009. — 400 p.

Further reading

4. Mikhailenko V.E., Vanin V.V., Kovalev S.M. Engineering and Computer Graphics. — K.: Karavela, 2012. — 363 p.
5. Haskin A.M. Drawings. — K.: Vyshcha shk., 1985. — 440 p.
6. V.V. Vanin, N.V. *Bilytska, O.G. Getman, N.V. Mikhlevska. Descriptive geometry and engineering graphics. Learning tasks for programmable learning. Textbook for students of non-mechanical specialties.— K.: NTUU "KPI", 2020.* — 69 p

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

Information Resource

7. Complex of methodical materials. Distance Learning Platform "Sikorsky": https://do.ipo.kpi.ua/course/view.php?id=2870
8. Complex of methodical materials. Sikorsky Distance Learning Platform: https://do.ipo.kpi.ua/course/view.php?id=3187
9. Library *ftp://77.47.180.135/* .
10. Methodical documentation of the department's website 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

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

The program of the discipline provides for lectures and practical classes. Methodological support for the study of the course is the use of an information resource, which presents a methodological set of materials: a lecture course with a step-by-step explanation of the educational material of individual topics of the course and the use of animation elements; video tutorials; a workbook, both in print and in the form of a website with interactive step-by-step solutions to home and classroom problems posted on the Sikorsky Learning Platform. In the case of distance learning, all these materials can be used during lectures and practical classes on the Zoom platform, etc., as well as be available

when organizing students' independent work within the framework of remote access to information resources at a convenient time for them.

Lecture

The purpose of the lectures is to reveal the main provisions of the topic, the achievements of science, the *clarification of unresolved problems, and the generalization of work experience. In addition, to give recommendations on the use of the main conclusions on the topics in practical classes, as well as to provide students* with *explanations of concepts that are difficult to perceive, to motivate them to further study.*

Lecture topics:

Lecture 1. Entry. Point projection.
Lecture 2. Projection of a straight line.
Lecture 3. Projection of a plane and a circle.
Lecture 4. Curved lines and surfaces.
Lecture 5. Intersection of surfaces with a plane.
Lecture 6. Single penetration of surfaces.
Lecture 7. Intersection of surfaces.
Lecture 8. Main types of design documents
Lecture 9. Rules for the preparation of design documentation. Images: views, sections, sections.
Lecture 10. Dimensioning.
Lecture 11. Structural and technological elements of parts.
Lecture 12. Thread as a structural element of the part.
Lecture 13. Features of the image of a part of the "Shaft" type
Lecture 14. The wheel is geared.
Lecture 15. Assembly drawing. Connections on the assembly drawing
Lecture 16. Features of filling out text documentation. Specification.
Lecture 17. Features of the image of casting parts.

Practical classes

The purpose of practical classes is an in-depth study of the topics of the credit module, a detailed consideration by higher education applicants of its individual theoretical provisions and

the formation of skills and abilities for their practical application through individual performance of appropriately formulated tasks.

Approximate topics of practical classes:

Projection methods. Point projection. Projection of a straight line. Method of replacing projection planes. The main tasks of the method.

Plane projection. The relative position of two planes. Curved lines. Projection of a circle.

Surface. Methods of defining surfaces, their definition, classification. Surfaces of rotation. Construction of points and lines on the surface, the conditions for their belonging to the surface.

Intersection of surfaces with a plane. Sweep.

Single and double penetration.

General rules for drawing up drawings (formats and basic inscriptions, scales, lines, font, general rules for applying dimensions, etc.).

Images: views, sections, sections. Execution of a drawing of the model.

Drawing dimensions on a projection drawing of the model.

Slicing. Execution of a working drawing of a part with a thread. Surface roughness parameters.

Structural and technological elements of parts. Execution of a sketch of a part of the "Shaft" type.

Execution of the assembly drawing "Connection ".

Drawing up a specification for the assembly drawing.

Computer Practicum

The main purpose of the computer workshop is to obtain a set of knowledge and skills in the construction and design of electronic drawings of technical objects and diagrams, as well as modeling objects by means of the AutoCAD computer-aided design system.

Approximate list of computer workshops:

Introduction to AutoCad CAD, creating a drawing template. Working with graphic primitives. Working with bindings. Drawing by layers.

Editing commands, image control commands. Working with text

Dimensioning. Use templates. Design of a drawing of a flat contour.

Working with a polyline. Working with splines. Create paths and areas. Hatchings.

Individual tasks

To deepen the study of the educational material of the discipline and acquire practical skills, work is provided on individual initial data, the purpose of which is:

• consolidation of theoretical provisions of topics and sections of the discipline;

• checking the level of assimilation of knowledge gained by higher education students at lectures, practical classes and computer workshops, as well as during independent work on the course.

According to the curriculum, there are 8 graphic works, which are performed according to a mixed system (in practical classes and independently):

1) "Replacement of projection planes" (Diagram 1);

2) "Intersection of the surface by a plane" (Diagram 3);

3) "Cuts are simple";

4) "Cap nut";

5) "Shaft";

6) "Cogwheel gear";
7) "Connection";
8) "Specification",
and 5 graphic works of the computer workshop:
1) "The contour is flat";
2) "The cuts are simple";
3) "Body" (3D model);
4) "Trunnion" (3D model);
5) "Lid" (3D model).
In the learning process, in addition to traditional methods of teaching new material and controlling the knowledge of applicants, strategies of active and collective learning are used, which are determined by the following methods and technologies:
1) elements of problem-based learning methods: statement of the problem and interviews about ways to solve it during the lecture presentation of the material;
2) personality-oriented (developmental) technologies based on active forms and methods of teaching: conducting discussions on the most effective methods of solving classroom tasks and constructing working drawings according to a general drawing, choosing the main image, using sections to reflect the internal shape of parts;
3) information and communication technologies that ensure the problem-research nature of the learning process and the activation of independent work of higher education applicants: electronic presentations for lectures, the use of audio and video support for training sessions.

6. Student's Independent Work

Processing of lecture materials. Doing homework in the workbook for each topic.
Execution of individual tasks: diagrams, drawings and sketches of parts.
Two weeks are allotted for each task.
For the organization of the applicant's independent work in practical, laboratory classes and when performing individual tasks, appropriate methodological documentation has been developed. This is a workbook, methodical instructions and manuals, video lessons from a computer workshop that cover all topics of the course, methodical maps, reference tables, options for individual tasks, samples of graphic works, etc.

Policy & Control

7. Academic discipline policy (educational component)

The study of the discipline "Engineering and Computer Graphics" requires from the applicant for higher education:
- compliance with educational and academic ethics;
- compliance with the schedule of the educational process;
- be balanced, attentive in the classroom;
- systematic elaboration of theoretical material;
- compliance with the schedule for the protection of graphic work. The applicant's answer must demonstrate signs of independence in the performance of the task, the absence of signs of repetition and plagiarism.

Incentive points are assigned by the lecturer for active work at lectures (answers to the lecturer's questions), participation in the Olympiad in engineering graphics, early defense of individual tasks.
For late completion of individual tasks (being late for one week or more), penalty points are awarded (no more than 2 points for each work).
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 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". Read more: 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 procedure and expect it to be considered in accordance with predetermined procedures.

8. Types of control and rating system for assessing learning outcomes (CRO)

The rating of the applicant for the credit module consists of two components:
***I. Starting component** (60%) is formed as the sum of rating points received by the applicant based on the results of current control measures, incentive and penalty points during the semester. It includes:*
1. points received for the performance of graphic works;
2. points received for completing the tasks of the computer workshop;
3. Points received for tests.
***II. Examination component** (40%) – consists of points received for completing the examination work*
I. Initial component
1. Graphic works
In practical classes and in the course of independent work, applicants perform 8 graphic works (max 40 points in total)
1) "Cuts are simple";
2) "The incisions are complex";
3) "Cap nut;
4) "Shaft";
5) "Cogwheel gear";
6) "Connection", "Specification".

Calculation and graphic works

1. *Replacement of projection planes;*
2. *The intersection of a surface with a plane.*

2. Computer Practicum (max 25 points in total):

1) "The contour is flat";

2) "Projection drawing" (Sections are simple);

3) "Body", 3D model;

4) "Cover", 3D model;

5) "Trunnion", 3D model.

Rating points system and evaluation criteria:

1. full self-fulfillment of 5 points;

2. Self-fulfillment, minor errors 4 points;

3. performance with errors that are corrected in consultation with the teacher 3 points;

4. Gross mistakes or non-fulfillment of 0 points

Rating points system and evaluation criteria: 1. full self-fulfillment of 5 points; 2. Self-fulfillment, minor errors 4 points; 3. performance with errors that are corrected in consultation with the teacher 3 points; 4. Gross mistakes or non-fulfillment of 0 points 3. Tests . During the semester, it is necessary to complete 4 tests, the tasks for which applicants receive in practical classes on relevant topics. Each test is worth a maximum of 5 points, that is, an applicant can receive a maximum of 20 points. Topics of tests: 1) "Point, line"; 2) "Replacement of projection planes"; 3) "Surfaces, projections of points on surfaces"; 4) "Rifling".

Rating points system and evaluation criteria:

1. complete answer (at least 90% of the required information) 5 points

2. Complete answer (at least 75% of the required information), or complete answer with minor errors 4 points

3. incomplete answer (at least 60% of the required information) 3 points

4. less than 60% of the required information 0 – points

3. Incentive points. Applicants who participated in the Olympiad in the discipline "Engineering Graphics" receive incentive points depending on their positive achievements in this Olympiad.

4. Penalty points are awarded for late completion of tasks (without valid reasons): -1 point if the task is completed with a delay of 1 week, -2 points if the task is completed with a delay of 2 or more weeks, but the rating point cannot be lower than 3 points.

The maximum number of points for the starting component is 85, the minimum is 55. The starting rating is reduced to a 60-point scale by multiplying	*Computer Practicum*	*ST*	*Maximum Points*	*Coefficient 0.7*

by 0.7 :
Graphic works

40	*25*	*20*	*85*	*85x0,7=60*

Calendar control (certification)

Calendar control is carried out twice a semester as a monitoring of the current state of compliance with the requirements of the syllabus. And calendar control. Based on the results of 7 weeks of training, the applicant must pass the following graphic works "Simple sections", "Simple sections", computer work. workshop "Contour" and perform the 1st and 2nd tests. II calendar control. Based on the results of 13 weeks of training, the applicant must pass graphic works "Nut", "Shaft", computer works. workshop "Projection drawing, 3D model and perform the 3rd and 4th tests.

Exam

Conditions for admission to semester control (exam):

1. all graphic works and tasks of the computer workshop must be passed and positively evaluated

2. The starting rating of the applicant must be at least 45 points (36 on a 60-point scale).

The exam test ticket consists of two practical tasks, the completion of each of which is estimated at a maximum of 20 points. The maximum exam rating is 40 points.

The system of rating points and the criterion for evaluating the tasks of the examination control work:
"excellent" - complete solution of the problem 19-20 points

"good" - minor errors 16-18 points

"satisfactory" - the task was completed with errors, but not less than 60% 12-15 points

"unsatisfactory" - the task was not completed, or was completed less than 60% 0 points

In the case of the exhibition of control work, the start-up and the ex-replacement of the points are to be transferred to the unbalanced scale: Rating points	*Traditional evaluation*
95-100	*excellent*
85-94	*Very good*
75-84	*good*
65-74	*satisfactory*
60-64	*enough*
<60	*unsatisfactory*

Non-Audit of Minds *Non-admission*
Admission to Semester
Control

Applicants for higher education who have not passed all graphic works and (or) tasks of the computer workshop are not allowed to perform the examination test.

Work program of the discipline (syllabus):

Compiled by: Senior Lecturer of the Department of Descriptive Geometry, Engineering and Computer Graphics Mikhlevska N.V.

Approved by the Department of NGIKG (Minutes No. 6 dated 25.05.2023)

Approved by the Methodological Commission of the ER VPI (Minutes No. 6 dated 16.06.2023)

Approved by the Academic Council of NNPE (Minutes No. 11 dated 26.06.2023)