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

Working program of the educational component

ENGINEERING GRAPHICS of the discipline ENGINEERING AND COMPUTER GRAPHICS (Silabus)

The Department of Descriptive Geometry, Engineering, and Computer Graphics

Details of the discipline

Level of higher education	**First (bachelor's) degree**
Field of knowledge	**12 Information technology**
Specialty	**123 Computer engineering**
Educational program	**System programming**
Status of the discipline	*Обов'язкова (нормативна) (цикл професійної підготовки) ПО5*
Form of study	*full-time*
Year of preparation, semester	*II year, fall semester*
Scope of the discipline	*2 credits (60 hours)*
Semester control / control measures	*Credits*
Schedule of classes	*Lectures - once every two weeks (18 hours)*
Language of instruction	*Ukrainian*
Information about course leader / 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: Olha Lebedieva e-mail: olhalebedieva@gmail.com, meganom8@ukr.net; Tel: working 044 204 94 46, mob. 063 789 59 53*[1] *Practical : Olha Lebedeva* *Tetiana Nadkernychna e-mail: t_nadker@ukr.net* *Tel: working 044 204 94 46, mob.. 095 334 04 64*
Placement of the course	Link to the remote resource Moodle https://do.ipo.kpi.ua/course/view.php?id=3347

Program of the discipline

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

The discipline "Engineering Graphics" belongs to the cycle of professional and practical training. Engineering Graphics provides the development of spatial imagination in students, the ability to analyze and synthesize spatial forms, the development of skills for performing and reading technical drawings, teaches students geometric modeling of technical objects and processes and provides training for solving problems at the vocational level in solving professional disciplines in the specialty.

Engineering graphics is one of the disciplines of the fundamental cycle, which form the basis of engineering education.

The prerequisites for studying are secondary school.

The purpose of the discipline is to develop students' competencies and abilities:

- to spatial and algorithmic thinking;
- to build and read drawings with their subsequent use in the study of physics, chemistry, mechanics, computer science, design, technological processes and other disciplines, as well as in further work in any field of science and technology;
- to the construction and design of technical drawings in accordance with applicable standards;
- to the use of geometric modeling methods in the creation of hardware and software of information technology, development and application of computer systems and networks.
- to abstract thinking, analysis and synthesis

The subject of the discipline:

- methods of geometric modeling,
- graphical (projection) methods for solving engineering geometric problems,
- optimization methods for solving engineering graphics problems,
- requirements of standards for design documentation.

The knowledge gained in the course will help future professionals to find the right solutions to professional problems. As a result of studying the discipline, students should receive:

Knowledge:

- basic principles of geometric modeling of objects;
- projection methods of construction and study of spatial objects by their flat images on drawings;
- requirements of existing state and international standards in force in Ukraine and used in the development of design and technological documentation;

Ability to:

- perform and read projection images of any geometric objects;
- model real technical objects with their graphic analogues;
- use a drawing book as a flat geometric model of objects on which you can study the same geometric parameters as on a real product;
- prepare design documents in accordance with the requirements of applicable standards;
- use drawings at different stages of design.

Experience:

- solving metric and positional problems of descriptive geometry;
- construction of a projection drawing of a spatial geometric object;
- construction and study of spatial objects based on their flat images on drawings
- making a drawing of a three-dimensional model using drawing tools in compliance with the requirements of existing state and international standards in force in Ukraine;

Skills:

- reading flat drawings of spatial geometric models;
- building flat projections of a spatial model and studying its geometric properties;
- performing a flat drawing of a spatial model using drawing tools in compliance with the requirements of the standards in force in Ukraine.

The main tasks of the discipline:

- According to the requirements of the discipline program, students must demonstrate the following learning outcomes:

General competencies (GC):

- GC 1 Ability to abstract thinking, analysis and synthesis
- GC 2 Ability to learn and master modern knowledge
- GC 3 Ability to apply knowledge in practical situations
- GC 7 Ability to identify, formulate and solve problems.

Professional competencies (PC):

- PC 1 - Ability to apply the legislative and regulatory framework, as well as national and international requirements, practices and standards in order to carry out professional activities in the field of computer engineering.

Programmatic learning outcomes:

- **Competencies:**
- UM1 - Apply knowledge to identify, formulate and solve technical problems of the specialty, using methods that are most suitable for achieving the goals
- UM 2 - Solve problems of analysis and synthesis of tools specific to the specialty
- UM 3 - To think systematically and apply creative abilities to generate new ideas
- UM 4 Apply knowledge of technical characteristics, design features, purpose and rules of operation of software and hardware of computer systems and networks to solve problems of the specialty;
- UM 7 Work effectively both individually and as part of a team;
- UM 11 Evaluate the results obtained and defend the decisions made with reasons;
- UM 15 Realize the need for lifelong learning in order to deepen the acquired and new professional knowledge, improve creative thinking
- UM 16 Perform work of high quality and achieve the set goal in compliance with the requirements of professional ethics

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

Prerequisites for engineering graphics in the framework of pre-university training: geometry, stereometry, mathematics, physics, and in the structure of the EPP: "Higher Mathematics" and "Algorithms and Methods of Computing".

Post-requisites in engineering graphics: "Computer Graphics, Computer Aided Design of Computer Systems, Computer Electronics, Theory of Electrical Circuits and Signals, Data Structures and Algorithms, Parallel Programming, Computer Logic, Computer Circuitry and Components, Computer Networks, in course design: "CR in Computer Electronics", "CR in Computer Logic", "CR in Data Structures and Algorithms", "CR in Computer Networks", "CR in Computer Circuitry and Components", in diploma design.

3. The content of the discipline

Form of study	Semester (credit) modules	Total credits/ hours	Distribution of study time by types of classes			Semester certification
			Lectures	Practical classes	Students' independent work	
Daytime	Total	2/60	18	18	24	
	2	2/60	18	18	24	credit

4. List of sections and topics in engineering graphics

Module 1: Projection methods. Modeling of two-dimensional and three-dimensional geometric objects

Introduction. Subject and objectives of the course. Place of the course in the complex of disciplines for engineering training of bachelors and masters of computer engineering.

Topic 1.1. Methods of projection. Central and parallel projection. Projection of a point and a straight line. Projection of a point on three recognizably perpendicular planes. Complex drawing of a point and a straight line. Construction of the third projection of a point. Classification of lines. The task of the line in the drawing. Belonging of a point to a line. Method of replacing projection planes. Determination of the natural value of a segment. The relative position of two lines in space.

Topic 1.2. Modeling of planes. Projection of planes. Setting a plane on a drawing. Classification of planes. Belonging of a line and a point to a plane. Traces of planes. Converting a plane of general position to a plane of level. Intersection of planes.

Topic 1.3 Surfaces. Ways to define surfaces. Classification of surfaces. Linear surfaces, expandable and non-expandable. Surfaces of rotation, their determinant. Construction of points and lines on surfaces.

Topic 1.4 Intersection of surfaces by a plane. The general method of constructing a section of surfaces by a plane. Determination of the shape of the section of surfaces of the 2nd order. Construction of cross sections of a cylinder, cone, sphere by planes of a particular position. Construction of cross-sections of faceted surfaces by planes of particular and general position. Scans. Methods for constructing expanded surfaces.

Topic 1.5 Double section. Single and double penetration, solving problems on the construction of the line of intersection of a horizontal cut with the outer and inner surfaces. Making useful sections.

Topic 1.6 Mutual intersection of surfaces. General algorithm for constructing intersection lines. The concept of intermediaries - planes of special position and spherical intermediary surfaces.

Module 2: Types of technical drawings and rules for their design

Topic 2.1. The system of standards of the USCC, GOST 2. 301-68, 2. 302-68, 2. 303-68, 2. 304-68, 2. 307-75. Formats, scales, lines, fonts, dimensioning. Geometric drawing. Conjugation of geometric elements.

Topic 2.2. Projection drawing. Images on drawings: views, sections, sections. Projection apparatus. Classification of sections. The main provisions of GOST 2. 305-68. Application of dimensions.

Topic 2.3. Axonometry. General information. Distortion coefficients. Axonometry of flat figures and circles. Construction of a rectangular axonometric projection of a three-dimensional geometric object by its projections. Direct and inverse problems of axonometry.

5. Teaching materials and resources

Basic literature

1. Vanin V.V., Perevertun V.V., Nadkernychna T.M., Vlasiuk H.G. Engineering Graphics Textbook Fundamentals of Descriptive Geometry, Kyiv, BHV, 2009, 400 pp. (NTB, http://geometry.kpi.ua/files/Inz_graf_Vanin.pdf)
2. Vanin V.V., Bliok A.V., Gnitetska G.O. Design documentation, Textbook. Kyiv, Caravel, 2012, 200 p.
3. V.E. Mykhailenko, V.V. Vanin, S.M. Kovalev Engineering graphics. Lviv, Novyi Svit, 2002, 284 p. Methodical instructions and control tasks for the courses "Descriptive Geometry" and

"Engineering Graphics". Compilers: N.K. Vitkun, A.E. Izvolenska, N.A. Parakhina, L.D. Chornoshchekova, Kyiv, KPI, 1992 - 60 p.

Additional literature

4. Educational tasks in descriptive geometry and engineering graphics. Compilers: N.K. Vitkun, M.D. Bevz, V.V. Vanin, S.M. Horban, V.Y. Zalevsky, KPI, 2003, 64.
5. DSTU ISO 5457:2006. Technical documentation for products. Drawings. Dimensions and formats.
6. DSTU GOST 2.104:2006 Unified system of design documentation. Basic inscriptions.
7. DSTU ISO 5455:2005. Technical drawings. Scales.
8. DSTU ISO 128-24:2005 Technical drawings. General principles of design. Part 24. Lines on engineering drawings
9. DSTU ISO 3098-0:2006 Technical documentation for products. Fonts. Part 0: General requirements
10. DSTU ISO 128-40:2005 Technical drawings. General principles of design. Part 40. Basic provisions on sections and cross-sections
11. DSTU GOST 2.317: 2014 Unified system of design documentation. Axonometric projections

6. Educational content

Methods of mastering the educational component Engineering graphics of the discipline Engineering and computer graphics

6.1. Distribution of study time by topic

Titles of content modules and topics	Number of hours				
	Total	including			
		Lectures	Practice (seminars)	Laboratory (comp. pr.)	IWS
1	2	3	4	5	6
Engineering graphics					
Topic 1: *Introduction.General rules for drawing up drawings. Conjugation. The system of standards. Calculation and graphic work 1*	7	2	2	-	3
Topic 2. *Methods of projection. Modeling of a point and a line Control work 1*	5	2	2	-	1
Topic 3. *Modeling of planes. Projection of a circle Control work 2 Calculation and graphic work 2*	8	2	2	-	4
Topic 4. *Modeling of curved lines and surfaces Control work 3*	5	2	2	-	1
Topic 5. *Projection drawing. Images. Views and sections.*	8	2	2	-	4

Calculation and graphic work 3					
Topic 6: *Axonometry* *Calculation and graphic work 4*	8	2	2	-	4
Topic 7. *Intersection of surfaces by a plane* *Control work 4*	5	2	2		1
Topic 8. *Double section* *Control work 5* *Calculation and graphic work 5*	9	2	2	-	5
Topic 9. Intersection of surfaces	5	2	2	-	1
Total hours	**60**	**18**	**18**	**-**	**24**

6.2. Lectures

№	Title of the lecture topic and list of main issues (list of teaching aids, references to literature and assignments for IRS)
1	***Lecture 1:*** *Introduction. Projection of a point.* The subject and objectives of the course, its place in the complex of disciplines for engineering training of bachelors and masters in the field of computer engineering. Methods of projection. Central and parallel projection. Monge's epure. Complex point drawing. Position of points relative to projection planes. Direct and inverse problems. **Teaching aids:** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom activities) ***Recommended reading:*** *[I] Section I, pp. 12-17*
2	***Lecture 2:*** *Projection of a straight line.* Complex drawing of a straight line. Classification of lines. The task of the line on the drawing. Belonging of a point to a line. Method of replacing projection planes. Determining the natural value of a segment. The relative position of two lines in space. **Teaching aids:** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom activities) ***Recommended reading:*** *[I] Section I, pp. 18-23*
3	***Lecture 3:*** *Projection of planes* The task of the plane on the drawing. Classification of planes. Belonging of a line and a point to a plane. Traces of planes. Transformation of the plane of general position into the plane of level. Projections of a circle. ***Teaching aids:*** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom activities) ***Recommended reading:*** [1] Section I, pp. 24-30;[11]
4	***Lecture 4****. Surfaces and curved lines* Surfaces. Ways to define surfaces. Classification of surfaces. Linear surfaces, unfolding and not unfolding. Surfaces of rotation, their determinant. Construction of points and lines on surfaces. **Teaching aids:** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom activities) ***Recommended reading***:[1] Chapter 2, pp. 60-76;
5	***Lecture 5.*** *Prection drawing. Images on drawings: views, sections, sections* Projection apparatus. Main and main image, views, sections, sections*. Simple sections. Classification of sections. Examples of execution. Application of dimensions.* ***Didactic tools:*** Reference tables, methodical maps, model ***Recommended reading:*** [2], [3], DSTU ISO 128-40: 2005 Technical drawings. General principles of design. Part 40. Basic provisions on sections and cross-sections
6	***Lecture 6****. Axonometric projections* General information. Distortion coefficients. Axonometry of plane figures and circle. Building a

	model in rectangular axonometric projections. ***Teaching aids:*** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom activities). Methodical maps. ***Recommended reading:*** [1] Chapter 5 pp. 112-118
7	***Lecture 7.*** *Sections of surfaces by a plane. Scans.* The general method of constructing a section of surfaces by a plane. Determination of the shape of the section of surfaces of the 2nd order. Construction of cross-sections of a cylinder, cone, ball by planes of a separate position. Construction of cross-sections of faceted surfaces by planes of particular and general position. Scans. Methods of constructing expanded surfaces. ***Teaching aids***: Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom classes) ***Recommended reading:*** [1] Chapter 4, pp. 76-90
8	***Lecture 8.*** Construction of projections of bodies of complex shape. Single penetration. Double penetration. General methods for solving single and double penetration problems. Single penetration, solving problems on the construction of the line of intersection of a horizontal cutout with an external surface. Double penetration. Making useful cuts. ***Teaching aids:*** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom activities) ***Recommended reading***:[4]
9	***Lecture 9. Intersection of surfaces.*** General algorithm for finding lines of intersection of surfaces. The use of geometric intermediaries - planes of special position and spherical surfaces-mediators. Monge's theorem. Conclusions of Monge's theorem. ***Teaching aids:*** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom classes) ***Recommended reading***: [1] Chapter 4 pp. 96-102

6.3. Practical classes

The main objectives of the cycle of practical classes are designed to consolidate the knowledge gained in lectures and develop skills in applying it in practice to solve specific problems.

№	**Title of the class topic and a list of key issues** (list of didactic support, references to literature and assignments for IRS)
1	**Practical lesson 1: Introduction. General rules for drawing up drawings.** Information is provided on the rules of design documentation. The current standards of DSTU ISO 5457: 2006 are considered. Technical documentation for products. Drawings. Dimensions and formats; DSTU GOST 2.104:2006 Unified system of design documentation. Basic inscriptions; DSTU ISO 5455:2005. Technical drawings. Scales; DSTU ISO 128-24:2005 Technical drawings. General principles of design. Part 24. Lines in engineering drawings; DSTU ISO 3098-0:2006 Technical documentation for products. Fonts. Part 0: General requirements The explanation is accompanied by examples. The construction of conjugation of geometric elements is considered. **Didactic tools:** Workbook (theoretical information on the topic), reference table "Rules for design documentation " Recommended reading: State standards of Ukraine DSTU ISO 5457: 2006. Technical documentation for products. Drawings. Dimensions and formats; DSTU GOST 2.104: 2006 Unified system of design documentation. Basic inscriptions; DSTU ISO 5455:2005. Technical drawings. Scales; DSTU ISO 128-24:2005 Technical drawings. General principles of design. Part 24. Lines in engineering drawings; DSTU ISO 3098-0:2006 Technical

	documentation for products. Fonts. Part 0: General requirements. Conjugations (Section VI, clause 1, pp. 82-117). RGR-1 (Section VI, clause 11, p. 57), [12.2 I], [1] Section 7, pp. 136--146 **IWS: Completion of WGR1 "Introduction to engineering graphics"**
2	**Practical lesson 2: Projection of a point and a line.** The complex drawings of a point and a straight line, the conditions for a point to belong to a line, the classification of lines, the determination of the natural value of a line segment, the relative position of lines in space are considered. **Teaching aids:** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom activities) **Recommended reading: [I] Chapter I, pp. 12-23** **IWS: Doing homework in the workbook on this topic.** **Test.**
3	**Practical lesson 3: Projection of a plane.** Problems on the construction of points and lines belonging to the plane are considered. The transformation of the plane of general position into the plane of the level is performed. The projection of a circle located in the plane of a particular position is considered**.** **Teaching aids:** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom activities) **Recommended reading:[1] Section I, pp.24-30;[11]** **IWS:** Doing homework in the workbook on this topic. **WGW 2 "Transformation of projection planes. Projection of a circle".** **Test.**
4	**Practical lesson 4. Curved lines and surfaces. Construction of points and lines on surfaces.** The issues of surface definition, construction of surface projections are considered. Problems on the construction of points belonging to the surface are solved. Lines on the surface are studied. **Teaching aids:** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom activities) **Recommended reading:** [1] Chapter 2, pp. 60-76; **IWS: Doing homework in the workbook on t his topic.** **Test.**
5	**Practical lesson 5. Images. Views, sections, sections.** Perform a projection drawing of a wooden model: views, simple sections, combining views and sections. Application of dimensions. Design of the drawing. **Didactic tools:** Reference tables, methodical maps, wooden model. **Recommended reading:** [2], [4], DSTU ISO 128-40: 2005 Technical drawings. General principles of design. Part 4. Basic provisions on sections and sections. **IWS: РГР3 Performing a projection drawing of a model from nature or from a visual representation in three projections with simple sections** **Test.**
6	**Practical lesson 6. Axonometry.** Performing axonometric images of geometric bodies according to the image on a complex

	drawing. **Teaching aids:** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom activities) Reference tables, methodical maps. **Recommended reading:** [1] Chapter 5 pp. 112-118, DSTU GOST 2.317:2014 Unified system of design documentation. Axonometric projections **IWS: Doing homework in the workbook on this topic.** **WGR4 Building an axonometric image of a model according to a projection drawing**
7	**Practical lesson 7. Intersection of surfaces by a plane. Construction of scans.** Problems are solved to construct the line of intersection of surfaces by a plane of individual and general positions. Scans of surfaces are built. **Teaching aids:** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom activities) **Recommended reading:** [1] Chapter 4 pp. 76-90 **IWS: Doing homework in the workbook on this topic.** **Test.**
8	**Practical lesson 8. Images of geometric bodies of complex shape.** Construction of double penetration of the sphere. **Teaching aids:** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom activities) **Recommended reading:** [4] **IWS: Doing homework in the workbook on this topic.** **WGR-5 Double penetration**
9	**Practical lesson 9. Intersection of surfaces.** Construction of lines of intersection of surfaces using mediators - planes of separate position and spheres. Use of Monge's theorem. **Teaching aids:** Workbook (theoretical information on the topic of the lecture and conditions for home exercises and classroom activities) **Recommended reading:** [1] Chapter 4, pp. 96-102 **IWS: Performing homework in the workbook on this topic**

7. Individual work of the student

7.1. Types of individual work:

- preparation for classroom classes on the topic of the lecture - 1 week;
- solving homework on the topic - 1 week;
- completion of calculation and graphic work - 2 weeks from the date of assignment.

7.2. Policy and control

7.2.1. Policy of the discipline (educational component)

- *Attendance at classes (both lectures and practicals) is mandatory, and students must bring lecture notes, a workbook, and drawing tools;*
- *rules of behavior in the classroom: student activity is rewarded with points, phones must be turned off, it is forbidden to use communication devices to search for information on the teacher's Google Drive or the Internet, etc;)*
- *rules for the defense of individual assignments: the student must explain the solution to the problem and the methodology of performing the constructions;*
- *rules for assigning incentive and penalty points: incentive points are assigned for active cooperation during the lecture and practice, for independent error-free performance and crediting of the WGW, for using an original way of solving the problem and manifestations of independent thinking during the express survey at the lecture, performing classroom and homework; penalty points are assigned in case of student absence from classes without a valid reason, lack of preparation for the practical lesson on the lecture material, untimely performance of the WGW.*
- *Policy on deadlines and retakes: in case of failure to meet the deadline, punitive points are assigned, the same applies to retakes;*
- *Policy on academic integrity: if there are signs of violation of academic integrity, the student is offered to redo the assignment according to another option with punitive points;*

7.2.2. Types of control and rating system of learning outcomes assessment (LSA)

Current control: express surveys, surveys on the topic of the lesson, CW on the main topics;
Calendar control: carried out twice a semester as a monitoring of the current state of fulfillment of the requirements of the silabus.
Semester control: credit
Conditions for admission to the semester control: completion of all calculations, solving 60% of the tasks in the workbook, semester rating of more than 60 points.

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

Number of points	Score
100-95	Excellent
94-85	Very good
84-75	Good
74-65	Satisfactory
64-60	Sufficient
Менше 60	Unsatisfactory
The conditions of admission are not fulfilled	Not allowed

Working program of the academic discipline (silabus):

Compiled by senior lecturer Olga Lebedieva

Approved by the Department of Descriptive Geometry, Engineering and Computer Graphics (Minutes No. 6 of 25.05.23)

Approved by the Methodological Commission of the Faculty of Applied Mathematics (Minutes № 10 of 26.05.23)