Ministry of Education and Science of Ukraine
National Aerospace University
"Kharkiv Aviation Institute"

Department of Descriptive Geometry and Computer Modeling (№ 406)

APPROVED
Vice Head of educational program

M. Romanov
«31» 08 2021

GRADUATING PROGRAM OF THE DISCIPLINE

Academic practice (Geometric modeling and graphic information technologies)
(title of discipline)

Field of Study: 13 "Mechanical engineering", 14 "Electrical Engineering" 15 "Automation and instrumentation", 27 "Transport"
(code and title of the field of study)

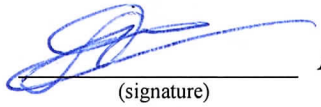
Program Subject Area: 134 "Aerospace engineering", 131 "Applied Mechanics", 133 "Industrial Machinery Engineering", 141 "Electric power, electrical engineering and electromechanics", 142 "Power Engineering", 144 "Heat Power Engineering", 151 "Automation and computer-integrated technologies", 272 "Air transport", 274 "Road transport"
(code and title of the program subject area)

Educational program: "Design and manufacturing of composite structures", "Maintenance and repair of aircraft and aircraft engines", "Design, manufacture and certification of aircraft", "Cars and automotive", "Gas turbines and compressor stations", "Robotomechanical systems and logistics systems", "Aircraft Engines and Power Plants ", "Technologies for the Production of Aircraft Engines and Power Plants ","Computer-aided Design and Production Technologies","Energy Management "," Computer-Integrated energy systems design technologies ","Unmanned aerial vehicles ", " Rocket engines and power plants ", "Rocket and space systems ", "Satellites, engines and power plants", " Non-traditional and Renewable Energy Sources ".
(title of educational program)

Mode of study: Full-time
Degree: First (Bachelor)

Kharkiv 2021

Developed by:
Head of Descriptive Geometry and Computer Modeling Department, PhD


A. Cherniavskyi
(signature)

The educational program was considered at the meeting of Descriptive Geometry and Computer Modeling Department (№406), protocol № 1 dated 31.08.2021

Head of the Descriptive Geometry and
Computer Modeling Department (406)


A. Cherniavskyi
(signature)

1. Discipline syllabus

<table>
<tr><td rowspan="2">Indicator</td><td rowspan="2">Field of study,
subject area,
educational program,
degree</td><td>Characteristics
of the discipline</td></tr>
<tr><td>Full-time</td></tr>
<tr><td>Credits – 3</td><td rowspan="15">Field of study
13 “Mechanical engineering”, 14 “Electrical Engineering”, 15 “Automation and instrumentation”, 27 “Transport”
(code and title)
Program subject area
“Design and manufacturing of composite structures”, “Maintenance and repair of aircraft and aircraft engines”, "Design, manufacture and certification of aircraft", "Cars and automotive", "Gas turbines and compressor stations", "Robotomechanical systems and logistics systems", "Aircraft Engines and Power Plants ", "Technologies for the Production of Aircraft Engines and Power Plants ","Computer-aided Design and Production Technologies","Energy Management "," Computer-Integrated energy systems design technologies ”,“Unmanned aerial vehicles ”, “ Rocket engines and power plants ”, “Rocket and space systems ”, “Satellites, engines and power plants”, “ Non-traditional and Renewable Energy Sources ”.
(code and title)
Educational program:
“Design and manufacturing of composite structures”, “Maintenance and repair of aircraft and aircraft engines”, "Design, manufacture and certification of aircraft", "Cars and automotive",</td><td>Training cycle (optional)</td></tr>
<tr><td>Modules – 1</td><td>Academic year</td></tr>
<tr><td>Content modules – 3</td><td>2021 / 2022</td></tr>
<tr><td rowspan="2">Individual assignments
_____
_____
(title)</td><td>Semester</td></tr>
<tr><td>2-nd</td></tr>
<tr><td rowspan="2">Total hours – 60/90</td><td>Lectures[2)]</td></tr>
<tr><td>4 hours</td></tr>
<tr><td rowspan="2">Weekly hours for full-time study[1)]:
- classroom –30
- individual student work – 15</td><td>Practices, seminars[2)]</td></tr>
<tr><td>18 hours</td></tr>
<tr><td>Laboratory[2)]</td></tr>
<tr><td>38 hours</td></tr>
<tr><td>Individual work</td></tr>
<tr><td>30 hours</td></tr>
<tr><td>-</td></tr>
<tr><td>–</td><td>–</td></tr>
<tr><td>Type of control</td></tr>
<tr><td>pass</td></tr>
</table>

	"Gas turbines and compressor stations", "Robotomechanical systems and logistics systems", "Aircraft Engines and Power Plants ", "Technologies for the Production of Aircraft Engines and Power Plants ","Computer-aided Design and Production Technologies","Energy Management "," Computer-Integrated energy systems design technologies ","Unmanned aerial vehicles ", " Rocket engines and power plants ", "Rocket and space systems ", "Satellites, engines and power plants", " Non-traditional and Renewable Energy Sources " **Degree** First (bachelor)	

Note:

[1)] The ratio of the classroom hours to hours of the independent and individual work for full-time education is 2/1.

[2)] Classroom load can be reduced or increased by one hour depending on the schedule.

2. The purpose and objectives of the discipline

Academic practice aims to consolidate knowledge and skills acquired by students for the development of spatial representation and constructive-geometric thinking, ability to analyze and synthesize spatial forms and relationships based on graphical models. It prepares students to use computer aided design systems for making design documentation, mastering advanced techniques and methods of design, obtaining skills for solving engineering problems.

The purpose of the academic practice:

- develop students' spatial technical imagination while studying theoretical and practical foundations of engineering and computer graphics;
- study standards for design documentation; execute sketches of parts; preparing design and technical documentation;
- acquisition of knowledge and skills necessary to read and create technical drawings;
- mastering basic principles of geometric modeling;
- introduction to modern graphic means of interactive computer graphics;
- practical usage of engineering graphics topics used in this specialty.

Objectives:

- development of spatial representation, constructive-geometric thinking on the basis of graphic models of spatial forms, abilities to analyze geometric forms;
- study methods to construct various geometric spatial objects;
- acquire knowledge about the rules and standards for design documentation;
- acquire skills for creating and reading drawings of individual parts and assembly units;
- working with modern CAD systems;
- acquire skills in automatizing for development design documentation.

Acquiring competencies:

General competencies:

- formation of communication skills in a professional team;
- readiness to interact with consumers of information;
- ability to be creative, to give birth to innovative ideas, own hypotheses;
- ability to apply methods of drawing up reports and explanatory notes in practice;
- independent work skills;
- ability to search, critically analyze, synthesize, generalize and systematize scientific information, to outline research goals and choose optimal ways and methods to achieve them;
- clarification and deepening of professional interests.

Special (professional) competencies:

- ability to demonstrate knowledge of the discipline "engineering and computer

graphics"; ability to develop and draw up a variety of design and technical documentation;
- readiness to monitor the compliance of developed projects and technical documentation with standards, technical conditions and other regulatory documents;
- ability to have skills of independent work on a computer and in computer networks, to carry out computer modeling using CAD systems;
- ability to represent geometric images of parts and objects of Mechanical Engineering in a graphics way;
- ability to use information technologies, including modern computer graphics tools in engineering field;
- further development and improvement of students ' professional skills in the major "engineering and computer graphics" acquired during their studies at the University.

Learning outcomes: Apply modern methods of design, construction and production of elements and systems of aviation and rocket and space technology in professional activities.

As a result of academic practice the student should

know theory of construction of technical drawings; basic concepts necessary for performing and reading drawings of parts, assembly units; modern standards of computer graphics, elements of geometric modeling, computer graphics software;

be able to:

represent technical ideas through drawings; perform and read technical diagrams, drawings and sketches of parts, components, assembly drawings and general view drawings; apply the standards necessary for the development of design documentation; apply modern means of drawing and preparing design documentation; use graphic packages for the purpose of geometric modeling and development of design documentation; apply knowledge of engineering graphics in their professional activities;

has an idea of:

the tools for solving graphic problems in their subject area, modern software tools for preparing design documentation.

Prerequisites:

To master academic practice students should pass the course “Geometric Modeling and Graphics information technologies”.

Co-requisites:

When studying the discipline, it is desirable to know the basics "Materials Science" and "Interchangeability and Standardization".

Postrequisites:

The principles and methods studied in the course are related to basics of engineering and widely used throughout all students’ learning process. Mastering of this course is necessary for the courses "Machine Parts", "Mechanics of Materials", "Technical Mechanics" and others. It’s also important for laboratory works, course projects and explanatory notes, diploma project.

3. Discipline program

Topic 1. Products and design documentation. Product design stages. Sketching of machine parts. General view drawings. Views. Sectioned views, sections, dimensioning. Threads and thread joints. Representation in a drawing and conventional designation. Drawing of machine parts.

Topic 2. Modern computer technologies. Computer graphics software. Mathematical and geometric models. CAD. Three-dimensional modeling. Tools for 3D modeling. 2D images based on 3D models. 3D models of assembly units and their drawings. Libraries of standard components. BOM. Specification
Orthographic projection of and relative position of geometric objects.

4. Discipline structure

Modules and topics	**Hours**					
	total	**including**				
		lec	**prac**	**lab**	**indiv**	**indep**
1	**2**	**3**	**4**	**5**	**6**	**7**
Topic 1. CAD systems, their purpose and specifics. Goals and objectives of the practice. Reporting form.	2	2	-	-	-	-
Topic 2. Types of design documentation.	2	2	-	-	-	-
Topic 3. Sketching of machine parts	16	-	16	-	-	-
Topic 4. 3D modeling of machine parts and assembly units using CAD systems.	24	-	-	24	-	-
Topic 5. Working drawings of typical machine parts using CAD systems.	10	-	-	10	-	-
Topic 6. Design documentation. Creation and working up with.	6	-	2	4	-	-
Total hours	**60**	**4**	**18**	**38**	**0**	**0**

5. Practical classes

№	Title	Hours
1	Introduction to the practice program, determining the scope of the task. Familiarization with design documentation of the assembly unit.	2
2	Making a sketch of the "body" part. Surface analysis and development of an algorithm for building a 3D model.	6
3	Making sketches of all non-standard parts of the assembly unit.	8
4	Preparation of a practice report.	2
	Total hours	**18**

6. Laboratory works

№	Title	Hours.
1	Lab 1-4. A part model and a working drawing based on the model in CAD systems.	8
2	Lab 5-6. A parametric model of machine part in CAD system.	4
3	Lab 7. A model of assembly unit with standard parts from the CAD library.	2
4	3D models of all parts of the assignment.	10
5	Working drawings of parts in CAD by their 3D models	4
6	3D model of the assembly unit in CAD system	4

7	Assembly drawing based on a 3D model of an assembly unit in CAD	2
8	Kinematic analysis of the unit, according to the assignment	4
	Total hours	**38**

7. Self-study

№	Title	Hours.
1	Algorithms for constructing 3D models of parts and components in CAD	5
2	Basics of Design Documentation. Dimensioning.	5
3	Basics of Design Documentation. Threads and threaded joints. Representation in a drawing.	5
4	Drawing of machine parts.	5
5	CAD systems.	5
6	Preparation of a report on academic practice.	5
	Total	**30**

8. Teaching methods

The most important requirement for higher education is the formation of creative personality qualities. Analysis of the main types of creative activity shows that their systematic implementation develops following person's qualities like the speed of orientation in changing conditions, the ability to see the problem and not be afraid of its novelty, originality and productivity of thinking, ingenuity, intuition, etc. Such qualities are of very high importance now and will undoubtedly grow up in the future.
Depending on the topic, the explanatory, illustrative, reproductive methods and the problem presentation method are used in teaching.
The results of mastering the discipline "engineering and computer graphics" are achieved through the use of interactive methods and technologies in the learning process to form the necessary competence among students:
- Lectures using multimedia technologies;
- Conducting laboratory and practical classes.

9. Control methods

Certification based on the results of academic practice is carried out in the form of a differentiated pass based on the preparation and defense of the report. Upon completion of the academic practice, students submit a practice report that includes text, tabular and graphic materials that reflect the solution of the problems according to the practice program.
The sequence of presentation of the report materials should correspond to the practice program.

Requirements for the academic practice report.

The practice report should contain the following parts:
Title page with the signature of the head of the practice.
Practical assignment issued by the head of the practice.
Content-displays a list of topics and questions contained in the report.
Introduction - defines goals, objectives, and areas of work.
Main part - defines a brief description of the task, goals, as well as the types, structure,

and scope of work performed. Also, in this part of the work, the student should answer all the questions included in the practice program.
Individual task - includes a full detailed review of the tasks set by the head of the practice.
Conclusion - contains the main conclusions and results, the results of the work done, the main proposals (measures) for improving the performance.

The following methods are used for current monitoring:
- control of sketches and drawings,
- oral questioning,
- monitoring the implementation of a laboratory works and 3D models of an individual assignment.

Evaluation criteria

The necessary amount of **knowledge** to get a positive assessment:

know the theoretical foundations of geometric and projection drawing, proper standards and requirements for performing machine-building drawings.

The required amount of **skills** to get a positive assessment:

be able to read and create graphic works within the curriculum in accordance with the requirements of technical, design and technological documentation. Independently solve an educational, practical or control tasks in accordance with the requirements of technical, design and technological documentation. Be able to solve the problem independently, choose the best solution of the problem. The result of the work fully corresponds to the current qualitative and quantitative indicators, or may be better. Computer graphics allows the student to perform graphic work using technical means (CAD) that saves the time, gives more conveniences and opportunities for design work.

Quantitative evaluation criteria (distribution of points).

Satisfactory (60… 74). Show up minimum of knowledge and skills. Defend individual assignment.
The student has learned the basic concepts and provisions of the discipline, but is not sure about the standards for design documentation, answers unconvincingly, and additional questions cause uncertainty or lack of knowledge.
The CAD program usage is uncertain. Graphic works are performed with errors (no sections or cross-sections in appearance, not all dimensions are placed). Control tests are not fully answered.

Good (75… 89). Know the minimum firmly, protect individual tasks, complete all tasks, pass tests and do independent work outside the classroom.
The student has mastered the basic concepts and principles of the discipline, understands the program material, knows the content of the curriculum, freely uses the acquired theoretical knowledge when performing graphic works, but allows certain inaccuracies and errors when performing drawings. The student has mastered the theoretical material on the relevant topic, on the performance of graphic works. Graphic works

were performed according to the design documentation rules, but minor errors were made when dimensioning according to the requirements. Operates CAD program, performs tasks for independent processing. Correctly gives answers to a control tests.

Excellent (90… 100). Pass checkpoints with an excellent rating. Deeply know all the topics and be able to apply them.

The student has mastered the theoretical material on the discipline, the basic rules for performing drawings according to design documentation for practical (graphic) work and individual assignments, and also knows how to use reference literature and technical documentation. Performs all graphic works in accordance with the standarts for design documentation, correctly performs tasks. Correctly gives answers to the control tests. He is familiar with the CAD systems, namely, he can create 3D models of machine parts and assembly units, use parametric modeling tools, can use CAD libraries and applications, as well as create design documentation for 3D models and assembly units.

Assessment scale: national and ECTS

Current testing and independent work				Total	Final Test in case of refusal of the current testing points and admission to the assessment.
Laboratory works	Sketches	3D models and drawings	Conference		
30	30	30	10	100	100

The sum of points for all types of educational activities	**Score by a national scale**
90 – 100	Excellent
83 – 89	good
75 – 82	
68 – 74	satisfactory
60 – 67	
1 – 59	unsatisfactory; allows additional attempts

10. Methodical support

Methodical instructions for performance and tasks for practical work, as well as for graphic calculation work.

11. Recommended Books

1. James H. Earle. Engineering Design Graphics: Pearson/Prentice Hall, New York, 2008.

2. Frederick E. Giesecke, Alva Mitchell, Henry Cecil Spencer, Ivan Leroy Hill, John Thomas Dygdon, James E. Novak, Shawna Lockhart. Technical Drawing. New Jersey: Pearson Education, 2009.
3. V.O.Gordon. A Course in Descriptive Geometry/ V.O. Gordon, M.A. Sementsov-Ogievskii – Moscow: Mir, 1980.
4. Andrii Cherniavskyi, Yurii Litvin, Tygran Muradyan, Oleksandr Sidachenko. Problems on descriptive geometry. Kharkov: KhAI, 2017.
5. Joints of machine parts / Andrii Y Cherniavskyi, Andrii V Chumachenko, Katerina P. Msallam, Oksana I. Panchenko, Natalia V. Perekhrest, Zinaida O. Pogorelova, Oleksander A. Sidachenko – Manual. – Kharkov: National Aerospace University "Kharkiv Aviation Institute", 2017. – 108 p.
6. Shafts and gears. Representation in a drawing [Text]: manual / Andrii Y. Cherniavskyi, Andrii V. Chumachenko, Kateryna P. Msallam, Oksana I. Panchenko, Nataliia V. Perekhrest, – Kharkiv : National Aerospace University «Kharkiv Aviation Institute», 2019. – 84 p.
7. Workbook on Engineering Graphics / A.Y. Cherniavskyi, A.V. Chumachenko, T.K. Muradyan, N.V. Perekhrest, – Kharkiv: National Aerospace University «Kharkiv Aviation Institute», 2020. – 136 p.
8. Чернецький М.М. Лекції з нарисної геометрії: Навч. посібник. – Київ: ІСДО, 1995. – 295 стор.
9. Dym, Clive L. Engineering design: a project-based introduction / Clive L. Dym, Patrick Little and Elizabeth J. Orwin: Harvey Mudd College, 2014.
10. David G. Ullman. The Mechanical Design Process: McGraw-Hill, New York, 2010.

12. Information resources

Website of the department **http://k406.khai.edu**