

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
National Aviation University
Faculty of Architecture, Civil Engineering and Design
Computer Technologies of Design and Graphics Department



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« 01 » 10 2021

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« 20 » 10 2021



Quality Management System

COURSE TRAINING PROGRAM
on
«Descriptive Geometry»


Educational Professional Program: «Aircraft Equipment»

Field of Study: 13 «Mechanical engineering»

Speciality: 134 «Aviation and space rocket technology»

Form of study	Semester	Total (hours / ECTS credits)	Lectures	Laboratory classes	Self-study	HW/ CGP/C	Form of semester control
Full-time	2	105 / 3,5	17	34	54	1HW - 2 s.	Graded test - 2 s.

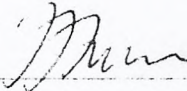
Index: ECB -1-134-1/21-2.1.6

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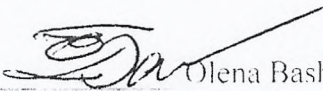
The Course Training Program on "Descriptive Geometry" is developed on the basis of the educational program and Bachelor Extended Curriculum № ECB -1-134-1 21, for Speciality 134 «Aviation and space rocket technology» Educational Professional Program «Aircraft Equipment» and corresponding normative documents.

Developed by:

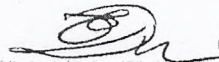
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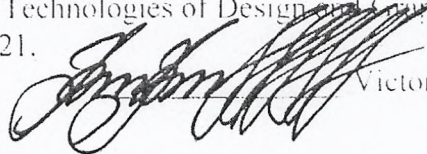
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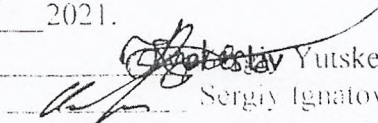

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Discussed and approved by Computer Technologies of Design and Graphics Department,
Minutes № 13 of «30» 08 2021.
Head of the Department

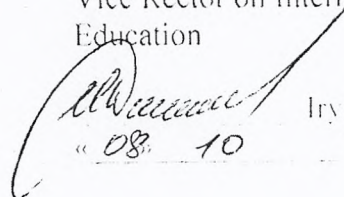

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Educational Professional Programs guarantor
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« 08. 10 2021

Document level – 3b


The planned term between the revisions - 1 year

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INTRODUCTION

The Course Training Program of the academic discipline " Descriptive Geometry" was developed on the basis of the "Methodological recommendations for the development and execution of the syllabus of educational discipline of full-time and part-time forms of training", approved by rector's order No. 249/roz. of 29.04.2021 and relevant regulatory documents.

1. EXPLANATORY NOTE

1.1. Role, goal and objectives of the academic discipline

The role of the discipline in the field of science and the system of professional training.

The discipline lays the foundations of engineering education, forming knowledge, skills and abilities of geometric modeling of three-dimensional objects of space.

The goal of the discipline is to reveal modern scientific concepts, concepts and methods of displaying the geometric properties of technical objects in the form of drawings.

The objectives of the discipline are:

- mastering the theoretical foundations of methods for constructing images of spatial forms on the plane;
- development of the ability of imaginary reproduction of a spatial form according to its flat image;
- research of algorithms for solving positional and metric problems of geometric modeling of spatial forms based on their images.

1.2. Educational outcomes of the academic discipline.

Mastering the theoretical foundations and methods of constructing orthogonal and axonometric projections of space objects.

1.3. Competences obtained through the academic discipline:

- independently recreate in their imagination on the basis of flat projection images spatial prototypes of real or projected products, their shape, size (read the drawing);
- independently draw up a plan and determine methods for solving positional and metric problems of geometric modeling of spatial forms based on their orthogonal or axonometric images.


1.4. Interdisciplinary links: this discipline is based on the knowledge of such disciplines "Introduction to the specialty", "Higher mathematics" and is the basis for the study of further disciplines, namely: "Engineering and Computer Graphics».

2. PROGRAM OF THE ACADEMIC DISCIPLINE

2.1. Content of the academic discipline

Educational material of discipline is structured on the module principle and consists of two educational modules, namely:

- **module №1 “Bases of geometric modelling”**,
- **module №2 «Modelling of space objects »**, each of which is logically complete, relatively independent, integral part of the educational discipline, learning of which provides of Module test and analysis of its implementation.

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2.2. Modular structure and integrated requirements for each module

Module №1 “Bases of geometric modelling”

Topic 1. Introduction. Types of products. Types and completeness of design documentation. Basic rules of design engineering documentation. Method of projections.

System of design documentation according to ДСТУ 3321–96. Definition of a product. The structure of the established types of products: details, assembly unit, complex, set.

Types of design documents. Basic rules of drawing according to state standards - sizes and formats (ДСТУ ISO 5457:2006), scales (ДСТУ ISO 5455:2005), lines (ДСТУ ISO 128–20:2003; ДСТУ ISO 128–24:2005), drawing scripts (ДСТУ ISO 3098–0:2006; ДСТУ ISO 3098–2:2007; ДСТУ ISO 3098–6:2007), basic inscriptions (ДСТУ ГОСТ 2.104:2006), put dimensions (ДСТУ ISO 129–1:2007).

Basic concepts of geometric modeling of space (ДСТУ ISO 129–1:2007). The method of two images. Projection model consisting of orthogonal projections of object points on mutually perpendicular projection planes. Complex drawing of point. Determining the relative position of a pair of points.

Topic 2. Orthogonal projections of main elements of geometrical space.

Complex drawing of point. Properties of projections of straight lines in relative to the plane of projections: oblique, level, projecting.

Complex drawing of plane. Properties of projections of plane by changing their position relative to the planes of projections: oblique, level, projecting. Belonging of a line and a point to a plane.

Topic 3. Methods of transformation of orthogonal drawing.

The theoretical basis and practical application of methods of transformation of orthogonal drawings in metric and positional problems of designing of technical products. Classification of the methods of transformation of orthogonal drawings.

The method is based on replacing of the planes of projections and maintaining the direction of projection. The essence of the method. Four main transformation of descriptive geometry.

The method is based on the change in position of the object relative to the plane of projections - plane-parallel shift. The essence of the method. Four main transformation of descriptive geometry.

Determining the relative position of the main elements of the geometric space using methods of transforming an orthogonal drawing..

Topic 4. Axonometric projections of solids.


The essence of the method of axonometric projection, the basic theorem of axonometry and its consequences. Standard axonometric projections according to ДСТУ ISO 5456-3:2006 . Construction of axonometric images of objects according to their orthogonal image in standard rectangular and oblique projections.

Module №2 «Modelling of space objects»

Topic 1. Polyhedrons.

Determinants facet surfaces. Facets torsos, pyramids and prisms. Euler's theorem for convex polyhedrons. Plane sections of polyhedrons. Methods of construction of developments of face surfaces (triangulation, normal section, paste).

Mutual intersection of polyhedrons.

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Topic 2. Curved lines and curved surfaces.

Curves lines in science and technology, methods of default. Classification of curves lines. Curvature of a plane curve and its evolute and involute. The curves of the second order, involute of circle. Cylindrical and conical screw line. Construction of contour curves of the second order by using the engineering discriminant as an example of drawing of the fuselage of the aircraft.

Classification of curved surfaces by types of generators and algorithms of creation; application in aircraft designs. Methods of constructing flat sections of curved surfaces.

Methods of constructing a line of mutual intersection of surfaces using auxiliary cutting planes and spheres. Mutual intersection of curves of second-order surfaces along flat curves.

Developments of curved surfaces - are approximate (cone and cylinder), conditional (spheres).


Topic 3. Basic provisions for the construction of images of technical forms.

General principles of obtaining orthogonal images on drawings (ДСТУ ISO 5456-2:2005). Definition of the views. Basic, additional and local views. Remote elements (ДСТУ ISO 128-30:2005; ДСТУ ISO 128-34:2005). Definition of section. Simple and complex sections. Rules of combination of a part of a view and a part of a section. Definition of section. Sections are made, superimposed, in the gap of the main image (ДСТУ ISO 128-40:2005; ДСТУ ISO 128-44:2005; ДСТУ ISO 128-50:2005). Conventions and simplification when performing images.

2.3. Thematic plan of the academic discipline


Table 2.1

№	Topic	Academic Hours			
		All	Lectures	Laboratory classes	Self-study
1	2	3	4	5	6
Module №1 "Bases of geometric modelling"					
2 semester					
1.1	Introduction. Types of products. Types and completeness of design documentation. Basic rules of design documentation. Method of projections.	6	2	2	2
1.2	Projections of straight line, projections of plane	6	2	2	2
1.3	Transformation of an orthogonal drawing when solving positional and metric design problems by replacing projection planes.	6	2	2	2
1.4	Transformation of an orthogonal drawing using the method of plane-parallel shift	4	-	2	2

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End of table 2.1

1	2	3	4	5	6
1.5	Display the relative position of two lines, a line and a point, a point and a plane.	7	2	2	3
1.6	Display the relative position of two planes, a straight line and a plane.	5	-	2	3
1.7	Module test №1	4	-	2	2
Total for Module 1		38	8	14	16
Module №2 «Modelling of space objects»					
2 semester					
2.1	Polyhedrons	7	2	2	2
2.2	Curved lines	5	-	2	3
2.3	Drawings of linear and curvilinear curved surfaces	8	2	2	4
2.4	Conical sections, sections of cylinders and spheres.	8	2	2	4
2.5	Construction of a line of mutual intersection of curved surfaces using cutting planes and spheres.	5	-	2	3
2.6	Construction of developments of curved surfaces - approximate (cone and cylinder), conditional (spheres).	5	-	2	3
2.7	Basic provisions for the construction of images of technical forms.	7	2	2	3
2.8	Construction of views	4	-	2	2
2.9	Construction of sections and cross-sections	4	-	2	2
2.10	Conventions and simplification when performing images	4	-	2	2
2.11	Homework	8	-	-	8
2.12	Module test №2	3	1	-	2
Total for Semester 2		67	9	20	38
Total For Module 2		105	17	34	54
Total For Academic Discipline		105	17	34	54

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2.4. Hometask

According to the approved methodical guidelines, in Semester 2 students do their homework (HW) with the purpose of fixing and deepening of theoretical knowledge and abilities of students and is the important stage in mastering of educational material.

Homework is executed on the base of educational material given to Self-study students and is a component of the module № 1 "Basis of geometric modelling " and module № 2 "Modelling of space objects".

The purpose of the homework is to study and assimilation of the projection method, in determining the characteristics of the sets of points of the geometric space on the example of the design elements of the design of the aircraft. The problems of geometric modeling polyhedrons, curves lines and surfaces in orthogonal and axonometric projections are consider.

The execution, registration and protection of the homework is carried out by each student individually in compliance with methodical guidelines

Time needed to do homework is 8 hours of self-study.


3. TRAINING MATERIALS FOR THE DISCIPLINE

3.1. Teaching Methods

The following teaching methods are used in the study of the discipline:

Lectures classes are performed in the multimedia classrooms of the university using a specialized software product to perform AutoCAD drawing in dialog mode that allows you to quickly create and edit images.

Laboratory classes are performed using workbooks which aim to help freshmen students in organizing productive learning of discipline material. The domestic task includes professionally oriented tasks of designing aviation engineering: calculation of kinematics of release and cleaning of the chassis of the aircraft, modeling of the aircraft fuselage circuit.

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3.2. Recommended Literature (basic and additional)

Basic Literature

3.2.1. *Bashta O.T.* Descriptive Geometry in worked problems: manual /O.T.Bashta, O.V.Dzhuryk. – К.:NAU, 2017. - 224 p.

3.2.2. *Bashta O.T.* Problems and exercises of descriptive geometry: methodical guide/O.T.Bashta, O.V.Dzhuryk, V.I.Makarov. – К.:NAU, 2000. - 32 p.

3.2.3. *Bashta O.T.* Geometric Construction with elements of Computer Drawing: manual /O.T.Bashta, O.V.Dzhuryk. – К.:NAU, 2001. - 204 p.

3.2.4. *Михайленко В.С.* Нарисна геометрія: підручник / В.С. Михайленко, М.Ф. Євстигнєєв, С.М. Ковальов. За ред. В.С. Михайленка. 3-тє вид., переробл. – К.: Видавничий дїм «Слово», 2013. – 304 с.

3.2.5. *Ковальов Ю.М.* Прикладна геометрія: підручник / Ю.М. Ковальов, В.М. Верещага. – К.: Дїя, 2012. – 472 с.

3.2.6. *Хмеленко О.С.* Нарисна геометрія: підручник. / О.С. Хмеленко – К.; Кондор, 2008. – 440 с.

3.2.7. *Макаренко М.Г.* Нарисна геометрія: методичні рекомендації до виконання розрахунково-графічних робіт / уклад.: М.Г. Макаренко, В.І. Макаров, В.П. Юрчук. –К.: НАУ, 2013. – 60 с.

3.2.8. НЖЕНЕРНА та комп'ютерна графіка: методичні рекомендації до виконання контрольних робіт для студентів заочної та дистанційної форм навчання /уклад. М.Г. Макаренко, О.Т. Башта, О.В. Джурик та ін. – К.: НАУ, 2016. – 108 с.

3.2.9. *Ковальов Ю.М.* Нарисна геометрія. Завдання для практичних занять та самостійної роботи: практикум / уклад.: Ю.М. Ковальов, М.В. Терехова, М.Г. Макаренко [та ін.] 2-ге вид. –К.: НАУ, 2014. – 64 с.

The additional literature

3.2.10. Ілюстрований українсько-російсько-англійський словник термінів з нарисної геометрії, інженерної та комп'ютерної графіки: словник/O.T.Башта, О.В.Джурик. – 2-ге видан. – К.: НАУ, 2013. – 172 с.

3.2.11. *Ковальов Ю.М.* Основи геометричного моделювання: навч. посіб. / Ю.М. Ковальов – К.: Вища шк. 2003. – 232 с.

3.2.12. *Макаров В.І.* Нарисна геометрія. Інженерна та комп'ютерна графіка: навч. посіб. / В.І. Макаров, В.Г. Шевченко, М.Г. Макаренко та ін.. – К.: Книжкове вид-во НАУ, 2006, 259 с.

3.2.13. ЕСКД. Правила выполнения чертежей различных изделий (с изменениями), –М.: Издательство стандартов, 1982. – 223 с.


3.3. Internet Information resources .

3.3.1. https://drive.google.com/file/d/1P_thq0Vu4Mol8TLL8isiZ4AZAtxt402G/view

3.3.2. [IAP.nau.edu.ua/index.php/kafedry/prikladnoji-geometriji-ta-komp-yternoji-grafiki](http://iap.nau.edu.ua/index.php/kafedry/prikladnoji-geometriji-ta-komp-yternoji-grafiki)

3.3.3. bib.nau.edu.ua

3.3.4. <http://er.nau.edu.ua:8080/handle/NAU/28533>

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4. RATING SYSTEM OF KNOWLEDGE AND SKILLS ASSESSMENT

4.1. Evaluation of certain types of work done by students of the points made in accordance with Tables.4.1.

Table 4.1


Kind of Academic Activities	Max Grade
Module №1 “Bases of geometric modelling”	
2 Semester	
Performance and deference of laboratory classes	(5x6)=30
<i>For carrying out module test №1, a student must receive not less than</i>	18
Carrying out Module Test №1	15
Total for module 1	45
Module №2 «Modelling of space objects»	
8 Semester	
Performance and deference of laboratory classes	(4x8)=32
Performance and deference of HW	8
<i>For carrying out module test №2, a student must receive not less than</i>	24
Carrying out Module Test №2	15
Total for module 2	55
Total For Academic Discipline	100

A Semester Grade is determined (in points and in the National Scale) as a result of performing all kinds of educational work during the semester.

4.2. A student is considered to have passed the module if both his/her Current Module Grade and Module Test Grade are positive.

4.3. The Semester Module Grade is calculated as the sum of the Total Module Grades.

4.4. The Semester Module Grade and the Graded Test together make up a Total Semester Grade which is calculated according to the National Scale and the ECTS Scale.

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4.5. The Total Semester Grade in points, the National Scale and the ECTS Scale is written into a student's record book, for example: **92/Ex/A, 87/Good/B, 79/Good/C, 68/Sat/D, 65/Sat./E**, etc.

4.6. The Total Semester Grade of the subject is determined as the arithmetic average grade of the total semester grades in points (for the fourth semester for this subject) with its further transfer into the National Scale and ECTS Scale. The indicated Total Semester Grade of the subject is entered in the Diploma Supplement.

Appendix 4

Correspondence of the Total Semester Grades to the National Scale and the ECTS System

Total Semester Grades	National Scale	ECTS System	
		ECTS Grade	Explanation
90-100	Excellent	A	Excellent (excellent performance with insignificant shortcomings)
82 – 89	Good	B	Very Good (performance above the average standard with few mistakes)
75 – 81		C	Good (good performance altogether with a certain number of significant mistakes)
67 – 74	Satisfactory	D	Satisfactory (performance meets the average standards)
60 – 66		E	Sufficient (performance meets the minimal criteria)
35 – 59	Bad	FX	Bad (a second testing is required)
1 – 34		F	Bad (a student shall retake the course)

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(Ф 03.02 – 01)

АРКУШ ПОШИРЕННЯ ДОКУМЕНТА

№ прим.	Куди передано (підрозділ)	Дата видачі	П.І.Б. отримувача	Підпис отримувача	Примітки
	<i>УІЕГА</i>	<i>0</i>	<i>Шмеківа Ю.У</i>	<i>[Signature]</i>	

(Ф 03.02 – 02)

АРКУШ ОЗНАЙОМЛЕННЯ З ДОКУМЕНТОМ

№ пор.	Прізвище ім'я по-батькові	Підпис ознайомленої особи	Дата ознайомлення	Примітки

(Ф 03.02 – 04)

АРКУШ РЕЄСТРАЦІЇ РЕВІЗІЇ

№ пор.	Прізвище ім'я по-батькові	Дата ревізії	Підпис	Висновок щодо адекватності

(Ф 03.02 – 03)

АРКУШ ОБЛІКУ ЗМІН

№ зміни	№ листа (сторінки)				Підпис особи, яка внесла зміну	Дата внесення зміни	Дата введення зміни
	Зміненого	Заміненого	Нового	Анульованого			

(Ф 03.02 – 32)

УЗГОДЖЕННЯ ЗМІН

	Підпис	Ініціали, прізвище	Посада	Дата
Розробник				
Узгоджено				
Узгоджено				