National Aviation University
Faculty of Architecture, Civil Engineering and Design
Computer Technologies of Design and Graphics Department

AGREED
Dean of the Faculty of Air Navigation,
Electronics and telecommunications
_____ Sergiy Zavgorodniy
«29» червня 2022

APPROVED
Vice-Rector for Academics
_____ Anatoliy Polukhin
«06» 07 2022

Quality Management System

COURSE TRAINING PROGRAM
on
«Engineering and Computer Graphics»

Educational Professional Program: "Computerized control and automation systems."

"Computer-integrated technological processes and production."

"Information technologies and engineering of aviation computer system"

Field of Study: 15 "Automation and Instrumentation"
Speciality 151 "Automation and computer-integrated technologies."

Form of study	Sem ester	Total (hours/ credits ECTS)	Lectures	Practice classes	Self-study	Form of semester control
Full time	2	135/4,5	17	51	67	Credit Test – 2 s.

INDEX:НБ-2-151-2/21-2.1.5; НБ-2-151-3/21-2.1.5.

QMS NAU CTP 10.01.03-01–2022

The Course Training Program on "Enginering and Computer Graphics" is developed on the basis of the Educational programs "Computerized control and automation system" and Bachelor Extended Curriculum № НБ(РБ)-2-151-2/21; № НБ(РБ)-2-151-3/21 for Speciality 151 "Automation and computer-integrated technologies" and corresponding normative documents.

Developed by:

Senior lecture of the ComputerTechnologies of Design and Graphics Department _____ Vasil Makarov

Professor of Computer Technologies of design and graphics department _____ Olena Bashta

Senior lecture of the Computer Technologies of design and graphics department _____ Olena Dzhuryk

Discussed and approved by Computer Technologies of Design and Graphics Department, Minutes № . 11 of 16 . 06 22
Head of the Department _____ Victoria Vasylenko

Discussed and approved by the Graduate Department for the Educational program of Speciality 151 "Automation and Computer-integrated technologies" - department Aviation Compute Integrated Complexes . .Minutes № 11 of «16» 06 2022

Educational Professional Programs guarantos _____ M.Mukhina

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Vice Rector on International Collaboration and Education

_____ Iryna Zarubinska

«05» 07 2022

Document level – 3b
The planned term between the revisions - 1 year
Master copy

(Ф 03.02 – 110)

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INTRODUCTION

The Course Training Program of the academic discipline "Engineering and Computer Graphics» 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 NOTES

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 academic discipline "Engineering and Computer Graphics" is a theoretical and practical basis for a set of competencies that form the profile of a specialist of avionics.

The goal of teaching the discipline "Engineering and Computer Graphics" is for students to master modern scientific concepts, concepts and methods of displaying the geometric properties of technical objects in the form of design documents in accordance with the requirements of interstate, state and departmental standards.

The objectives of the discipline are:

- development of the ability of imaginary reproduction of a spatial form according to its flat image;
- mastering the basic rules and norms of design and execution of drawings and other types of design documentation established by the interstate standards of the ЄСКД;
- acquaintance with the basics of automated execution of graphic documentation using application packages.

1.2. Educational outcomes of the academic discipline.

Independent execution of design documents when performing term papers, term papers and diploma projects - drawing details, specification, assembly drawing, according to the requirements of interstate, state and departmental standards for design documents.

1.3. Competences obtained through the academic discipline:

- make a plan and determine methods for solving positional and metric problems of geometric modeling of spatial forms based on their orthogonal or axonometric images.
- to recreate in the imagination on flat projection images spatial prototypes of real or projected products, their form, the sizes (to read drawings of details, general view drawing of assembly units).

1.4. **Interdisciplinary links**: This discipline is the basis for the study of further disciplines, namely: "Aircraft structures and functional systems", ""Technical service and repair of avionics".

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:

- of the educational **module №1 "Projection bases of image construction",**
- of the educational **module №2 «Development a working design documentation for parts and assembly units»,** 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.

2.2. Modular structuring and integrated requirements for each module

Module №1 "Projection bases of image construction"

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, assambly 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. Displays the relative position of the main elements of the geometrical space.

Topic 3. Polyhadrons and curved surfaces.

Determinants facet surfaces. Euler's theorem for convex polyhedrons.

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

Construction of flat sections of face and curved surfaces. Surface scans - accurate, approximate, conditional.

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.

Topic 5. Basic provisions for the construction of images of technical forms.

General principles of obtaining orthogonal images on drawings (ДСТУ ISO 5456-2:2005). Basic provisions and definition of the standard. 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.

Topic 6. Interactive graphics application packages. AutoCAD graphics editor.

Definition of computer graphics according to ДСТУ 2939 - 94. Direction of application and main tasks of computer graphics.

AutoCAD system: general information, system purpose, user interface, commands for building and editing geometric "primitives", drawing dimensions.

Module № 2 «Development of working design documentation for parts and assembly units».

Topic 1. Requirements for working drawings of details.

Definition drawing details as a design document.

Requirements to the working drawing of details and their practical implementation at execution of drawings of details from nature:

- analysis of the shape of the part as a set of simple geometric figures, oriented in a certain way and related to the operations of union, intersection or subtraction;
- selection of the minimum, but sufficient number of images (types, sections, sections, remote elements) for production of a detail;
- selection of bases and measurement of the part and its components, followed by drawing the required dimensions on the drawing;
- determination of the surface roughness of the part and their marking on the drawing;
- record of technical requirements to the part □ heat treatment, protective covers and others;
- filling in the main inscriptions of the drawing.

Features of execution of working drawings of details of separate groups.

Topic 2. Types of connections of components of a product. Their images and symbols

Methods of detachable and non-detachable connections of parts.

Classification of detachable joints by design features (threaded, keyed, splined, pin, articulated).

The formation of threads, their classification, basic parameters, conditional image of the thread. Designation of standard fastening threads. Standard threaded fasteners for general engineering and aviation industry standards. Conventions and simplifications when making images of connections with standard threaded fasteners.

Rules for drawing some permanent joints of parts: riveting, welding, soldering and gluing.

Execution of drawings of threaded joints under the initial conditions.

Topic 3. Detailing of drawings of the general view of the asambly unit.

Rules of reading and analysis of the drawing of the general type of the assambly unit for the purpose of definition of its design, ways of connections of details among themselves, the order of assembly of a product. Determining the geometric shape and size of parts that are part of a assambly unit.

Development of drawings of details according to the drawing of the general view of the assambly unit.

Topic 4. Working design documentation for assambly units.

Requirements for the specification of the assambly unit, the rules for filling in the columns and lines of the specification.

Requirements for the assembly drawing of the assembly unit. Selection of the minimum but sufficient number of images, put the sizes, record of technical requirements. Conventions and simplifications on assembly drawings. The sequence of execution of the assembly drawing according to the sketches of the components of the product.

2.3. Thematic plan of the academic discipline

Table 2.1

№	Topic	Academic Hours			
		All	Lectures	Practice classes	Self-study
1	2	3	4	5	6
Module # 1 "Projection bases of image construction"					
1.1	Introduction. Types of products. Types and completeness of design documentation. Basic rules of design documentation. Method of projections.	7	2	2	3
1.2	Orthogonal projections of main elements of geometrical space	7	2	2	3
1.3	Polyhadrons and curved surfaces	7	2	2	3
1.4	Axonometric projections of solids.	7	2	2	3
1.5	Construction of views, sections and cross-sections of technical forms.	7	-	2 2	3
1.6	Interactive graphics application packages. AutoCAD graphics editor.	12	2	2 2 2	4
1.7	Module test №1	4	-	2	2
Total for the Module 1		**51**	**10**	**20**	**21**
Module # 2 «Development of working design documentation for parts and assembly units».					
2.1	Requirements for working drawings of details. Features of execution of working drawings of details of separate groups	6	2	2	2
2.2	Types of connections of components of a product. Their images and symbols	4	-	2	2
2.3	Execution of images of connections with standard fastening products with a thread for the general machine-building and according to standards of the aviation industry.	10	2	2	6

End of table 2.1

1	2	3	4	5	6
2.4	Detailing a drawing of a general view of assembly unit.	10	2	2	6
2.5	Working design documentation for assambly units.	6	-	2	4
2.6	Graphic editor AutoCAD. Construction of graphic primitives in the AutoCAD graphics editor.	8	-	2	6
2.7	Commands for general drawing editing in the AutoCAD graphics editor.	6	-	2	4
2.8	Algorithm for drawing a part of the "Body" type in the environment of the graphic editor AutoCAD.	7	-	4	3
2.9	Selection of the optimal variant of commands for construction of sections and sections when performing drawings of parts in the AutoCAD environment.	6	-	4	2
2.10	Schemes. Types and types of schemes. Development of the basic electric scheme.	6	-	2	4
2.11 -	Module test №2	6	1	2	3
Total for Semester 2		**135**	**17**	**51**	**67**
Total For Module 2		**84**	**7**	**31**	**46**
Total For Academic Discipline		**135**	**17**	**51**	**67**

3. TRAINING MATERIALS FOR THE DISCIPLINE.

3.1. Teaching methods.

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

Lectures are held in the multimedia classrooms of the university using a specialized software product for performing AutoCAD drawings in a dialog mode, which allows you to quickly create and edit images.

The content of laboratory tasks includes professionally oriented tasks for the development of working design documentation for aircraft products.

3.2. Recommended Literature (basic and additional)

Basic Literature

3.2.1. *Bashta E.T.* AutoCAD. Computer Graphics: manual / E.T.Bashta, E.V.Dzhuryk. – K.: NAU. 2003. – 242 p.

3.2.2. *Михайленко В .Є.* Інженерна та комп'ютерна графіка: підручник / В. Є.Михайленко, В. М. Найдиш, А. М. Підкоритов, І. В. Скидан; за ред. В. Є.Михайленка. – К.: Вища шк. 2004. –342с.

3.2.3. *Ванін В .В.* Оформлення конструкторської документації: навч. посіб. 4-те вид., випр. і доп. / В. В. Ванін, А. В. Бліок, Г. О. Гнітецька. – К.: Каравела, 2012. – 200 с.

3.2.4. *Макаренко М.Г.* Інженерна графіка: посібник / М.Г. Макаренко. – К.: НАУ. 2017. – 180 с.

3.2.5. *Макаренко М.Г.*:Комп'ютерна графіка: практикум / М.Г. Макаренко. 2-е вид., допов. і перероб.– К.: НАУ. 2013. – 76 с.

3.2.6. ІНЖЕНЕРНА 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.

3.2.7. ЕСКД. Основные положения (с изменениями) —М.: Издательство стандартов, 1975. – 350 с.

3.2.8. ЕСКД. Общие правила выполнения чертежей (с изменениями) –М.: Издательство стандартов, –М.: 1991. – 236 с.

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

The additional literature

3.2.10. *Bashta E.T.* Computer Graphics: methodical guide / E.T.Bashta, E.V.Dzhuryk. – K.: NAU. 2004. – 55 p.

3.2.11. *Богданов В. М.* Інженерна графіка: довідник / В. М. Богданов, А. П. Верхола, Б. Д. Коваленко та ін.; за ред. А. П. Верхоли. – К.: Техніка, 2001. – 268 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.

3.3. Internet Information resources.

3.3.1. https://drive.google.com/file/d/1P_thq0Vu4Mol8TLL8isfZ4AZAtxt402G/view

3.3.2. 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

3.3.5. https://nmetau.edu.ua/file/inzhenerna_grafika

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	Maximum Grade
Module № 1 "Projection bases of image construction"	
Performance and deference of practice classes	(5x6)=30
For carring out module test №1, a student must receive not less than	18
Carrying out Module Test №1	15
Total for module 1	**45**
Module №2 «Development of working design documentation for parts and assembly units».	
Performance and deference of practice classes	(4x18)=32
For carring out module test №2, a student must receive not less than	24
Carrying out Module Test №2	15
Total for module 2	**55**
Total for the 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.

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)

(Ф 03.02 – 01)

АРКУШ ПОШИРЕННЯ ДОКУМЕНТА

№ прим.	Куди передано (підрозділ)	Дата видачі	П.І.Б. отримувача	Підпис отримувача	Примітки
	ЦМСАО	06.07.22	Шишкіна Н.Г.	[signature]	

(Ф 03.02 – 02)

АРКУШ ОЗНАЙОМЛЕННЯ З ДОКУМЕНТОМ

№ пор.	Прізвище ім'я по-батькові	Підпис ознайомленої особи	Дата ознайом-лення	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	Анульо-ваного			

(Ф 03.02 – 32)

УЗГОДЖЕННЯ ЗМІН

	Підпис	Ініціали, прізвище	Посада	Дата
Розробник				
Узгоджено				
Узгоджено				