





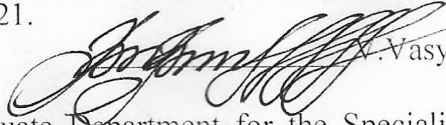
The Course Training Program on "Engineering Graphics" is developed on the basis of the educational programs and Bachelor Extended Curriculums № ECB -1-272-1/21, № ECB -1-272-2/21 for Speciality 272 «Aviation Transport» and Educational Professional Programs: «Maintenance and Repair of Aircraft and Aircraft Engines» and «Airports Technologies of Works and Technological Equipment» and corresponding normative documents.

Developed by:

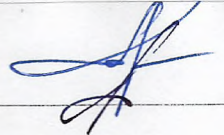
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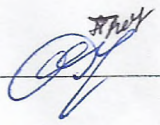
Discussed and approved by Computer Technologies of Design and Graphics Department,
Minutes № 13 of «30» 08 2021.

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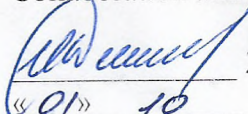
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Aircraft Engines» – Aircraft Continuing Airworthiness Department, Minutes № 8 of
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«01» 10 2021

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INTRODUCTION

The Course Training Program (CTP) of the subject "Engineering Graphics» is developed on the basis of the "Methodical recommendations to the development and design of Course Training Program of education discipline", approved by the order of the rector № 249/од, of "29" _04_ 2021, and corresponding normative documents.

1. EXPLANATORY NOTES

1.1. Place, purpose, tasks of education discipline.

The place of the education discipline in the system of professional training.

The education discipline "Engineering Graphics" is a theoretical and practical basis for a set of competencies that form the profile of a specialist in work technology and technological equipment of airports.

The purpose of teaching the discipline "Engineering 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 ECKD;
- acquaintance with the basics of automated execution of graphic documentation using application packages.

1.2. The results of the training, since it is possible to reach the education 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. Competence, which gives the ability to provide education 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: "Machine Parts"..

2. CURRICULUM OF THE DISCIPLINE.

2.1. Subject content.

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.

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

Topic 3. Polyhedrons 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: type "Shaft", type "Body", according to standards of group 4 ECKD (cylindrical gear wheels)..

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 assembly unit.


Rules of reading and analysis of the drawing of the general type of the assembly 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 assembly unit.

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

Topic 4. Working design documentation for assembly units.

Requirements for the specification of the assembly 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.


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2. CONTENT OF THE SUBJECT

2.3. Thematic plan

Table 2.1

№	Topic	Academic Hours			
		All	Lectures	Laboratory classes	Self-study
1	2	3	4	5	6
Module # 1 “Projection bases of image construction”					
1 semester					
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	6
1.7	Module test №1	4	-	2	2
Total for the 1st Module		51	10	18	23
Module # 2 «Development of working design documentation for parts and assembly units».					
1 semester					
2.1	Requirements for working drawings of details.	6	2	2	2
2.2	Features of execution of working drawings of details of separate groups	6	-	2	4
2.3	Types of connections of components of a product. Their images and symbols	6	2	2	2

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End of table 2.1

1	2	3	4	5	6
2.4	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.	6	-	2	4
2.5	Detailing a drawing of a general view of assembly unit.	8	-	2 2	4
2.6	Working design documentation for assembly units	6	2	2	2
2.7	Development of the specification and the assembly drawing of the assembly unit according to sketches of component products.	8	-	2	6
2.8	Calculation-graphic paper	10	-	-	10
2.9	Module test №2	3	1	-	2
Total for the 2nd Module		59	7	16	36
Total for the 1st semester		105	17	34	54
Total for the discipline		105	17	34	54


2.4. Calculation-graphic paper.

Calculation-graphic paper is executed in the first semester, in accordance with the ratified methodical recommendations. The purpose of Calculation-graphic paper is fixing and deepening of theoretical knowledge and abilities of students and is the important stage in mastering of educational material.

Calculation-graphic paper is executed on the base of educational material given to Self-study students and is a component of the module # 1 «Projection bases of image construction» and module # 2 «Development of working design documentation for parts and assembly units». The purpose of Calculation-graphic paper is to independently consolidate theoretical knowledge of engineering graphics and gain skills in developing working design documentation.

Students individually, according to methodological recommendations, execute and protect eight educational design documents.

The time required for implementation of Calculation-graphic paper - to 10 hours of Self-study.

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3. EDUCATIONAL AND METHODOLOGICAL MATERIALS ON DISCIPLINE

3.1. Methods of Teaching

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. Рекомендована література

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

3.2.5. *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.

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

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

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

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

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

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


The additional literature

3.2.12. Ілюстрований українсько-російсько-англійський словник термінів з нарисної геометрії, інженерної та комп'ютерної графіки: словник/О.Т.Башта, О.В.Джурик. – 2-ге видан. – К.: НАУ, 2013. – 172 с.

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

3.2.14. *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.

3.2.15. *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.

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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. A RATING SYSTEM FOR ASSESSING STUDENTS' KNOWLEDGE AND SKILLS ACQUIRED

- 4.1. Assessment of certain types of educational work performed by the student is carried out in points in accordance with table.4.1

Table 4.1

Module №1 “Projection bases of image construction”	
Kind of Academic Activities	Max Grade
Performance and deference of laboratory classes	(5x6)=30
<i>For carrying out module test №1, a student must receive not less than 18 values</i>	
Carrying out Module Test №1	15
Total for the module №1	45
Module №2 «Development of working design documentation for parts and assembly units»	
Kind of Academic Activities	Max Grade
Performance and deference of laboratory classes	(4x8)=32
Performance and deference of Calculation-graphic paper	8
<i>For carrying out module test №2, a student must receive not less than 24 values</i>	
Carrying out Module Test №2	15
Total for the module №2	55
Total for the subject	100



Graded Test Rating is determined (in points and on a National scale) based on the results of all types of educational work during the semester.

4.2. Completed types of educational work are credited to the student, if he received a positive rating for them (Appendix 3).

4.3. The total of ratings for individual academic activities completed by a student constitutes a Current Semester Module Rating, which is entered in a module control register.

4.4. In the case of Graded Test, the final semester rating is converted into a grade on the National Scale Rating and ECST Rating (Appendix 4).

4.5. The Total Semester Rating Score, the National Scale Rating and ECST Rating are entered in examination register, student's academic card and record book, e.g. **92/ Excellent/A, 87/Good/B, 79/Satisfactory/D, 68/Satisfactory/D, 65/Satisfactory/E**, etc.

4.6. The Total Rating on the subject corresponds to the Total Semester Rating. The specified Total Rating on the subject is entered in 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

(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				