(Ф 03.02 – 110)

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

AGREED
Dean of Aerospace faculty
_____ M. Kulyk
«01» 09 2021

APPROVED
Vice-Rector for Academics
_____ A.Polukhin
«18» 10 2021

Quality Management System

COURSE TRAINING PROGRAM

on

"Descriptive Geometry and Engineering Graphics"

Educational Professional Programs:
«Maintenance and Repair of Aircraft and Aircraft Engines»;

Field of Study: 27 «Transport Services»
Speciality: 272 «Aviation Transport»

Year of study - 1st Semester - 2nd
Lectures – 38
Laboratory Classes – 38 Graded Test – 2 semester
Self-study – 104
Total (hours/ECTS credits) – 180/6,0

Index: ECB -1-272-1/20-1.13

The Course Training Program on "Descriptive Geometry and Enginering Graphics" is developed on the basis of the Educational Program and Bachelor Extended Curriculum № ECB -1-272-1/20 for Speciality 272 «Aviation Transport» Educational Professional Program «Maintenance and Repair of Aircraft and Aircraft Engines» and corresponding normative documents.

Developed by:

Senior lecturer of the ComputerTechnologies of Design and Graphics Department _____ O. Dzhuryk

Assistant of professor of the ComputerTechnologies of Design and Graphics Department _____ V.Makarov

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

Head of the Department _____ V.Vasylenko

Discussed and approved by the Graduate Department for the Speciality 272 «Aviation Transport» and Educational Professional Program «Maintenance and Repair of Aircraft and Aircraft Engines» – Aircraft Continuing Airworthiness Department Minutes № 8 of «31» 08 2021.

Head of the Department _____ O.Popov

Vice Rector on International Collaboration and Education

_____ Zarubinska I.B.

«21» 09 2021

Document level – 3b

The planned term between the revisions - 1 year

Registered copy

CONTENTS

INTRODUCTION

The Course Training Program (CTP) of the subject "Descriptive Geometry and 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 Directive #071/од. of "10" _07__2019, Directive #088/роз. of "16" _10__2019 and corresponding normative documents.

1. EXPLANATORY NOTE

1.1 Planned Results.

The **place** of this discipline in the system of professional training of a specialist.

The education discipline "Descriptive Geometry and Engineering Graphics" is the theoretical and practical basis of a set of competences that form the profile of a specialist in the field of maintenance and repair of aviation engineering.

The **purpose** of studing the discipline "Descriptive Geometry and Engineering Graphics" is for students to master modern scientific concepts, concepts and methods of reflecting the geometric properties of technical objects in the form of design documents in accordance with interstate, state and departmental standards.

The **tasks** of studying the discipline "Descriptive Geometry and Engineering Graphics" 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.

As a result of studying the discipline the student must acquire the following competencies:

- independently recreate in the imagination on flat projection images spatial prototypes of real or projected products, their form, the sizes (to read drawings of details, drawings of the general look of folding units).
- independently perform the following design documents □ drawing details, specifications, assembly drawing in accordance with the requirements of interstate, state and departmental standards for the design documents.

.

Interdisciplinary Relations: This discipline is based on the knowledge of such disciplines "Introduction to the specialty" and is the basis for the study of further disciplines, namely: "Design and maintenance of aircraft", "Cross-cutting interdisciplinary course project on sustainable development."

:

1.2. Educational Subject Program

The educational material of the discipline is structured according to the modular principle and consists of two educational modules, namely: **module # 1 "Projection bases of image construction", module # 2 «Development a working design documentation for parts and assembly units»** which is logically completed, relatively independent, integral part of the discipline, the assimilation of which is modular control work and analysis of the results of its implementation.

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. Unified Design Documentation System (ЄСКД). Product Definition. Product structure in accordance with ГОСТ 2.101- 68: detail, assambly unit, complex, set.

Types of design documents in accordance with ГОСТ 2.102-68.The basic rules for the design of drafts by interstate standards - formats (ГОСТ 2.301 - 68), scales (ГОСТ 2.302 - 68), lines (ГОСТ 2.303 - 68), drawing fonts (ГОСТ 2.304 - 81), basic inscriptions (ДСТУ ГОСТ 2.104: 2006) , drawing of sizes (ГОСТ 2.307 - 68).

Basic concepts of geometric modeling of space. Two-image method. 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 straight line. 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.

Transformation of an orthogonal drawing when solving positional and metric problems of designing technical products

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 ГОСТ 2.317 – 79.. 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 (ГОСТ 2.305 – 68).

Definition of the views. Basic, additional and local views. Definition of section ,. Simple and complex sections. Rules of combination of a part of a view and a part of a section. Remote elements. Definition of cross-section. Sections are made, superimposed, in the gap of the main image. Conventions and simplification when performing images. Symbol of materials in sections and sections (according to ГОСТ 2.306 - 68)

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", put 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 (ГОСТ 2.101-68).

Requirements to the working drawing of details and their practical implementation at execution of drawings of details from nature (ГОСТ 2.109-73):

- 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 (ГОСТ 2.307 – 68);

- determination of the surface roughness of the part and their marking on the drawing (ГОСТ 2.309 – 73);

- 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 ЄСКД (cylindrical gear wheels and springs).

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 (ГОСТ 2.311 – 68). 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 (ГОСТ 2.315 – 68).

Rules for drawing some permanent joints of parts: riveting, welding (ГОСТ 2.312 – 68), soldering and gluing (ГОСТ 2.313 – 68).

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 (ГОСТ 2.106 – 96). The rules for filling in the columns and lines of the specification.

Requirements for the assembly drawing of the assembly unit (ГОСТ 2.109 – 73). . 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. CONTENT OF THE SUBJECT

2.1. Structure of the Subject

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"					
2 semester					
1.1	Introduction. Types of products. Types and completeness of design documentation. Basic rules of design documentation. Method of projections.	10	2	2	6
1.2	Orthogonal projections of main elements of geometrical space	10	2	2	6
1.3.	Transformation of an orthogonal drawing when solving positional and metric design problems	10	2	2	6
1.4	Polyhadrons and curved surfaces	10	2	2	6
1.5	Axonometric projections of solids.	10	2	2	6
1.6	Basic provisions for the construction of images of technical forms (according to ГОСТ 2.305 - 68).	10	2	2	6
1.6	Construction of views, sections and cross-sections of technical forms.	6	-	2	4
1.7	Interactive graphics application packages. AutoCAD graphics editor.	10	2	2	6
1.8	Module test №1	4	-	2	2
Total for the 1st Module		**80**	**16**	**16**	**48**
Module # 2 «Development of working design documentation for parts and assembly units».					
2 semester					
2.1	Requirements for working drawings of details.	9	2	2	5
2.2	Features of execution of working drawings of details of separate groups	9	2	2	5
2.3	Features of execution of working drawings of details according to standards of group 4 ЄСКД	6	-	2	4

End of table 2.1

1	2	3	4	5	6
2.4	Types of connections of components of a product. Their images and symbols	8	2	2	4
2.5	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.	9	2	2	5
2.6	Execution of images of non-detachable joints of details (rivets, welding, soldering, gluing)	9	2	2	5
2.7	Reading and analysis of a drawing of a general view of a assambly unit.	9	2	2	5
2.8	Detailing a drawing of a general view of assembly unit.	8	2	2	4
2.9	Features of detailing products with standard elements	6	-	2	4
2.10	Working design documentation for assambly units	9	2	2	5
2.11	Development of the specification and the assembly drawing of the assambly unit according to sketches of component products.	9	2	2	5
2.12	Text design documents	4	2	-	2
2.13	Module test №2	5	2	-	3
Total for the 2nd Module		**100**	**22**	**22**	**56**
Total for the discipline		**180**	**38**	**38**	**104**

3. EDUCATIONAL AND METHODICAL 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 drawing AutoCAD in a dialog mode, which allows you to quickly create and edit images.

In the laboratory, role-playing games are formed with the formation of groups with the appropriate division of responsibilities. Tasks are performed according to the manual [3.2.3], which provides productive assimilation of students' study material of the discipline. The content of the 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 O.T. Descriptive Geometrry in worked problems: manual /O.T.Bashta, O.V.Dzhuryk. – K.: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. – K.:NAU, 2000. - 32 p.

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

3.2.4. *Bashta E.T.* AutoCAD. Computer Graphics: manual / E.T.Bashta, E.V.Dzhuryk. – K.: 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. Бліок, 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. – K.: 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.

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..4. http://er.nau.edu.ua:8080/handle/NAU/28533

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.4.1.1

Table 4.1.1

Module №1 «Projection bases of image construction»		**Module №2** «Development of working design documentation for parts and assembly units».	
Kind of Academic Activities	Max Grade	Kind of Academic Activities	Max Grade
Performance and deference of laboratory classes (3x8)	24	Performance and deference of laboratory classes (3x11)	33
Execution of separate tasks on knowledge of theoretical material	9	Execution of separate tasks on knowledge of theoretical material	4
For carring out module test №1, a student must receive not less than 19 values		*For carring out module test №2, a student must receive not less than 22 values*	
Carrying out Module Test №1	15	Carrying out Module Test №2	15
Total for module №1	**48**	**Total for module №2**	**52**
Total for the 1st and 2nd modules			**100**
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 5).

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 specified Total Rating on the subject is entered in Diploma Supplement.

Appendix 5

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 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				