(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
«11» 10 2021

APPROVED
Vice-Rector for Academics
_____ A.Polukhin
«20» 10 2021

Quality Management System

COURSE TRAINING PROGRAM
on
«Engineering and Computer Graphics»

Educational Professional Program: «Aircraft Equipment»

Field of Study: 13 «Mechanical engineering»
Speciality: 134 «Aviation and space rocket technolody»

Training Form	Semester	Total (hours/ credits ECTS)	Lectures	Laboratory classes	Self-study	Home works	Semester grades
Full time	3	105/3,5	17	34	54	1	Exam – 3 s

Index: ECB -1-134-1/21-2.1.9

The Course Training Program on "Enginering and Computer Graphics" 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 technolody» Educational Professional Program «Aircraft Equipment», order № 392/од of 06.07.2021 and corresponding normative documents.

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«18» 10 2021

Document level – 3b

The planned term between the revisions - 1 year

Registered copy

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INTRODUCTION

The Course Training Program (CTP) of the subject "Engineering and Computer 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 and Computer Graphics" is a theoretical and practical basis for a set of competencies that forming the profile of a specialist in the field of design of aerospace and rocket technology.

The purpose 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. 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 use of the graphic software product.

1.3. Competence, which gives the ability to provide education 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 create spatial geometric models of products using a graphical software product.

1.4. Interdisciplinary links: This discipline is based on knowledge of such disciplines "Introduction to the specialty", "Descriptive Geometry" and is the basis for the study of further disciplines, namely: "Design of machines and mechanisms and the basis of interchangeability", "Automation of aircraft design processes".

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 "Interactive graphics application packages. Development of working design documentation for parts ";**
- of the educational **module №2 «Development of working design documentation for**

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 "Interactive graphics application packages. Development of working design documentation for parts".

Topic 1. Interactive graphics application packages. AutoCAD Graphic Editor.

Definition of computer graphics (CG) in accordance with ДСТУ 2939 - 94. Areas of application CG and the main tasks. CG Technical means of CG: electronic computers, input devices and display devices of this exchange, the output device. Software of CG. Characteristics of software products for engineering: AutoCAD, Solid Works, КОМПАС.

The system AutoCAD: general information, appointment of system, user interface, commands of building and editing of geometric "primitives", put of sizes.

Topic 2. Fundamentals of Solid State Modeling in AutoCAD.

Logical operations of creating a spatial geometric model of a technical object: merging, subtraction, intersection of elementary geometric bodies. The "tree" of constructing a complex geometric object.

AutoCAD 3D Build Tasks. Select the type of isometric image. The commands for constructing the Modeling panel.

Dynamic imaging of the Housing product by dynamic spatial operations: stretching, shifting, rotation, etc. Combination, subtraction of bodies. Cutting along coordinate planes.

Topic 3. Requirements for working drawings of details.

Requirements for working drawings of detail and their practical implementation of the performance parts drawings from nature:

- analysis form of detail as a combination of simple geometric shapes oriented in some way to each other and related operations of union, intersection, or subtraction;
- choice of minimal but sufficient number of images (views, sections, cross-sections, remote elements) to manufacture of parts;
- choice of bases and measurement of detail and its parts with followed by put the required size drawings;
- determine surface roughness of detail and its designation in the drawing in accordance with the requirements of ГОСТ 2.309 - 73;
- record of technical requirements for the details - heat treatment, protective covers and others;
- filling the main drawing inscriptions.

Topic 4. Features of execution of working drawings of details of separate groups.

Features of execution of working drawings of details of type "Shaft". Outline and designation of standard structural and technological elements of the shaft.

Features of execution of working drawings of details of type "Body". Crossing out and marking the standard structural and technological elements of the body parts.

Drawings of details according to the standards of group 4 ЄСКД. Drawings of cylindrical gear wheels according to the requirements of ГОСТ 2.403-75. Drawings of springs according to the requirements of ГОСТ 2.401-68.

Performance drawing of details by full-scale models.

Topic 5. Algorithms for drawing parts in an AutoCAD environment.

Two-dimensional geometric model of the product. Optimize a set of commands to build part details on her drawing. Teams of hatching and dimensional information. Features of filling the main inscriptions of the drawing.

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

Topic 1. Types of connections of parts of the product. Their images and symbols.

Methods detachable parts and all-in-one connections with each other.

Classification detachable joints for structural features (thread, key, spline, pin, articulation).

Formation of thread, their classification, basic parameters, simplified representation of thread. Designation of standard fasteners threads. Standard fasteners threads for general engineering and use the standards for the aviation industry. Conventions and simplification when performing image connections with standard fasteners with the thread.Threaded connection of pipelines on the outer cone.

Terms of execution drawings of some all-in-one connections details: rivets, welding, soldering and gluing.

Performing threaded connection drawings on source in the AutoCAD Editor environment.

Topic 2. Drawings detailing the general form assembly units.

The rules of reading and analysis of the general view drawings drafting unit to determine its structure, how connections between themselves parts, order assembly of the product. Determining the geometric shape and size of parts that are drafting unit.

Development of the drawing of details on the drawing of the general type of a complex unit in the environment of the graphical editor AutoCAD.

Topic 3. The working design documentation for assembly units.

Requirements for specification of assembling units, rules of filling of graph and lines of specification.

Requirements for the assembly drawings of assembly unit. Choice the minimal but sufficient number of images, application of sizes, recording of technical requirements . Conventions and simplification in assembly drawings. The execution sequence of assembly drawings which based on sketches of components of the product. Features performance of assembly drawing among graphic editor AutoCAD.

Features of execution of assembly drawing in the environment of the AutoCAD graphic editor.

Development of specification and assembly drawing by parts drawing for assembly unit in AutoCAD graphical editor environment.

2. CONTENT OF THE SUBJECT

2.3. Thematic plan

Table 2.1

№	Topic	Academic Hours			
		All	Lectu-res	Labora-tory classes	Self-study
1	2	3	4	5	6
Module № 1 "Interactive graphics application packages. Development of working design documentation for parts".					
1.1	Interactive graphics application packages. AutoCAD graphical editor user interface.	4	2	-	2
1.2	AutoCAD graphics editor: drawing and editing commands for "graphic primitives"	7	2	2	3
1.3	Basics of solid modeling in AutoCAD.	6	2	2	2
1.4	Axonometric projections of solids. Requirements to working drawings of details Drawing up of information model of a detail with use of logical geometrical operations and sequence of its realization at development of the working drawing	4	2	-	2
1.5	Algorithms for performing part drawings in the AutoCAD environment	4	-	2	2
1.6	Features of execution of working drawings of details "shaft"	4	-	2	2
1.7.	Features of execution of working drawings of details "body"	4	-	2	2
1.8.	Features of execution of working drawings of details according to standards of group 4 ЄСКД (gear wheels, springs, pipelines)	4	-	2	2
1.9.	Module test №1	4	-	2	2
Total for the 1st Module		**41**	**8**	**14**	**19**

End of the table 2.1

1	2	3	4	5	6
Module №2 «Development of working design documentation for assembly units»					
2.1	Types of joints of product components. The formation of threads, their classification, basic parameters, conditional image of the thread.	7	2	2	3
2.2	Imaging connections with standard threaded fasteners in the AutoCAD graphics editor environment.	4	-	2	2
2.3	Threaded connection of aircraft system pipelines along the outer cone.	4	-	2	2
2.4	Drawings of fixed joints of parts: riveting, welding, soldering and gluing in the environment of the graphic editor AutoCAD.	6	2	2	2
2.5	Requirements for drawings of the general form of the folding unit. Detailing of general drawings.	7	2	2	3
2.6	Development of a drawing of the part type "body" according to the drawing of the general view of the folding unit in the middle-higher of the graphic editor AutoCAD.	4	-	2	2
2.7.	Development of a drawing of a part of the type "push nut" on the drawing of the general view of the folding unit in the environment of the graphic editor AutoCAD.	4	-	2	2
2.8.	Working design documentation for assembly units (specification and assembly drawing)	4	2	-	2
2.9.	Development of a sketch of a part (pos. 1, 2) of a full-scale assambly unit of aviation systems in the environment of the graphic editor AutoCAD.	4	-	2	2
2.10	Development of a sketch of a part (pos. 3, 4) of a full-scale assambly unit of aviation systems in the environment of the graphic editor AutoCAD.	4	-	2	2
2.11	Development of an assembly drawing for a full-scale assembly unit of aviation systems according to the developed sketches in the environment of the graphic editor AutoCAD.	5	-	2	3
2.12	Hometask	8	-	-	8
2.13	Module test №2	3	1	-	2
Total for the 2nd Module		67	9	20	38
Total for the 3th semester		**105**	**17**	**34**	**54**
Total for the discipline		**105**	**17**	**34**	**54**

2.4. Homework

Homeworks is executed in the third semester, in accordance with the ratified methodical recommendations. 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 „Interactive graphics application packages. Development of working design documentation for parts"and module № 2 «Development of working design documentation for assembly units». The purpose of the homework is to independently consolidate theoretical knowledge of engineering graphics and gain skills in developing working design documentation for parts and assemblies in the environment of the graphics editor AutoCAD.

Execution, design and defense of homework is carried out by the student individually in accordance with the methodological recommendations.

The time required for implementation of Homework - to 8 hours of Self- study.

2.5. List of questions to prepare for the exam.

The list of questions and the content of tasks for preparation for the exam are developed by the leading teacher of the department in accordance with the work program, approved at the meeting of the department and communicated to students.

3. EDUCATIONAL AND METHODICAL MATERIALS ON DISCIPLINE

3.1. Methods of Teaching

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

The lectures are conducted in multimedia audiences of the university using specialized software for executing AutoCAD drawers in dialog mode, which allows to create and edit images quickly.

In the laboratory classes, role-playing games are used with the formation of design teams (groups) with the appropriate division of responsibilities. Laboratory tasks are performed according to manuals [3.2.3; 3.2.4], which ensures productive mastering by students of the educational material of the discipline. The use of computers in the construction of images of design objects can increase the accuracy of geometric calculations. 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 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. 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

Kind of Academic Activities	Max Grade
Module № 1 "Interactive graphics application packages. Development of working design documentation for parts".	
3 Semester	
Performance and deference of laboratory classes	(5x6)=30
For carring out module test №1, a student must receive not less than	18
Carrying out Module Test №1	10
Total for the module №1	**40**
Module №2 «Development of working design documentation for assembly units»	
3 Semester	
Performance and deference of laboratory classes	(4x10)=40
Performance and deference of HW	10
For carring out module test №2, a student must receive not less than	24
Carrying out Module Test №2	10
Total for the module №2	**60**
Total for the discipline	**100**

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. The sum of the final semester module and examination ratings, in points, is the final semester rating, which is converted into grades 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 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				