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MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
National Aviation University
Educational and Research Institute of Airports
Computer Technologies of Design and Graphics Department

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Acting Rector

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Quality Management System

SYLLABUS
on
«Engineering and Computer Graphics

Field of Study: 14 «Electrical Engineering»
Speciality: 142 «Power Machinery»
Specializations: «Gas Turbine Plants and Compressor Stations»

Year of Study – 2nd
Semester – 3d, 4th
Classroom Sessions – 102
Examination - 4th semester
Self-study – 108
Graded Test - 3d semester
Total (hours/ECTS credits)– 210/7,0

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The Syllabus on "Engineering and Computer Graphics" is based on the educational and professional program and Bachelor Curriculum № CB-1-142/16 for Speciality 142 "Power Machinery" and Specialization «Gas Turbine Plants and Compressor Stations» and correspondent normative documents.

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1.EXPLANATORY NOTES

The syllabus on «Engineering and Computer Graphics» is developed on the basis of "Methodical instructions for development and issuance of syllabus and course training programs of the subjects" enacted by order as of 16.06.2015 №37/роз.

This education discipline lays the foundation of engineering education, forming knowledge and skills of geometric modeling of three-dimensional objects of space.

The purpose of teaching of discipline is opening of modern scientific conceptions, notions and methods of display geometrical properties of technical objects in the form of design drawings.

Objectives to study the subject are:

– mastering theoretic basis methods of imaging space forms on the plane;

– development imaginary skills of reproduction space forms by its plane images;

– mastering of basic rules and norms of design and execution drawings and other design documentation laid down by international standards ЄСКД;

– mastering the basics of automated execution of graphic documentation using software packages.

As the result of mastering the discipline a student should:

To know:

- graphic methods of solving problems of geometric construction, that mainly lie in the definition of the shape, size and relative position of objects on the drawing;

- requirements of international, national and departmental standards for registration of design documents;

- functional abilities of widespread software products for developing design documents.

To be able:

- independently perform the following design documents - detail drawings, specifications, assembly drawings, circuit, an explanatory note using drawing tools and a personal computer with graphics and text software products;

- self-renew in the mind spatial prototypes of actual or planned products, their shape, size with a flat projection imaging (to read drawings).

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

- educational **Module №1 «Projection bases of images";**

- educational **Module №2 «Development of working design documentation"**

- educational **Module №3 « Graphical editor AutoCAD. Development of design documentation",** each of which is logically complete, relatively independent, integral part of the editional discipline, learning of which provides for Module test and analysis of its implementation.

Educational discipline "Engineering and Computer graphics" based on knowledge of such disciplines as: "Descriptive Geometry", "Higher Mathematics" and there is a base to study educational disciplines "Basics of designing", "Designing of gas turbines", "Manufacture and repair of gas turbines and compressors."

2. SUBJECT CONTENT

2.1. Module №1 «Projection bases of images».

Topic 2.1.1. Introduction. Types of products. Types and completeness of design documentation. Basic rules of design drawings ЄСКД standards.

Systems standardization. Unified design documentation (ЄСКД). Definition of the product. The structure kinds of products: details, assembly units, complex, set in accordance with ГОСТ 2.101-68.

Characteristics of design documents in accordance with ГОСТ 2.102-68. Determination of the basic design document for the products. Basic and a complete set of design documents.

The main rules of design drawings in accordance with interstate standards - formats (ГОСТ 2.301 - 68), scales (ГОСТ 2.302 - 68), lines (ГОСТ 2.303 - 68), fonts of drawing (ГОСТ 2.304 – 81), the basic inscriptions (ДСТУ ГОСТ 2.104:2006), put of sizes (ГОСТ 2.307 – 68).

Topic 2.1.2. Projection bases of images. Construction of the views.

The main provisions of the imaging in accordance with ГОСТ 2.305 - 68. Determination of the view. Basic, advanced and local views. Conventions and simplify the performance of images. Execution drawings of technical forms.

Topic 2.1.3. Projection bases of images. Construction of the simple and complex sections and cross-sections.

Determination of section, conditional symbol of materials in sections and cross-sections in accordance with ГОСТ 2.306 - 68. Simple and complex sections. Rules of the combination of the part of view and part of section. Ascenders. Definitions of cross-section. Removed, revolved cross-sections, sections in rupture of the main image. Conventions and simplify the performance of images. Execution drawings of technical forms.

Topic 2.1.4. Basic rules for the application of the drawings size. Conventions and simplification in the performance drawings.

Rules applying size to ГОСТ 2.307-68 for drawings. General requirements. Dimensional and remote line. Symbols and inscriptions. System of application sizes: application size from design bases, application the size of the technological bases. Methods of application sizes: chain coordinate method (from the base station), the combined method.

2.2. Module №2 «Development of working design documentation»

Topic 2.2.1. Working drawings of parts of nature. Information model of detail.

Definition of detail drawings as design document in accordance with ГОСТ 2.101-68. Requirements for working drawings of detail in accordance with ГОСТ 2.109-73 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 in accordance with ГОСТ 2.307 – 68;
- 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 2.2.2. Features of execution drawings of details of the "shaft".

Determining of the shape and the presence of standard elements. Selecting the main image and the required number of images. Conventional designation of center holes, image of chamfers, grooves, conversions, slots.

Topic 2.2.3. Features of execution drawings of details of the "gear wheel".

The main parameters of gears. ГОСТ 2.403-75 requirements for execution drawings spur gears. Calculations of parameters of convention and facilitation, technical specifications, application size, roughness of the performance drawings.

Topic 2.2.4. Features of execution drawings of parts of the "body."

Location of main image. Rules of application of constructing rounding and conjugation for cast and forged parts. Putting drawings on the size of body parts**.**

Topic 2.2.5. Drawings of detail in accordance with the standards of group 4 ЄСКД.

Features of performance of drawings springs. Content of drawings in accordance with the standards. Rules of performance of working drawings in accordance with the ГОСТ 2.401-68. Types of springs: compression, tension, torsion. Chart of compression, stretching, bending.

Topic 2.2.6. Types of connections of parts of the product. Their images and symbols.

Detachable ana non-detachable connection of parts together. General information about the connection of details. Types of connection details . ДСТУ 2497-94. Formation of threads, their classification, basic parameters, conventional image of thread in accordance with the ГОСТ 2.311 - 68. Marking of standard formation of threads, their classification, basic parameters, conventional image ГОСТ 2.311 - 68. Marking of standard fasteners threads. Keyed, spline connections.

Topic 2.2.7. Drawings of threaded connections of the details of standard products with thread.

Classification of detachable joints on structural characteristics (screw, key, spline, pin, articulation), options. Standard fasteners with thread for general engineering and standards for the aviation industry. Conventions and simplification when performing image connections with standard fasteners with thread in accordance with ГОСТ 2.315 - 68. Performance of drawings with threaded connections at baseline**.**

Topic 2.2.8. Drawings aviation connections on pipelines cone.

Treaded connections of pipe on external cone. The main parameters of pipe connections at ГОСТ 3262-75, ГОСТ 380-71, ГОСТ 1050-74. Shaped connecting parts to ГОСТ 6357-81. Rules of execution of drawings of pipe connections.

Topic 2.2.9. Drawings of non-detachable connections.

Terms of execution drawings of some non-detachable connections of details: rivets, welding in accordance with ГОСТ 2.312 - 68, soldering and gluing in accordance with ГОСТ 2.313 - 68.

Execution of drawings of threaded connections at baseline.

Topic 2.2.10. Schemes. Kinds and types of schemes. General requirements for implementation of schemes.

Definition of scheme in accordance with ДСТУ 3321:2003. General requirements for schemes in accordance with ГОСТ 2.701-84. Kinds and types of schemes. Rules of implementation of hydraulic and pneumatic schemes in accordance with ГОСТ 2.704 – 76.

Topic 2.2.11. Development of schematic hydraulic circuit.

Implementation of schematic hydraulic or pneumatic circuit of system of the aircraft. Conditional of graphical notation, size of symbols. Making of a list of circuit elements. Designation of components and devices in circuits in accordance with ГОСТ 2.721-74, ОСТ 2.780-96, ГОСТ 2.781-96, ДСТУ ГА.2.4-1:2009, ДСТУ ГА.2.4-8:2009.

2.3. Module №3 « Graphical editor AutoCAD. Development of design documentation"

Topic 2.3.1. Graphic editor AutoCAD. Input commands, operations with fileof drawings. Construction of graphic primitives in a graphics editor AutoCAD..

Running AutoCAD. GUI AutoCAD. Assignment of properties of line. Drawing line segments. Construction of polyline, polygon, ellipse, conjugation of two circles, chamfes. Implementation of inscription.

Topic 2.3.2. Teams common editing drawings in the graphic editor AutoCAD.

Moving and zooming. Removal of graphic primitive. Removal of part of graphic primitive. Extending of graphic primitive to the intersection with another. Editing of segment, moving and rotating of the objects, construction of symmetrical object using it mirror image, creating an array of images.

Topic 2.3.3. Algorithms of implementation of detail drawings of the "Shaft" among graphic editor AutoCAD.

Construction of circuit, elements of shaft, put the dimensions, roughness using teams of drawing of geometric primitives and editing image data.

Topic 2.3.4. Algorithms of implementation of detail drawings of the "Body" among graphic editor AutoCAD.

Construction of appropriate views, sections, cuts, application size, roughness using the teams of drawing of geometric primitives and editing of images obtained in the performance of detail drawings of the "Shaft".

Topic 2.3.5. Choosing the optimal option teams of building sections and cuts in the performance of drawings parts of the "Shaft", "Body" among graphic editor AutoCAD.

Construction of the outer contour of the body. Building of image of surface of the cylinder, ribs, prism as a square with the vertices on the axes. Choosing the best option of team building type of case front, building front section. Putting dimensions on drawings. Designation of surface roughness . Entry of technical requirements.

Topic 2.3.6 Execution of drawings of parts assembly unit among graphic editor AutoCAD.

Selecting of the required number of images. Construction of image of details and editing image data.Construction of the main inscription of drawing. Filling the main inscription and left angular graphs. Putting dimensions on drawings. Drawing sizes.

Topic 2.3.7. Execution drawings of assembly unit among graphic editor AutoCAD.

Requirements for the drafting of assembly drawings in accordance with ГОСТ 2.109 – 73. Choice minimal but sufficient number of images. Drawing sizes, recording specification components of the product.

Topic 2.3.8. Execution of image of assembly drawings of assembly unit among graphic editor AutoCAD.

Features of execution of drawing of assembly drawings. Conventions and simplification in assembly drawings. The sequence of execution of assembly drawings based on sketches by graphic editor AutoCAD. Development of specifications and assembly drawings for genuine parts of assembly unit.

Topic 2.3.9. Development of the explanatory note to the assembly drawings among text editor WORD. ГОСТ-2.106-68 requirements for registration of text documents. The sections that make up the explanatory note. Preparation of structural separation schemes for product components. Recommendations to read and execution of assembly drawing. The sequence of execution of assembly drawings.

Topic 2.3.10. Reading drawings of general form of assembly unit.

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

Topic 2.3.11. Drawings detailing the general view of the assembly unit among graphic editor AutoCAD.

Determining the geometric shape and size of parts that are drafting unit. Graphic construction of elements of details.

Topic 2.3.12. Features of performance of parts of drawings of the "Body" in the general form of drawings among graphic editor AutoCAD.

Determining the geometric shape and size of parts that are drafting unit. Design drawings of the details of the "Body" with general view drawings drafting unit.

Topic 2.3.13. Design drawings of the details of the "Nut" in the general form of drawings among graphic editor AutoCAD.

Determining the geometric shape and size of parts that are drafting unit. Design drawings of the details of the "Nut" in general view drawings drafting unit.

Topic 2.3.14. Development of principle hydraulic circuit among graphic editor AutoCAD.

Definition of scheme for ISO 3321: 2003. General requirements for schemes in accordance with ГОСТ 2.701 - 84. Kinds and types of schemes. Implementation regulations for hydraulic and pneumatic circuits in accordance with ГОСТ 2.704 - 76.

Development of principle scheme of pneumatic or hydraulic systems of aircraft among the graphic editor AutoCAD.

Topic 2.3.15. Basics of three-dimensional constructions.

Construction of the output image of grid. Construction of the output image of figures. The challenge mode of three-dimensional constructions.

Topic 2.3.16. Constructions of visual image of products in AutoCAD environment graphical editor for wire model.

Viewes and viewports. Dynamic change of appearance. Combination of bodies. Subtraction bodies.

Topic 2.3.17. Constructions of visual image products in AutoCAD environment graphics editor for the solid-state model.

Analysis the forms of part. Construction of top view of body. Dynamic body basics of the case. Image stiffeners.

3.LIST OF REFERENCES

3.1. Basic literature

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3.1.8. ЕСКД. Правила выполнения схем. – М.: Изд-во стандартов, 1987. – 135 с.

3.2. Additional literature

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3.2.2. *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.

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

(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

№ змін и	№ листа (сторінки)				Підпис особи, яка внесла	Дата внесення зміни	Дата введення зміни
	Зміненог о	Заміненог о	Нового	Анульо-ваного			

(Ф 03.02 – 32)

УЗГОДЖЕННЯ ЗМІН

	Підпис	Ініціали, прізвище	Посада	Дата
Розробник				
Узгоджено				
Узгоджено				
Узгоджено				