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MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
National Aviation University
Educational and Research Airspace Institute
Engineering Department

APPROVED
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Quality Management System

SYLLABUS

on

«Details of Machines»

Field of study: 27 “Transport Services”
Speciality: 272 “Aviation Transport”
Educational
Professional Program: Maintenance and Repair of Aircraft and Aircraft Engines
Airports Technologies of Works and Technological Equipment

Year of Study – 3 rd		Semester – 5 th
Classroom Sessions	– 51	Examination – 5 th semester
Self-study	– 99	
Total (hours/ECTS credits)	– 150/5,0	
Course Project	– 5 th semester	

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The Syllabus on «Details of Machines» is based on the Educational and Professional Program and Bachelor Curriculum № CB-1-272/16 for Speciality 272 «Aviation Transport» and Educational Professional Programs «Maintenance and Repair of Aircraft and Aircraft Engines», «Airports Technologies of Works and Technological Equipment» and correspondent normative documents and order №207/од of 27.04.18.

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Discussed and approved by the Scientific-Methodological-Editorial Board of Educational and Research Airspace Institute, Minutes № _____ of _____ 2018.

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“ _____ ” _____ 2018

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1. EXPLANATORY NOTE

The Syllabus of discipline "Details of Machines" is developed on the basis of "The guidelines for the development and execution of Syllabus and Course Training Program", enacted by order 16.06.2015r. №37/роз.

The discipline "Details of Machines" is the last general engineering discipline which combines engineering strength calculations theory and method of machines elements and units and provides fundamental engineering training of engineers.

The purpose of teaching the discipline is formation of students' knowledge about the basics of calculation and designing of typical general purpose machine elements and units and aircrafts.

The main objective of the discipline is to study the general principles of design and construction of elements and components of general and special purpose, which are found in a variety of mechanisms and machines; building models and computational algorithms of typical mechanical engineering with regard to the main criteria of efficiency that are needed in creating a new or upgrading existing and reliable operation of the industry equipment.

As a result of studying the discipline a student shall:

KNOW:

- main types of modern mechanical transmissions, their structure and design
- principles of designing of mechanisms and machines and features of their functioning;
- method of material selection and determination of allowable stresses;
- method of strength calculation of aircrafts and mechanical transmission typical elements;
- method of calculation and design of mechanical engineering and aircraft mechanisms typical elements which carry and transmit rotatory motion;
- method of strength calculation of mechanical engineering and aircraft elements detachable and permanent joints.

ABLE:

- to carry out engineering design strength calculation of typical machine elements and units;
- to develop a rational mechanism diagram;
- to solve certain design and construction tasks of elements and units on the base of given conditions of operation;
- to form a technical specification for general purpose elements and mechanisms design;
- to carry out the design documentation development stages and content of the individual design stages.

The subject matter of discipline is structured with module principle and is divided into two modules: training **module №1 „Mechanical transmissions”**; training **module № 2 „Machine elements for carrying and transmitting rotatory power and Joints”**, each of which is logically complete, relatively independent, integral part of the discipline, learning of which provides for modular test and analysis of its doing and course project defense.

A separate third module is a course project, which is done by student in the fifth semester. Course project is an important part to fix and to deepen theoretical and practical knowledge and skills, acquired by student during studying the discipline.

Academic discipline «Details of Machines» is based on the knowledge got during studying the disciplines: «Higher Mathematics», «Descriptive Geometry», «Physics», «Theoretical Mechanics», «Theory of Machines and Mechanisms» and is the basis for the study of such disciplines as: «Ground aviation technics», «Theory of heat engines», «Fundamentals of technical diagnostics», «Reliability of aeronautical engineering», «Flights safety».



2. THE CONTENT OF THE DISCIPLINE

2.1. Module № 1 «Mechanical transmissions».

Topic 2.1.1. Basic concepts and definitions of basis for machinery calculation and design.

The main directions of modern mechanical engineering and aircraft. The role of the discipline "Details of Machines" in the training of maintenance specialists for aircraft and aircraft engines. Classification of details and units. Types of loads acting on the machine details. The main criteria for machine performance.

Topic 2.1.2. Mechanical transmissions general information.

Purpose of transmissions and their classification. The basic kinematic and power ratios of transmissions. Using of mechanical transmissions in aviation technology.

Topic 2.1.2. Friction transmissions.

General information, classification, design and principle of operation. Strength calculation of cylindrical friction transmissions. Friction transmissions in engineering.

Topic 2.1.4. Basic concepts of gearings.

General Information. Types of gears. Materials of gears and types of heat treatment. Calculated load. Types of teeth failure and gears serviceability criteria. Allowable stresses.

Topic 2.1.5 Straight spur gears.

General information. Geometry of straight spur gears. Forces in the engagement of spur gears. Calculations for contact and bending stresses.

Topic 2.1.6 Helical spur gears.

General information. Geometry of helical spur gears. Forces in the engagement of helical gears. Equivalent wheel. Calculations for contact and bending stresses. Herringbone spur gears.

Topic 2.1.7. Bevel gears.

General information. Geometry of bevel gears. Forces in the engagement of bevel gears. Calculations for contact and bending stresses.

Topic 2.1.8. Worm gearings.

General Information. Classification of worm gearings. Geometry of worm gearings. Materials of worm pairs, failure types and allowable stresses. Slippage speed in worm engagement and efficiency. Forces in the engagement. Strength calculation of worm gears. Heat removal analysis of a worm gearing. The use of worm gears in aviation technology.

Topic 2.1.9. Belt drives.

General Information. Geometrical ratios and forces in transmission. Tension in belt drive. Slide, gear ratio and transmission efficiency. Pulling ability of belt drive. Durability of the belt. Ways of belt strain. Calculation of V-belt and flat belt drives.

Topic 2.1.10. Chain drives.

General Information. Basic geometric parameters and kinematics of transmission. Driving chains and sprockets. Performance criteria and calculation of chain drives.

2.2. Module № 2. «Machine elements for carrying and transmitting rotatory power and Joints ».

Topic 2.2.1. Axles and shafts.

Purpose and principle of operation. Construction of shafts and axles. Materials for shafts production. Designing and checking calculations of shafts. Designing features of reducers and aviation mechanisms shafts.

Topic 2.2.2. Rolling contact bearings.

General Information. Classification, labeling and accuracy classes of rolling bearings. The main types of rolling bearings. Selection of bearings for basic and static load rating. Design features of aviation reducers mounting group with rolling bearings.



Topic 2.2.3. Sliding contact bearings.

General Information. Bearing construction and industry use. Materials of bearings. Bearings with boundary and fluid friction. Basis of bearings calculation. The use of bearings in aircraft mechanisms mounting groups.

Topic 2.2.4. Coupling.

General information. Unmanaged, managed and self-managed couplings. Couplings additional forces on structure elements. Selection of couplings. Checking calculations of coupling elements.

Topic 2.2.5. Threaded joints.

General Information. Geometrical parameters of thread. The main types of threads and their standardization. Power relations in threaded joints. Elements of power screw theory. Conditions of self-locking, efficiency of screw pair. Main fasteners. Calculations of threaded joints: loaded by an axial force only; loaded by axial force and torque; loaded by shearing force in the plane of the junction. Calculation of group of bolted joints. Design of threaded joints in aviation mechanisms. Strength classes and materials of threaded elements.

Topic 2.2.6. Keyed and splined joints.

General Information. The main types of keyed joints. Choosing of keys and check analysis of keyed joints.

Splined joints. Purpose, classification, application. Check analysis of splined joints. Using of splined joints in aircraft assemblies.

Topic 2.2.7. Riveted joints.

General Information. Types of rivets and seams. Materials of rivets. Calculation of riveted joints. Operational features of riveted joints in aircraft structures.

Topic 2.2.8. Welded joints.

General information and industry use. The types of welds. Calculation of welds loaded by force and moment. Design of welded joints in engineering and aircraft structures.

2.4. Module № 3 «Course project».

Course project in the discipline is performed in the fifth semester in accordance with approved methodological recommendations in order to consolidate and deepen the theoretical knowledge and skills on the basis of calculation and design of aviation mechanisms mechanical transmissions and drives.

Course project performing is an important stage for the diploma project prospective specialists in designing aircraft maintenance.

The purpose of the course project is to perform the kinematic and power calculation of mechanical transmissions of reducers, the selection of bearings and bearing checking for durability, selection and strength checking of keys, the selection of gears and bearings lubrication, making of the graphic part and the explanatory note for the course project in accordance with The unified system for design documentation.

Performance, design and defense of the course project are carried out by a student individually according to the methodological guides.

Time for making the course project is 45 hours of student's individual work.

3. METHODOLOGICAL GUIDES AND TEACHING MATERIALS ON THE DISCIPLINE

3.1 Basic recommended sources.

3.1.1. В.Т. Павлице Основи конструювання та розрахунків деталей машин. К.: Вища шк., 1993. – 556 с.

3.1.2. В.М. Павлов, А.С. Крижановський, Г.М. Борозенець та ін. Деталі машин. Конспект лекцій. – К.: НАУ, 2008. – 164 с.



3.1.3. Г.М. Борозенець, В.М. Павлов, О.В. Голубничій, В.О. Кольцов. Прикладна механіка і основи конструювання: навч.посіб. – К.: НАУ, 2015. – 356 с.

3.1.4. Г.М. Борозенець, В.М. Павлов, І.В. Семак. Деталі машин. Методичні рекомендації до виконання курсового проекту для студентів напряму підготовки 6.070103 «Обслуговування повітряних суден». – К.: НАУ, 2013. – 72 с.

3.1.5. В.М. Павлов, Г.М. Борозенець, Є.М. Бабенко та інш. Деталі машин лабораторний практикум. – К.: НАУ, 2007. – 48 с.

3.1.6. С.А. Чернавский, Г.М. Ицкович, К.Н. Боков и др. Курсовое проектирование деталей машин. – М.: Машиностроение 1987. – 416 с.

3.1.7. Н.Ф. Киркач, Р.А. Баласаян Расчет и проектирование деталей машин. Часть II. – Харьков, Выща шк., 1988. – 140 с.

3.1.8. Kryzhanovskiy A.S., Kornienko A.O., Bashta O.V. Machine elements. Course project design: manual. – К.: НАУ, 2015. – 124 p.

3.2. Additional recommended sources

3.2.1. М.Н. Иванов Детали машин. – М.: Высш. шк., 1991. – 383 с.

3.2.2. Баласаян Р.А. Атлас деталей машин. – Х.: Основа, 1996. – 256 с.

3.2.3. Справочно-методическое пособие. В 2-х кн. Под ред. П.Н. Учаева. – М.: Машиностроение, 1988. – 544 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 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				
Узгоджено				