

NATIONAL AVIATION UNIVERSITY  
Educational and Research Airspace Institute  
Engineering Department  
Department of Aviation Machines Manufacturing and Repair Technologies

AGREED  
Director of Educational and  
Research Airspace Institute

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« \_\_\_ » \_\_\_\_\_ 2017

APPROVED  
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and Educative Activity

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« \_\_\_ » \_\_\_\_\_ 2017



Quality Management System  
**COURSE TRAINING PROGRAM**  
on  
**«Designing of Machines and Mechanisms and Bases of  
Interchangeability»**

Field of study: 13 «Mechanical engineering»  
Speciality: 134 «Aviation and Space Rocket Technology»  
Specialization: Airplanes and helicopters  
Aircraft Equipment

Year of study – 2<sup>nd</sup> Semester – 4<sup>th</sup>

Lectures – 34 Examination – 4<sup>th</sup> semester

Practicals – 17

Laboratory Classes – 34

Self-study – 125


Total (hours/ECTS credits) – 210/7

Homework (1) – 4<sup>th</sup> semester

Course Project – 4<sup>th</sup> semester

Index ECB–1– 134/16–2.1.13

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The Course Training Program on «Designing of Machines and Mechanisms and Bases of Interchangeability» is based on the Bachelor Extended Curriculums ECB - 1 - 134/16 for Speciality 134 «Aviation and Space Rocket Technology» and Specializations «Airplanes and helicopters», «Aircraft Equipment»; Syllabus for this Subject, Index CB–1–134/16–2.1.13, approved by the Rector \_\_.\_\_.2017, and correspondent normative documents.

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## INTRODUCTION

The Course Training Program of the course was developed based on the Syllabus of discipline "Designing of Machines and Mechanisms and Bases of Interchangeability" and "The guidelines for the development and execution of training programs and work training courses", enacted by order 16.06.15 №37/поз.

## 2. Subject content

### 2.1. Training schedule of the subject

№.	Topics	Volume of lessons (by hours)				
		All	Lectures	Practicals	Laboratory Classes	ECTS
1	2	3	4	5	6	7
<b>Module №1 «Bases of Interchangeability»</b>						
1.1	Definition of interchangeability and its varieties.	4	2	-	-	2
1.2	Phases of interchangeability ensuring	6	2	-	2	2
1.3	Technical means of measurement as a direction of ensuring the interchangeability	7	2	-	2	3
1.4	Mechanical means of interchangeability	7	2	-	2	3
1.5	Lever-mechanical means of measurement	6	2	-	2	2
1.6	Optical-mechanical and optical means of measurement	6	2	-	2	2
1.7	Pneumatical means of measurement	6	2	-	2	2
1.8.	Interchangeability of details at designing, production, operation and repair	8	2	-	2	4
1.9.	Homework	4	-	-	-	2
1.10	Module test № 1	8	-	-	2	8
<b>All after the module №1</b>		<b>62</b>	<b>16</b>	<b>-</b>	<b>16</b>	<b>30</b>
<b>Module № 2 «Mechanical transmissions»</b>						
2.1	Gearings. Basic concepts and definitions. Calculations for contact and bending stresses.	11	2	2	2	5
2.2	Straight and helical spur gears	13	4	2	2	5
2.3	Bevel gears.	11	2	2	2	4
2.4.	Worm gearings. Calculations for contact and bending stresses and worm gearings construction.	13	4	2	2	5
2.5	Module test № 2	6		2		4
<b>All after the module № 2</b>		<b>50</b>	<b>8</b>	<b>10</b>	<b>8</b>	<b>24</b>
<b>Module № 3 «Machine elements for carrying and transmitting rotatory power and</b>						

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<b>Joints».</b>						
3.1	Axles and shafts. General Information. Designing and checking calculations of shafts. Construction of shafts and axles.	11	2	2	2	5
3.2	Rolling contact bearings. General Information. Selection of bearings and analysis for basic and static load rating.	10	2	2	2	4
3.3.	Threaded joints. General Information. Geometrical parameters of thread. Strength calculations of the threaded joints.	11	2	2	2	5
3.4	Keyed and splined joints. General Information. Strength checking analysis	8	2		2	4
3.5	Riveted and welded joints. General Information. Construction and strength calculations.	8	2		2	4
3.6.	Module test № 3	5		1		4
<b>All after the module № 3</b>		<b>53</b>	<b>10</b>	<b>7</b>	<b>10</b>	<b>26</b>
<b>Module № 4 «Course project»</b>						
4.1	Calculation and design machines drives	45				45
<b>All after educational discipline</b>		<b>210</b>	<b>34</b>	<b>17</b>	<b>34</b>	<b>125</b>

### 2.1.1. Homework

Homework (HW) is performed in order to consolidate and deepen the theoretical knowledge and skills of students from such directions as means of measurements, interchangeability at designing, manufacturing and operation and is a part of the module # 1.

Student makes execution, arrangement and defending of HW in individual order.

Students receive task for performing HW from the guidelines, which were developed by the department. The time for executing HW is equal 8 hours

### 2.1.2. Course project

The purpose of course project is to strengthen students knowledge which are obtained after studying the discipline, to acquire practical skills in kinematic and force analysis of drive mechanisms, to study methods of analysis and design of general purpose mechanism elements and units and machines.

Course project consists of graphical part and calculations. Graphical part is made on A1 whatman paper (three drawing). Approximate amount of calculations (explanatory note) is ranged from 25 to 35 hand written pages of size A4 paper. Time for making the course project is 45 hours.


Tasks for the course project are given in the department developed methodical guides.

## 3. Basic concepts of guidance on the subject

### 3.1. List of references

#### Basic recommended sources.

3.1.1. *Кирилюк Ю.С., Якимчук Г.К, Бугай Ю.М.* Взаємозамінність, стандартизація та технічні вимірювання. – К: КМУЦА. 1997.

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3.1.2. *Кудрін А.П., Кулик М.С., Зайвенко Г.М., Волянська Л.Г., Панін В.В.* Технологія літакобудування. Ч. I. Типові технологічні процеси виготовлення деталей літальних апаратів. – К.: «НАУ - друк». Підручник. 2009. 265 с.

3.1.3. *Кудрін А.П., Лубяний В.В., Хишко В.Д.* «Взаємозамінність та технічні вимірювання». – К.: Астра-Пол, 2005.

3.1.4. *Гриценко В.Д., Кудрін А.П., Мамлюк О.В., Зайвенко Г.М., Пішта О.І.* Системи автоматизованого проектування в літакобудуванні. Навчальний посібник. – К.: НАУ. 2016. – 122с.

3.1.5. *Павлище В.Т.* Основи конструювання та розрахунок деталей машин. К.: Вища шк., 1993. – 556 с.

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

3.1.7. *Борозенець Г.М., Павлов В.М., Голубничій О.В.* та ін. Прикладна механіка та основи конструювання: навч. посіб. К.: НАУ, 2015. – 356 с.

3.1.8. *Павлов В.М., Борозенець Г.М., Семак І.В.* Конструювання машин та механізмів: методичні рекомендації і завдання до курсового проекту – К.: НАУ, 2015. – 96 с.

3.1.9. *Киркач Н.Ф., Баласанян Р.А.* Расчет и проектирование деталей машин. Часть II. – Харьков, «Выща школа», 1988. – 142 с.

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

3.1.10. *Kryzhanovskyi A.S., Kornienko A.O., Bashta O.V.* Machine elements. Course project design: manual. – К.: NAU, 2015. – 124 p.

#### **Additional recommended sources.**

3.1.11. *Кудрін А.П., Зайвенко Г.М., Волосович Г.А., Хишко В.Д.* Ремонт повітряних суден і авіадвигунів. Підручник. 2003. – К.: НАУ 2002.


3.1.12. *Чернілевський В.Д., Павленко В.С., Любін М.В.* Технічна механіка. Кн. 4. Деталі машин, К.: НМК ВО, 1992. – 360 с.

3.1.13. *Цехнович Л.И., Петриченко И.П.* Атлас конструкции редукторов.- К.: „Вища школа”, 1990. – 151 с.

3.1.14. *Баласанян Р.А.* Атлас деталей машин. – Х.: Основа, 1996. – 256 с.

### **3.2. List of basic guidance materials for the subject**

№	Name	Index of topics where guides are used	Number of examples
1.	Set of posters for lectures	1.1...1.2	8
2.	Set of posters for laboratory classes	1.3...1.4	2
3.	Set of prepared details for laboratory classes	1.4...1.5	2
4.	Full-scale devices for determining the details technical state	1.6...1.7	2
5.	Active equipment for laboratory work	1.7...1.8	2
6.	Set of posters for lectures, laboratory and practical classes	2.2...2.6 3.2...3.6	5
7.	Set of mechanisms models studied in the course sections	2.2...2.6	6

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8.	State Standards: materials mechanical properties determination; gearings, threaded, keyed and splined joints calculations	2.1...2.6 3.1...3.6	1
9.	Stands with samples of rolling and sliding contact bearings, threaded joints	3.2. 3.4	2
10.	Examples of course project	2.2...2.6 3.1...3.5	10
11.	Samples of aviation and general purpose reducers	2.2...2.5 3.1...3.5	8
12.	Examples of homework	1.2 ... 1.8	4

#### 4. Rating System of knowledge and skills assessment


4.1. Grading of different kinds of academic work performed by a student is done in accordance with Table 4.1.

Table 4.1.

Grading of different kinds of academic work performed by a student

4 Semester					
Module №1		Module №2		Module №3	
Kind of Academic Work	Max Grade	Kind of Academic Work	Max Grade	Kind of Academic Work	Max Grade
Performance and Defense of Laboratory classes (7x2)	14 (total)	Performance and Defense of Laboratory classes (4x3)	12 (total)	Performance and Defense of Laboratory classes (3x3)	9 (total)
Performance and defense of homework	5	Performance and defense of practical classes (4x2)	8 (total)	Performance and defense of practical classes (2x5)	10 (total)
<i>For carrying out module test № 1, a student must receive not less than 12 values</i>		<i>For carrying out module test № 2, a student must receive not less than 12 values</i>		<i>For carrying out module test № 3, a student must receive not less than 12 values</i>	
Module test №1	10	Module test №2	10	Module test №3	10
<b>Total for module №1</b>	<b>29</b>	<b>Total for module №2</b>	<b>30</b>	<b>Total for module №3</b>	<b>29</b>
<b>Examination</b>					<b>12</b>
<b>Total Semester Grade</b>					<b>100</b>
<b>Module № 4 «Course project»</b>					
Kind of academic work					Max grade
Making of a course project					50
Defense of a course project					50
Making and defense of a course project					100



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4.2. The kind of academic work, performed by a student, has been passed, if a student got positive grade according to National Scale – (see Table 4.2).

Table 4.2

Correspondence between Grade values and the National System

Performance and defense of laboratory classes		Performance and defense of homework	Performance and defense of practical classes		Module test	National System
Module № 1	Module № 2, 3		Module № 2	Module № 3		
13-14	3	5	8	5	9-10	excellent
11-12	2,5	4	6-7	4	8	good
9-10	2	3	5	3	6-7	satisfactory
under 9	under 2	under 3	under 5	under 3	under 6	failed

4.3. The grades a student has been given for the different kinds of academic work the summed up and the result constituting a Current Module Grade is entered into the Module Grade Register.

4.4. The Current Module Grade and the Module Test Grade together make up a Total Module Grade whose correspondence to the National System is shown in Table 4.3.

Table 4.3

Correspondence between Total Module Grade Values and the National System

Module № 1	Module № 2	Module № 3	National System
26 - 29	27 – 30	26 - 29	excellent
22 - 25	22 - 27	22 - 25	good
18 – 22	18 – 22	18 - 21	satisfactory
under 18	under 18	under 18	failed

4.5. The Total Module Grade received by a student for making and defense of a course project in values, National Scale grades and ECTS Scale grades, is entered into the Module Grade Register.

4.6. The Semester Module Grade is calculated as the sum of the Total Module Grades. The correspondence between Semester Module Grade values and the National System is given in Table 4.4.

Table 4.4

Correspondence between Semester Module Grade Values and the National Scale

Semester Grade Values	National Scale
79-88	excellent
66-78	good
53-65	satisfactory
under 53	failed

Table 4.5


Correspondence between Examination Grade Values and the National Scale

Examination Grade Values	National Scale
11-12	excellent
9-10	good
7-8	satisfactory
under 7	failed

4.7. The Semester Module Grade and the Examination Grade together make up a Total Semester Grade whose correspondence to the National Scale and the ECTS Scale is shown in Table 4.6.

4.8. The Total Semester Grade is entered into the Examination Register and into a student’s record book in values, National Scale grades, and ECTS Scale grades.



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4.9. The Total Semester Grade is entered into a student’s record book, for example: **92/Ex/A, 87/Good/B, 79/Good/C, 68/Sat/D, 65/Sat./E**, etc.

4.10. The Total Module Grade received by a student for making and defense of a course project, besides the Module Grade Register, is entered into a student’s record book and the Diploma Supplement, for example: **92/Ex/A, 87/Good/B, 79/Good/C, 68/Sat/D, 65/Sat./E**, etc.

4.11. The Total Discipline Grade corresponds to the Total Semester Grade.  
The Total Discipline Grade is entered in the Diploma Supplement

Table 4.6

Correspondence of Total Semester Grades to  
the National Scale and the ECTS Scale

Total Semester Grade Values	National Scale	ECTS Scale	
		Grade	Explanation
<b>90-100</b>	<b>Excellent</b>	<b>A</b>	<b>Excellent</b> (excellent performance with insignificant shortcomings)
<b>82 – 89</b>	<b>Good</b>	<b>B</b>	<b>Very Good</b> (performance above the average standard with a few mistakes)
<b>75 – 81</b>		<b>C</b>	<b>Good</b> (good performance altogether with a certain number of significant mistakes)
<b>67 – 74</b>	<b>Satisfactory</b>	<b>D</b>	<b>Satisfactory</b> (performance meets the average standards)
<b>60 – 66</b>		<b>E</b>	<b>Sufficient</b> (performance meets the minimal criteria)
<b>35 – 59</b>	<b>Failed</b>	<b>FX</b>	<b>Failed</b> (bad performance; a second testing is required)
<b>1 – 34</b>		<b>F</b>	<b>Failed</b> (very bad performance; a student shall retake the course)



