

(Ф 03.02 – 91)

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

APPROVED  
Acting Rector

«  »                      2017



Quality Management System

**SYLLABUS**  
**on**  
**«Science of Aviation Materials»**

Field of Study: 17 «Electronics and Telecommunications»  
Specialty: 173 «Avionics»  
Specializations: «Piloting and Navigation Equipment Complexes»  
«Ergonomics»

Year of study – 1

Semester – 2

Classroom Sessions – 34

Graded Test – 2 semester

Self-study – 56

Total (hours/ECTS credits)– 90/3

Index CB-14-173/16-2.1.12

**QMS NAU S 07.01.02-01-2017**



The Syllabus on «Science of Aviation Materials» is based on the educational and professional program and Bachelor Curriculum № CB-14-173/16 for Speciality 173 «Avionics» and Specializations «Piloting and Navigation Equipment Complexes», «Ergonomics» and correspondent normative documents.

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“ \_\_\_\_\_ ” \_\_\_\_\_ 2017

“ \_\_\_\_\_ ” \_\_\_\_\_ 2017

Document level – 3b

The planned term between the revisions – 1 year

**Master copy**



## 1. EXPLANATORY NOTE

The curriculum of discipline «Science of Aviation Materials» is developed on the basis of "the guidelines for the development and execution of training programs and work training courses", enacted by order 16.06.2015y. №37 / поз.

This discipline is a part of the body of knowledge required in the design, operation and maintenance of electronic equipment and control - navigation systems.

The aim of learning the discipline «Science of Aviation Materials» is to develop the knowledge and skills that ensure solution of engineering problems associated with the use of electrical and structural materials in the construction, maintenance and repair of avionic equipment and flight and navigation systems.

The aim of mastering the discipline is:

- mastery of knowledge about classification and marking of electrical and structural materials;
- ability to reasonably choose the correct materials under the terms of design, operation and maintenance;
- ability to analyze the effects of operational and environmental factors on the properties of electrical materials.

As a result of mastering the discipline student should:

### **To know:**

- physical concepts of phenomena in the materials for maintenance, their relationship with the properties;
- basic characteristics and properties of electrotechnical and structural materials;
- the results of maintenance influence on the materials of electronic equipment and navigation aids

### **Вміти:**

- to determine the basics characteristics of electrotechnical end structural materials;
- to value the material behavior by different maintenance conditions action;
- to choose the materials for electronic equipment an navigation aid reliability according their functional prescription.

- Handout of course is structured in a modular manner and consists of two classical training modules, namely:

- training **module №1 „Structural aircraft materials”**;
- training **module № 2 “Dielectrical and conductive materials”**

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.

Academic discipline «Science of Aviation Materials» is based on the knowledge got during studying the disciplines: «Higher Mathematics», «Physics», «Chemistry» and is the basis for the study of such disciplines as: «Optoelectronics and Laser Technique in Avionics Linc», «Electrical Power Supply of Aircraft», «Aviation Electrical Machines and Devices» and others.

## 2. THE CONTENT OF THE DISCIPLINE

### 2.1. Module №1 „Structural aircraft materials”

#### **Topic 2.1.1. Subject and structure of the discipline. The structure of solid body.**

Crystalline substances with ordered positioning of atoms and molecules and amorphous substances with chaotic positioning of atoms and molecules. Crystalline lattice and unit cell. Types of unit cell and its influence on properties. Imperfections of unit cell



(point, linear, surface) and their influence on electrical, mechanical properties. Polymorphism – several types of unit cell of a material at various temperature.

**Topic 2.1.2. Dielectrics and their principal physical and chemical properties.**

Definition of dielectrics. Insulating materials. The main electrical properties of dielectrics. Mechanical, thermal, humidity properties of dielectrics. Determination of polarization. Types of polarization. The concept of relative dielectric constant. Dependence of relative permittivity on temperature, frequency, intensity, pressure, humidity. Equation of polarization. Relative permittivity of the heterogeneity of the composition and structure of dielectrics. The concept of dielectric conductivity. Physics of currents. The dependence of the electrical conductivity of solid dielectrics with temperature, frequency, humidity, impurities and defects. The electrical conductivity of liquid and gaseous dielectrics. Energy losses in dielectrics. Types of losses, their dependence on temperature and frequency. The dependence of breakdown voltage on frequency, temperature, humidity. Break-down of liquid and solid dielectrics

**Topic 2.1.3. Classification of dielectrics.**

Classification of solid organic dielectrics: types, properties and application. Classification of solid nonorganic dielectrics: types, properties and application. Dielectrical gases and liquids. Active dielectrics. Materials for quantum electronics.

**Module №2 «Conductive, semiconductive and magnetic materials»**

**Topic 2.2.1. Classification and properties of conductive materials**

Conductor materials: conductivity types. Nature of conductivity of conductors. Basic properties of conductors and their dependence on various factors. Superconductivity. The influence of magnetic field on superconductivity. High-temperature conductivity. The classification of conductor materials, their properties and applications.

**Topic 2.2.2. Definition of semiconductors.**

Definition of semiconductors. The influence of external factors on the electrical conductivity of semiconductors. Nature of conductivity of semiconductors. Two types of conductivity. Physics of conductivity. Impurities in semiconductors. Thermoelectric phenomena in semiconductors.

**Topic 2.2.3. Classification and properties of semiconductive materials.**

Semiconductor materials: basic definitions. Seebeck effect, Peltier effect. Hall's effect, Gunn's effect, their nature and purpose. Materials for thermal and photoconductive application. Varistors. Materials for varistors. Hall's Sensor. Materials for Hall's sensors. Diodes. Transistors. Thermistors. The influence of the electric field at the contact semiconductor - semiconductor. The impact of light on semiconductor - semiconductor contact. Contact metal-semiconductor. Basic properties p-n junction. Amorphous semiconductors.

**Topic 2.2.4. Classification and properties of magnetic materials.** Classification of magnetic materials due to magnetic field behavior. Nature of ferromagnetism. The main properties of ferromagnetic materials. Primary and ground magnetization curve. Hysteresis loop. Energy losses in constant and alternating magnetic fields. Magnetic circuit with air gap. Classification of magnetic materials. Soft magnetic materials, their properties and applications. Special magnetic materials, their properties and applications. Amorphous magnetic materials.



### **3. METHODOLOGICAL GUIDES AND TEACHING MATERIALS ON THE DISCIPLINE**

#### **3.1 Recommended literature.**

3.1.1. Матеріалознавство: підручник./ М.В. Кіндрачук, В.Ф. Лабунець, Т.С. Климова, І.Г. Черниш.-К.: НАУ, 2011. – 492 с.;

3.1.2. Лахтин Ю.М. Материаловедение: Учебник / Ю.М. Лахтин, В.П. Леонтьева. – М.: Машиностроение, 2003. – 528 с.;

3.1.3 Бабак В.П. Конструкційні та функціональні матеріали. Частина 1. / В.П. Бабак, Д.Ф. Байса, С.Ф. Філоненко. – Київ: Техніка, 2003. – 344 с.;

3.1.4. Морозова И.Д. Электрорадиоматериалы / И.Д. Морозова. – М.: Воздушный транспорт, 2003р. – 200 с.

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

3.2.1. Лабунець В.Ф., Климова Т.С. Електротехнічні матеріали. Лабораторний практикум. / В.Ф. Лабунець, Т.С. Климова. – Київ: РВВ НАУ, 2003. – 80 с.;

3.2.2. Лабунець В.Ф. Авіакосмічні матеріали з високою питомою міцністю: навч. Посіб. / В.Ф. Лабунець. – К. : НАУ. – 2015. – 204 с.





(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			

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### УЗГОДЖЕННЯ ЗМІН

	Підпис	Ініціали, прізвище	Посада	Дата
Розробник				
Узгоджено				
Узгоджено				
Узгоджено				