MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

National Aviation University

Science of Aviation Materials

Methodical recommendations
on doing home work
for students of
Field of Study: 17 «Electronics and Telecommunications», Specialty: 173 «Avionics», Specialization: «Piloting and Navigation Equipment Complexes»

Kyiv 2017

УДК
ББК

Author: O.V. Tisov

Rewieved by: _____ “____” _____ 2015

Approved by engineering department of AEROSPACE INSTITUTE OF NATIONAL AVIATION UNIVERSITY (PROTOCOL № of y.)

Методичні рекомендації включають вимоги до виконання домашнього завдання з дисципліни “Авіаматеріалознавство“ і індивідуальні завдання з описом змісту для кожної теми для студентів спеціалізації «Комплекси пілотажно-навігаційного обладнання»

Methodical recommendations include requirements for carrying out the home task on the subject “ Science of Aviation Materials “ and the individual tasks with description of the contents of each topic for students of **Specialization: «Piloting and Navigation Equipment Complexes»**

Contents

Introduction

The homework on “Aviation Materials Science” is one of the basic kinds of students’ individual work. Doing this task students learn to analyze material acquired at lectures and laboratory classes. One of the most important tasks is working with internet issues and literature in library.

Homeworks are carried out in the third semester in accordance with the methodical guides to consolidate and to get deeper theoretical knowledge and skills of students. It is important for studying the discipline, which is delivered in the third semester.

Homework №1 is based on the material for self-studying and is a part of module №1 ‘Structural aircraft materials’.

The aim of homework №1, depending on variant, is studying the groups of composite materials, their compositions, properties and application in modern aircraft.

Carrying out, drawing up and defense of homework №1 is done by a student individually in accordance with methodical guides. The volume for homework №1 carrying out is 8 hours.

Homework №2 is carried out in the third semester in accordance with the methodical guides to consolidate and to get deeper theoretical knowledge and skills of students in electrotechnic materials studying. It is a part of module №2 ‘Dielectrics and conductors’.

The aim of homework №2 is studying the conductors properties, conductors properties dependence on the different conditions, conductors classification and application.

Carrying out, drawing up and defense of homework №2 is done by a student individually in accordance with methodical guides. The volume for homework №2 carrying out is 8 hours.

1. OBJECTIVES, STRUCTURE AND REQUIREMENTS TO HOMEWORK

1.1. Purpose of home work (HW).

The home work is directed on in-depth study of that part of material on the subject "Materials science", which concerns the self-study topics of the second module. They should learn to work with the a number of related issues. Thus, during the execution of WH students can acquire practical skills on the selection of appropriate literature and making short abstracts of it.

Doing home task is aimed at forming knowledge, skills and experience for deciding engineering tasks, which are connected with structural and special material application in design, manufacturing, maintaining and restoring of ground vehicles, road machine and ground installations, aircraft and special equipment

1.2. General requirements.

Home task should contain the following items:

- Summary, which is short explanation of obtained results of just a description of the work. This will help to estimate the individual contribution and depth of analyzing the task of HW;
- List of contents;
- Introduction (the state-of the-art);
- Solution (description) of the task, according to approved contents. Student may add some items, but can not omit any of approved subtitles of HW;
- Conclusions on the topic of HW;
- list of references.

1.3. Requirements for The structure of HW.

Title page is made in accordance with appendix 1. It is followed by summary, on a separate page. This is page #2. The third page is contents, which shows the titles (first, second and other orders) of HW parts and the pages on which they begin (appendix 2). The fourth page – is introduction. Introduction is followed by the main part of HW material, which is split into parts according to contents. The last page of the HW is a list of references used in it. There should be 10-15 references. The language of the HW is English.

Home work is printed only on 1 side of standard A4 sheet. All sheets should obviously be stapled or crimped. The usage of paper clip is not allowed. Also pages should be numbered at lower right corner of the page (accept of the first one).

Detailed requirements are listed in part 2 of current recomendations.

2. HOME WORK PREPARATION

2.1. General.

LANGUAGE The language is English; all papers must be submitted in that language. The Google-translation variant of language will not be accepted.

LENGTH OF HW Do not exceed twenty pages in **total**, including all diagrams and pictures. The diagrams and pictures should be included into text correctly, according to requirements. Also, HW should not be shorter then 15 pages

SUMMARY A 100-200 word summary should be included at the beginning of the home work. It is given already after the list of contents, on a separate page. No other text is added to page with summary. It should explain the main concepts, ideas and solution methods of the task/problem.

2.2. Style of paper

Paper Format: The paper format must be Din A4 (21 x 29.7 cm; 8.2 x 11.6 inch) with margins as mentioned below:

- top margin: 2.5 cm (0.98 inch)
- left margin: 2.5 cm (0.98 inch)
- right margin: 2.5 cm (0.98 inch)
- bottom margin: 2.5 cm (0.98 inch)

Text must be typed within the spacing noted above, leaving exact spacing desired for diagrams, tables, charts, photos, etc. During reproduction for printing, each page will be photo reduced to 3/4 of original size. Recommended typing spacing within the image area is 36 lines per page (line spacing 1.5), 65 characters (including spaces, 10 characters/inch) per line. For diagrams, remember that reduction will make print smaller.

Font type and size:

Font type for all headings and text is Arial.

- Font size Main-Header: 14 pt bold
- Font size Text: 14 pt
- Row-Spacing: 1,5 Row

2.3. FORMAT OF TEXT

Title:

ALL CAPITAL LETTERS

bold-faced, flush with left-hand margin. Title should begin on line 1.

First-order headings in text: ALL CAPITALS, flush left

Second-order: Initial Caps and Lowercase, flush left

Third-order: Initial Caps and Lowercase, indent 8 spaces (1 tab)

References: should be numbered in order of mention in the text, and listed at the end of the paper under a first-order heading LIST OF REFERENCES. Designation in the text should be as: (ref. 1) i.e. in parentheses. Do not include textual material in references; footnote such material instead. Likewise, do not include references in Tables or footnotes, but rather in the list of references. Use only references that are available to the general public. Reference should be composed as follows:

Patent: Pat. 84998 Ukraine C21D1/78 (2006.01) A method of producing wear resistant gradient plasma coating with high running in properties / Kindrachuk M.V., Korbut, E.M., Stebeletska N.M. and others., № u 201304817; Appl. 16.04.2013; Publish. 11.11.2013, Bull. Number 21. – 4p. **(In Ukrainian)**

Article Tubielewicz Krzysztof. Influence of wear during friction of chosen properties of a steel surface after burnishing process / Krzysztof Tubielewicz, Andrzej Zaborski, Wladyslaw Skoneczny // Tribologia. – 2003. – V. 22, №2. – P. 13 – 19.

Book: Chichinadze AV. calculation, testing and selection of friction pairs / A.V. Chichinadze, E.D. Brown, A.G. Ginsburg, Z.V. Ignatiev. Moscow: Nauka, 1989. – 267p. **(In Russian).**

Web: Title of source. [Web source] : – Kyiv, Ukraine international airlines. Mode of access: http://www.nbuv.gov.ua/articles/2003/03klinko.htm.

If the language of a document is other then English, then it is necessary to indicate this in parentheses.

TABLES: Tables should be numbered consecutively using Arabic numerals and placed flush right; the Table title should use Initial Caps and Lowercase placed flush left 2 x 1,5 lines below. Table footnotes should be indicated with lowercase letters.

FIGURES: Number figures in the order of their mention and provide legends for all figures and titles for all tables. A scale/ruler in the photograph may be useful. Be sure letter or number height on charts is large enough to be legible (ca. 3-4 mm for charts, 2 mm for pictures).

SYMBOLS AND ABBREVIATIONS: Define symbols and abbreviations the first time they are used, or make a list of "Symbols and Abbreviations" to be placed at the end of the paper, before the references.

PAGE NUMBERING: The page number should be placed on the bottom of the page, right hand flush.

3. **ESTIMATION AND GRADES.**

When estimating the home task the attention should be paid to the following two components:

- **The level of knowledge:**

The strength and depth of knowledge;
The level of thinking;
The ability to organize knowledge on certain topics;
The ability to draw up a comprehensive plan of response;
To give precise formulation;
The right to use the conceptual apparatus;
Culture of the answer (literacy, logic and sequence of presentation);

- **The skills of independent work:**

The ability to find the necessary literature;
Orientation in the flow of information on the chosen specialty;
Record keeping skills (drawing up simple and comprehensive plan, outline, lecture, performance, skills and scientific research work).

A grade is a quantitative measuring unit of students' learning outcomes assessment, based on a multi-value scale as they perform their pre-assigned set of academic tasks.

The ECTS grading system is a system of measuring the quality of all types of classroom and self-study work done by students as well as the level of their knowledge and skills by assessing them in values according to the 100-value scale with further transfer of these values into the national scale and the ECTS scale.

The grading system envisages the use of the following grades: the current module grade, the module test grade, the total module grade, the semester module grade, the examination grade and the total semester grade.

Table 1.

Grade correspondence between grade values and the National test scale

Carrying out and defense of home work	National Scale
5	Excellent
4	Good
3	Satisfactory
Under 3	Bad

A student is considered to have passed the homework if both his/her grade is positive, i.e. higher than ‘bad’ according to the national scale.

If a student has not got a positive Homework Grade he (she) must have repeating test in accordance with the established procedure

A student is not allowed to increase his/her positive Grade by taking a repetitive test.

5. RECOMMENDED LITERATURE

1. Бабак В.П., Байса Д.Ф., Філоненко С.Ф., Різак В.М. “Конструкційні та функціональні матеріали”. Частини 1 та 2. – Київ: Техніка, 2003 – 314с та 363с.
2. Пасынков В.В., Сорокин В.С. Материалы электронной техники. – М.: Высшая школа, 1986. - 386с.
3. Богородицкий Н.П., Пасынков В.В., Тареев Б.М. – Электротехнические материалы. – Л.: Энергоатомиздат, 1985. – 304с.
4. Морозова И.Д. Электрорадиоматериалы. – М.: Воздушный транспорт, 1993. – 195с.
5. Лахтин Ю.М., Леонтьева В.П. Материаловедение. – Москва: Машиностроение, 1990. - 528с.

Additional recommended sources

6. Groover Mikell. Fundamentals of modern manufacturing. Materials, processes and systems. - USA, John Willey and sons, Inc, 2007. – 1022p.
7. S.L. Kakani, Amit Kakani. Materials science. - New Age International (P) Ltd., Publishers, 2004. – 640p.
8. Heat Treatment - Conventional and Novel Applications [http://www.intechopen.com /books/heat-treatment-conventional-and-novel-applications] Edited by Frank Czerwinski. Publisher: InTech,2012. – 420p.
9. William D. Callister, jr. Materials Science and Engineering. USA, John Willey and sons, Inc, 2007. – 721p.
10. Dielectric materials [http://www.intechopen.com /books/dielectric-material]. University of Oradea, Romania. Edited by Marius Alexandru Silaghi,Publisher: InTech, 2012. – 312p.
11. Applications of High-Tc Superconductivity [http://www.intechopen.com/books/applications-of-high-tc-

superconductivity] Edited by Adir Moyses Luiz. Publisher: InTech, 2011. – 272p.

12. Materials Science - Advanced Topics [http://www.intechopen.com /books/materials-science-advanced-topics] Edited by Yitzhak Mastai. Publisher: InTech, 2013. – 560p.

13. Other literature is available online: [http://www.intechopen.com /search?q=materials]

"Approved"
Head of engineering department
Kindrachuk M.V.

_____
"____" _____ 2017

Topics
for students home task #1
on **«Science of Aviation Materials»**

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

1. **Conductive alloys** (Properties. Metals and alloys. Alloys for thermocouples. Materials for terminals. Cermets and contactols)

2. **Classification of conductive materials** (The requirements to conductive materials. Classification of conductive materials. Application of conductive materials with low and high specific resistance)

3. **Metals with high conductivity** (Requirements and application. Basic types of metals and alloys. Influence of impurities on their conductivity)

4. **Metal-based high resistivity alloys for high temperature applications** (Why it is necessary to have these alloys. Variety of heaters. Nichroms. Fechrlals. Rhesistom)

5. **Superconductivity (**Definitions. Properties of superconductors. Two types of superconductivity. Basic varieties and application of superconductors)

6. **Cryogenic conductivity** (Definitions. Advantages and disadvantages. The variety of cryogenic materials and their application).

7. **High resistance metallic alloys** (Application of high resistance alloys. Requirements. Reference resistors. Constantan. Nickelin. Neizilber)

8. **Nonmetellic conductive materials** (Conductivity of non-metals. Graphite-based materials. Application of graphite-based materials)

9. **Dielectric materials** (Definitions. Properties. Classification. Polarization. Application of dielectrics for electrical insulation)

10. Conductivity of dielectrics (Definitions. Properties and application. Factors, influencing conductivity of dielectrics.)

11. The variety of dielectric materials (Classification of dielectric materials. Organic and inorganic dielectrics.)

12. Electrical strength of dielectrics (Definitions and classification of dielectrics. Conductivity of dielectrics. The break-down of dielectrics)

13. Gaseous dielectric materials (Definitions and characteristics. Types of dielectrics. Application of gaseous dielectrics. Properties of most frequently used liquid dielectrics (at least 10). Break-down of gaseous dielectrics).

14. Liquid dielectric materials (Definitions and characteristics. Types of liquid dielectrics. Influence of impurities on their conductivity. Application of liquid dielectrics. Properties of most frequently used liquid dielectrics (at least 10)).

15. Polarisation of dielectric materials (Definition of polarisation. Dielectric permeability. Types of polarisation and its influence on break-down. The influence of external factors on polarisation)

16. Solid dielecrical materials (Definitions and characteristics. Types of dielectrics. Application of solid dielectrics. Properties of most frequently used solid dielectrics (at least 10). Natural (rocks an biological) materials. Polymeric materials)

17. Properties of conductive materials (Definitions and properties of conductors. Conductivity, its physical nature. Factors influencing conductivity)

18. Active dielectrics (Properties and classification of dielectrics. Isolators and active dielectrics. Peisoelectrics. Segnetoelectrics, alloy “Invar”. Application of pieso- and segnetoelectrics)

19. Phisical properties of active dielectrics (Definitions and properties. Electrooptical materials. Electrets. Pyroelectrics. Sun batteries. Application of listed materials)

20. The variety of active dielectrics (Definitions and classification. Pieso- and pyroelectrics. Electrets. Segnetoelectrics. The properties of active dielectrics (at least 10 materials)

Appendix 1

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL AVIATION UNIVERSITY
ENGINEERING DEPARTMENT

APPLICATION OF COBALT-BASED ALLOYS FOR GAS-TURBINE ANGINES

Hometask on discipline: Materials science

Student: Peterson Petro
Group: 305 FA

Accepted: _____

Date "___" _____ 2015

Grade _____

Signature_____

Kyiv 2015

Appendix 2

Contents

Appendix 3

1. GRADIENT COMPOSITE COATINGS FOR WORKING SURFACES OF BRAKING DEVICES

1.1. Introduction and formulation of research problems.

1.1.1. Urgency of work

To achieve high and stable friction coefficient the intermediate layer should have specific heterogeneous … material (ref. 1)

Chemical composition of alloys is given in tab. 1.

……

Table 1.

Chemical and phase composition of eutectic alloys

Alloy	Chemical composition, %							Phase composition		Hardness, HB	Melting point, K
	Cr	*Ni*	*Ti*	*V*	*B*	*C*	*Fe*	Matrix	Harde-ning elements		
BTH	15,4	7,7	3,2	8,1	1,4	1,9	62,3	12X18H9T	TiB_2+ *VC*	470	1460

Powder alloy P-76 (ref. 4) (fig. 2) is characterized by uniform carbides distribution through the alloy. Grain size varies from 0.5 μm up to 20 μm. Wear chart is shown on fig. 3.

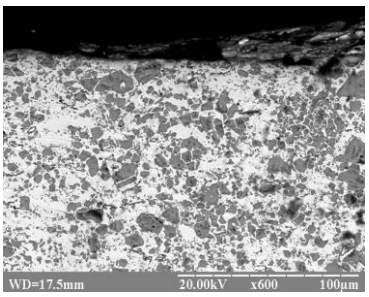

Fig. 2. Microstructure of cast alloys XTH-62 (*a*), P-69 (*b*) and cemented Co-TiC carbides (*c*)

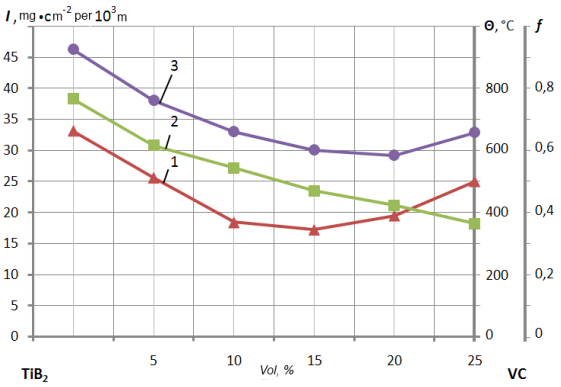

Fig. 3. Dependence tribotechnical properties melted coating VTN plasma volume content of TiB2 and VC at P = 2 MPa, V = 0,5 m / s 1 - f; 2 - Θ; 3 – I