Ministry of Education and Science of Ukraine
National Aerospace University named by M. E. Zhukovsky
"Kharkiv Aviation Institute"

Department of Airplane Manufacturing Technology (No. 104)

APPROVED

Guarantor of the educational program/
Head of the EMC1
_____ Serhii NYZNYK
(signature) (initials and surname)
«29» 08 2023

SILABUS OF ELECTIVE ACADEMIC DISCIPLINE

Technologies of Protective Coating
(Discipline)

Field of Study: 13 «Mechanical Engineering»
14 «Electrical Engineering»
27 «Transport services»
(Code and Name of Field of Study)

Programme Subject Area: 131 Applied mechanics
133 Industrial machinery engineering
134 Aviation and aerospace technologies
141 Electrical energetics, electrical engineering and electromechanics
142 Power machinery
144 Thermal power engineering
272 Aviation transport
274 Motor vehicle transport
(Code and Name of Programme Subject Area)

Educational Program: in all educational programs of specialties
(Name of Educational Program)

Mode of study: Full-time

Level of Higher Education: first (bachelor)

Kharkiv 2023

Developer:
Pavlenko O. A., PhD, Associate Professor of the Dep. #104 
(surname and initials, position, academic degree, and academic title) (signature)
Voronko I. O., PhD, Associate Professor of the Dep. #104 
(surname and initials, position, academic degree, and academic title) (signature)

Syllabus of academic discipline was considered at the meeting of the Department of Airplane Manufacturing Technology (#104)
(The Department Name)

Protocol № _1_ from "_28_" _August_ 2023

Head of the Department: PhD, Associate Professor  K. V. Maiorova
(Sci. Degree and Acad. Title) (Signature) (name and surname)

Agreed with the representative of the applicants for education:

_____ _____ _____
(Signature) (name and surname)

1. General information about the teacher

Pavlenko Oleksiy, PhD, Associate Professor of the Department No. 104.

List of disciplines:

1. Airplanes Manufacturing Processes
2. Technologies of Aircraft Manufacturing
3. Basics of Computer Aided Design
4. Fundamentals of 3D Modelling
5. Integrated Computer Aided Technologies
6. Computer-Aided Design Of Technological Tooling
7. Pre-Graduation Course

Directions of scientific research:

1. 3D Modelling and NC Machining.
2. Impulse Machines For Material Processing And Industrial Waste Disposal.
3. Thermal Impulse Technology and Machines for Part Surface Finishing,

Contact information – email: alexey.pavlenko@khai.edu

Voronko Iryna, PhD, Associate Professor of the Department No. 104.

List of disciplines:

1. Airplanes Manufacturing Process;
2. Basics of Computer Aided Design;
3. Computer Aided Design of Technological Tooling;
4. Fundamentals of AM and Maintenance;
5. Technologies of Aircraft Manufacturing;
6. Technologies of Protective Coating;
7. Quality Management, Control and Testing in Aircraft Production

Directions of scientific research:

1. Application of impulse technologies on aircraft structures in aircraft manufacturing.

2. Machining processes in the aircraft industry.

Contact information – email: i.voronko@khai.edu

2. Description of the discipline

The semester in which the discipline is submitted is the 8th semester.

Volume of discipline:

5 ECTS credits (150 hours), including classroom – 64 hours (lectures – 32 hours), laboratory work – 32 hours), self-study – 86 hours

Forms of education

full-time, remote, dual, part-time

Discipline is elective.

Types of educational activities – lectures, laboratory work, self-study**.**

Types of control – current, modular and final (semester) control (exam).

The language of instruction is English.

Mandatory preliminary disciplines (prerequisites) are required – Physics; Chemistry.

Mandatory related disciplines (corrections) are required – disciplines in the specialty.

3. The purpose and objectives of the discipline

The Purpose:

The study of modern methods and means of technological equipment for the parts and products protection of aviation equipment (airplanes, helicopters), cars from corrosion.

The Task:

Mastering the basic, systematically complete knowledge about the technological features of typical and advanced means and methods for applying and controlling corrosion-resistant coatings; training in the means and techniques of rational design of technologies for protective coatings and their control; mastering the design of typical operations for the execution of relevant technological documentation, considering the requirements of labor protection, life safety and ecology.

After mastering the discipline, the applicant will acquire the following **competencies:**

GC 2. Ability to communicate in a foreign language.

GC3. Skills for the implementation of safe activities, the desire to preserve the environment.

GC5. Ability to work in a team.

GC6. The ability to generate new ideas (creativity).

GC7. Ability to make informed decisions.

GC8. Ability to learn and master modern knowledge.

PC3. The ability to assign optimal materials for elements of aviation technology.

PC6. The ability to develop and implement technological processes for the production of parts and objects of aviation equipment.

PC07. Skills in using information and communication technologies and specialized software in training and professional activities.

PC08. The ability to consider the economic and managerial aspects of the production of elements and objects of aviation technology in professional activities.

It is expected that after mastering the discipline, the applicant will achieve the following learning outcomes and he will:

PLO1. Communicate freely orally and in writing in the state and foreign languages on professional issues.

PLO3. Understand the environmentally hazardous and harmful factors of professional activity and adjust its content in order to prevent a negative impact on the environment.

PLO6. Possess independent learning and autonomous working skills for professional development and problem solving in a new or unfamiliar environment.

PLO9. Comply with the requirements of industry regulatory documents on the procedures for designing, manufacturing, testing and (or) certification of elements and objects of aviation equipment at all stages of their life cycle.

PLO10. Explain the influence of the design parameters of the elements of aviation technology on the flight performance. Have an idea of how to ensure the stability and controllability of aviation equipment.

PLO15. Description of experimental methods for studying the structural, physical-mechanical and technological properties of materials and structures.

PLO18. Understand and justify the sequence of design, construction, production, testing and certification of elements of aviation technology.

PLO22. Have skills in the development of technological processes, including the use of computer-aided design tools for the production of structural elements and systems of aviation equipment.

PLO23. Evaluate the economic efficiency of the production of parts and systems of aviation equipment.

Prerequisites – Physics; Chemistry.

Corrections – Technology for the Structures Production. Diploma project.

4. The content of the discipline

Module 1.

Content module 1. Typical and perspective means and methods of deposition and control of corrosion-resistant coatings.

Topic 1. Types of corrosion by the nature of corrosion destruction.

Form of occupation: lectures, laboratory work, self-study.

Volume of classroom load: 12 hours.

Topic of laboratory work: «Control of the main properties of paints materials and paints coatings»

Compulsory items and means (equipment, materials, tools) – a computer and Internet access.

Brief annotation.

Structural and technological features of the aircraft, helicopter as objects of corrosion protection. Types of corrosion according to the nature of corrosion damage. The procedure for determining the coverage of technical documentation. Technological means of increasing the corrosion resistance of aerospace engineering parts surfaces. Quality indicators and methods of control of protective coatings. Types of surface preparation for coating.

Volume of self-study of applicants is 15 hours.

Topics related to the self-study of the applicant:

Technological means of increasing the corrosion resistance of parts of aerospace engineering and automobiles. Equipment for the preparation of product surfaces before applying protective coatings. Basic means of cleaning metal surfaces.

Topic 2. Methods for quality control of protective coatings**.**

Form of occupation: lectures, laboratory work, self-study.

Volume of classroom load: 12 hours.

Topic of laboratory work: «Typical programs for the control of metal coatings»

Compulsory items and means (equipment, materials, tools) – a computer and Internet access.

Brief annotation.

Basic means of metal surfaces. Solutions for degreasing parts. Quality indicators and methods for monitoring metal protective coatings. Technological features of corrosion protection of parts made of aluminum, magnesium alloys. The main indicators of the quality of galvanic coatings and the causes of defects. Means for measuring the thickness of galvanic coatings without their destruction.

Volume of self-study of applicants is 15 hours

Topics related to the self-study of the applicant:

Reception of oxide films on aluminum alloys. Technological features of typical and advanced means and methods of application and control of corrosion-resistant coatings. Methods for quality control of protective coatings. Solvents used in the production of paints and varnishes. Devices for determination of conditional viscosity. Basic properties of paint coatings. Coating of paints and varnishes.

Topic 3. Components of paints and varnishes.

Form of occupation: lectures, laboratory work, self-study.

Volume of classroom load: 8 hours.

Topic of laboratory work: «Typical control programs for non-metallic inorganic coatings».

Compulsory items and means (equipment, materials, tools) – a computer and Internet access.

Brief annotation.

Components of paints and varnishes (LPM). LPM classification. Methods for applying coatings. Components of paints and varnishes. Film-forming substances for obtaining paints and varnishes.

Volume of self-study of applicants is 13 hours.

Topics related to the self-study of the applicant:

Determination of the adhesion strength of paints and varnishes with the base metal. Tools for applying protective paint coatings. Components of paints and varnishes. The main properties of the paintwork material. Film-forming substances for obtaining paints and varnishes. The main purpose of the plasticizer, pigments, fillers and driers.

Modular control 1

Form of classes: writing a modular work in the classroom (by the decision of the lecturer, participation in the online form is allowed).

Volume of classroom load: 2 hours

Compulsory items and means (equipment, materials, tools) – absent.

Volume of self-study of applicant – if necessary.

Preparing for modular control.

Module 2.

Content module 2. Equipment for electroplating and paint coating shops.

Topic 4. Equipment for electroplating and paint coating shops

Form of occupation: lectures, laboratory work, self-study.

Volume of classroom load: 12 hours.

Topic of laboratory work: «Equipment for the application and control of parts protective coatings»

Compulsory items and means (equipment, materials, tools) – a computer and Internet access.

Brief annotation.

Equipment and equipment for electroplating and paint coating shops. Equipment for chemical cleaning of surfaces of parts before applying protective coatings. The structure of the technological process of applying protective coatings and the sequence of its design. Comparative features of the main methods for protecting parts from corrosion. Technological methods for increasing productivity and reducing the cost of protective coating technologies. The composition of standards, reference books and methodological literature regulating the design of processes for applying and controlling protective coatings. Equipment for artificial drying of paint coatings.

Volume of self-study of applicants is 15 hours.

Topics related to the self-study of the applicant:

Chemical cleaners for metal surfaces. Solutions for degreasing aluminum alloys. The main purpose of phosphating, anodizing, chromium plating.

Topic 5. Ways to solve the problems of industrial sanitation at aircraft and auto enterprises.

Form of occupation: lectures, laboratory work, self-study.

Volume of classroom load: 12 hours.

Topic of laboratory work: «Putty, application of anti-corrosion protection».

Compulsory items and means (equipment, materials, tools) – a computer and Internet access.

Brief annotation.

Ways to improve and develop the technology of applying and controlling protective coatings of parts. Progressive methods of organizing production in the field of galvanic and paint coatings. Equipment for painting in an electric field. Environmentally friendly technologies for electroplating and paint coatings.

Volume of self-study of applicants is 15 hours.

Topics related to the self-study of the applicant:

Means for protecting the skin from the effects of solvents and hardeners. Rules of safety when working with lacquered materials. Fire-fighting measures in the preparation of paints and varnishes for work and during painting work.

Topic 6. Painting devices.

Form of occupation: lectures, laboratory work, self-study.

Volume of classroom load: 4 hours.

Topic of laboratory work: «Preparation of the gun for painting and application scheme».

Compulsory items and means (equipment, materials, tools) – a computer and Internet access.

Brief annotation.

Pneumatic way of drawing a paint and varnish covering. Schemes of formation and flow of paintwork materials. Air gun spray systems. Typical distortions in the shape of the torch imprint.

Volume of self-study of applicants is 13 hours

Topics related to the self-study of the applicant.

Types of defects when applying paints and varnishes with pneumatic guns for painting. Repair painting technology. Stages of object preparation. Features of staining characteristic surfaces.

Modular control 2

Form of classes: writing a modular work in the classroom (by the decision of the lecturer, participation in the online form is allowed).

Volume of classroom load: 2 hours

Compulsory items and means (equipment, materials, tools) – absent.

Volume of self-study of applicant – if necessary.

Preparing for modular control.

5. Individual tasks

Not included in the curriculum.

6. Teaching methods

Verbal, visual, practical, reproductive (explanatory and illustrative). Conducting classroom lectures, laboratory classes, self-study of applicants based on materials published by the department (methodological aids).

7. Control methods

Control and evaluation of the quality of acquired knowledge, skills and practical skills of applicants is systemic, based on the principle of end-to-end control, which allows to ensure the relationship between all types of the educational process: lectures, laboratory, self-study of applicants, current control, exam.

Assessment of applicants' knowledge is carried out on the basis of the results of current control, written module control, final control in the form of an exam.

8. Evaluation criteria and distribution of points received by applicants

Distribution of points received by applicants (quantitative evaluation criteria)

Components of academic work	Components of academic work	Number of classes (tasks)	Total points
Content module 1			
Work in laboratory classes	0…2,5	8	0…20
Attendance and activity in lecture classes	0...1,25	8	0...10
Modular control	0…20	1	0…20
Content module 2			
Work in laboratory classes	0…2,5	8	0…20
Attendance and activity in lecture classes	0...1,65	6	0...10
Modular control	0…20	1	0…20
Semester total			**0…100**

Grading scale adopted

The sum of points	Score on a traditional scale	
	Exam, differentiated test	Test
90 – 100	Perfectly	Credited
75 – 89	Good	
60 – 74	Satisfactorily	
0 – 59	Unsatisfactorily	Not credited

The semester control (exam) is carried out if the applicant refuses the points of the current control and if he has admission to the exam (in the form of passing a set of laboratory works). For the delivery of laboratory work, a student can receive 40 points.

When taking the semester exam, the applicant has the opportunity to get a maximum of 60 points. The ticket for the exam consists of three theoretical questions. For a complete correct answer to theoretical questions, the applicant receives 20 points.

The effective assessment consists of the sum of points for theoretical and practical training.

Criteria for assessing the work of the applicant during the semester

Satisfactory (60-74). Have a minimum of knowledge and skills. Work out and defend all laboratory work. Be able to independently characterize the main types of corrosion, know the most common technologies for protecting parts from corrosion. Understand the designations of types of coatings in technical documentation.

Good (75–89). Firmly own a minimum of knowledge, complete all tasks. Show the ability to perform and defend all laboratory work within the time specified by the teacher with the rationale for the decisions and activities proposed in the work. Be able to select surface protection technology and methods of coating preparation and application, considering the technical requirements for parts and operating conditions. Be able to choose the right methods for removing the old coating and re-applying a protective layer on products during repairs.

Excellent (90-100). Full knowledge of basic and additional material. Know all topics. Focus on textbooks and instructions. Complete knowledge of all technologies used in the preparation, application and drying of surfaces of structural parts. Be able to use standards, reference books and methodological materials that regulate the technology of protective coatings.

9. Course Policy

Missed classes are made up in accordance with the schedule of consultations by prior agreement with the teacher. Questions relating to academic virtue are considered by the teacher or according to the procedure defined in the Regulations on Academic Virtue.

10. Methodological support

1. 1. Instructions for laboratory work of the departmental development (paper and electronic versions).
2. Course in the Mentor system: https://mentor.khai.edu/course/view.php?id=4387
3. Технология контроля защитных покрытий изделий авиационной и автомобильной техники [Текст]: учеб. пособие по лаб. практикуму / Ю.В. Дьяченко, Ю.А. Воробьев, В.В. Воронько и др. – Х.: Нац. аэрокосм. ун-т им. Н.Е. Жуковского «Харьк. авиац. ин-т», 2012. – 48 с.

11. Recommended resources

Basic

1. Davis, J.R. (2000) Corrosion: Understanding the Basics. ASM International, Materials Park.
2. Canosa, G. and Giudice, C. A. (2017) Introductory Chapter: Protection of Materials, New Technologies in Protective Coatings, http://dx.doi.org/10.5772/intechopen.69853.
3. Smith C. J. E., Higgs M.S. and Baldwin K. R. (1999) Advances in Protective Coatings and Their Application to Ageing Aircraft, Defence Evaluation and Research Agency Farnborough, United Kingdom.
4. Sukanchan Palit (2018) Recent Advances in Corrosion Science: A Critical Overview and a Deep Comprehension, Direct Synthesis of Metal Complexes, Elsevier, 379-411. https://doi.org/10.1016/B978-0-12-811061-4.00011-6

Auxiliary

1. Технология защитных покрытий изделий авиационной и автомобильной техники. Учеб. пособие. / Н.В. Нечипорук, Ю.В. Дьяченко, Ю.А. Воробьев, В.В. Воронько. – Х.: Нац. аэрокосм. ун-т им. Н.Е. Жуковского «Харьк. авиац. ин-т», 2011. – 180 с.

2. ДСТУ 2491-94. Покриття металеві та неметалеві неорганічні. Терміни та визначення. - Введ. 01.07.95. - К.: Держстандарт України, 1994. - 39 с.

3. Аналіз технологічних особливостей початкового і ремонтного фарбування виробів авіаційної техніки [Текст] / Ю. В. Д'яченко, І. О. Воронько, О.К. Горлов //Авіаційно-космічна техніка і технологія: зб. наук. пр. / М-во освіти і науки України, Нац. аерокосм. ун-т ім. М.Є. Жуковського «ХАІ». – Х., 2022. – № 5. – С. 21-39. http://nti.khai.edu/ojs/index.php/aktt/index

12. Informational resources

1. Protective Metal Coatings (MC) and Technology of MC Control https://www.youtube.com/watch?v=_GooouDDsIE&feature=youtu.be
2. Video_Oxide (OC) and Phosphate (PC) Coatings https://www.youtube.com/watch?v=YVA-mteqnXc
3. Protective and Decorative Properties of Lacquer Coatings (LC) https://www.youtube.com/watch?v=UuOd3HqyYPY
4. Department website: https://education.khai.edu/department/104