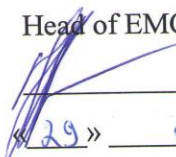


Ministry of Education and Science of Ukraine  
National Aerospace University named by M. Ye. Zhukovsky  
"Kharkiv Aviation Institute"

Department of Aircraft Manufacturing (#104)

**APPROVED**

Head of EMC 1

 Serhii NYZNYK

« 29 » 08 year 2023

**SYLLABUS  
OF EDUCATIONAL UNIT  
"TECHNOLOGIES OF AIRCRAFT MANUFACTURING"**

**D3, BELONGS TO THE MAJOR "AIRPLANES AND HELICOPTERS"**

**Field of Knowledge:** 13 "Mechanical Engineering"  
(Code And Name Of The Field Of Knowledge)

**Program Subject Area:** 134 "Aerospace Engineering"  
(Code And Name Of The Specialty)

**Educational Program:** "Design, Manufacture and Certification of Aircraft"  
(Name Of Educational Program)

**Training Mode:** Full-Time

**Level of Higher Education:** First (Bachelor)

**Kharkiv 2023**

Developers:

Olga SHYPUL, PhD, Associate Professor



Oleksiy PAVLENKO, PhD, Associate Professor



The syllabus was considered at the meeting of the Aircraft Manufacturing Department (#104)

Protocol № 1 from "28" August 2023

Head of the Department #104, PhD



Kateryna MAIOROVA

Agreed with the representative of education seekers:

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## **THE TEACHERS OF THE UNIT**

**Olga SHYPUL**, Ph.D., Associate Professor, Senior Researcher at the Department of Aircraft Manufacturing (#104) since 2003.

e-mail: o.shipul@khai.edu

*Teaching courses: Technologies of Aircraft Manufacturing, Simulations of Physics Processes, Experimental Research Methods in Technology of Aircraft Production, CAD/CAM/CAE systems and Modeling of Technological Process.*



*Research fields: Advanced finishing under the action of intense heat fluxes from combustible gases in closed chambers. Investigation of the strength characteristics of materials under the action of thermal pulse loads. Investigation of the electrical parameters of an advanced high-energy ignition system. Balance layout problem with the optimized distances between objects. Numerical and experimental investigation of exhaust release at thermal pulse deburring. Investigation of mixture formation to ensuring the quality. Development of a Digital Twin of reservoir filling by gas mixture component.*

**Oleksiy PAVLENKO**, Ph.D., Associate Professor, at the Department of Aircraft Manufacturing (#104) since 1988.

e-mail: alexey.pavlenko@khai.edu

*Teaching courses: Technologies of Aircraft Manufacturing, Basics of 3D Modelling, Computer Aided Design, Computer Aided Technologies, CAD of Technological Tooling.*



*Research fields: Worn out and Broken Machine Parts Reengineering Technologies, Computer Aided Machining, Recycling of Wastes after Machining, Sheet Metal Elastomer Forming.*

## **UNIT INFORMATION**

**Semester – 7.**

**The total number of ECTS credits – 4.**

**The total number of hours – 120**, including all activities related to the teaching, learning, and assessment of taught units.

**Planned types of educational activities** – lectures (32 hours), practical work (32 hours), individual work (56 hours), current tests and final exam. Each component is the time that the student spends in contact with the teaching staff, which includes activities such as lectures, laboratories, and practice. These activities may be online and could consist of activity that is synchronous (using real-time environments such as Google Meet, and BigBlueButton) or asynchronous (using tools via tutor-moderated Mentor System).

*Outside scheduled activities, students are expected to pursue their own independent learning to build their knowledge and understanding of the unit they are studying. Such independent activities include reviewing lecture material, reading*

*textbooks, working on example sheets, completing coursework, writing up laboratory notes, preparing for in-class progress tests, and revising for examinations.*

**The forms of education** – full-time, distance, dual.

**The language of teaching** – English.

**Pre-requisite units** – Mathematics; Physics; Theoretical Mechanics; Interchangeability and Standardization; Aviation Materials Science.

**Co-requisite units** – Mechanics of Materials and Structures; Technologies of Construction Materials; Theory of Mechanisms and Machines; Engineering Graphics; Basics of Interchangeability.

**The purpose of the unit:** acquisition by students of skills in designing and technological preparation of production of elements of aircraft designs with the use of three-dimensional systems of automated designing.

**The unit task:** a study of theoretical bases of automated design of products and equipment of aerospace equipment and acquisition of practical skills of modeling of aircraft structures in the CAD system.

**Acquired competences:**

- GC 04. Skills in using information and communication technologies.
- GC 06. Ability to generate new ideas (creativity).
- GC 07. Ability to make well-founded decisions.
- GC 08. Ability to learn and master modern knowledge.
- GC 17. Skills in the use of information and communication technologies and specialized software in education and professional activities.

**Expected learning outcomes:**

- PL04. Possess the means of modern information and communication technologies in an amount sufficient for training and professional activity.
- PL05. Explain your decisions and the grounds for their acceptance to specialists and non-specialists in a clear and unambiguous way.
- PL06. Possess the skills of self-study and autonomous work to improve professional skills and solve problems in a new or unfamiliar environment.
- PL16. To apply modern methods of design, construction and production of elements and systems of aviation and rocket and space technology in professional activities.

**Teaching** will be delivered through a combination of synchronous and asynchronous sessions, which may include lectures, practical activities supported by drop-in sessions, problem sheets and self-directed exercises.

**Assessment** During the study of the discipline, the following types of control are provided: current control during practical classes; defense the Calculation and Graphic Work, modular control during the semester; and/or the final control in the form of a written exam.

*Success as an undergraduate student depends on personal being able to make the transition to self-motivated, independent learning. The unit is designed to assist students in this development, starting with lessons in which timetabled teaching, such as lectures and practical classes, provides the foundations of knowledge and skills in a subject, moving on to individual research-based work. Over time students will be expected to take increasing responsibility for their own learning, guided by the feedback on their work that they will receive. At the heart of a student's studies at every*

*level, there must be regular and disciplined individual reading, reflection, making reports, and writing and it is this skill of independent studies, above all others, that will serve the student best when leaving the University.*

## **THE CONTENT OF THE DISCIPLINE**

### **Module 1.**

**Content module 1.** *Sheet metal stamping in production of aircraft parts.*

**Topic 1.** General characteristics of sheet metal stamping in production of aircraft parts. Aircraft part's features as an object of production by sheet metal stamping. General characteristics and operations of sheet metal stamping. Materials and semi-finished products used in manufacturing of aircraft parts by sheet metal stamping.

**Topic 2.** Production of flat blanks and parts by sheet metal stamping. Classification of processes of cutting of sheet preparations. Principals of optimal layout. Cutting of sheet material on scissors, milling, and in stamps. Structural solutions of dies for blanking-punching. Obtaining aircraft parts of a spatial form by bending, drawing, and stretch wrap forming. Forming of aircraft parts in stamps with elastic pads.

**Topic 3.** Features of manufacturing parts of aircraft objects from profiles and pipes. Stamping operations during the manufacture of parts of aircraft objects from profiles and pipes. Existing ways of bending profiles. Drawing and trimming profiles. Bending of profiles and sections with stretching. Rubber pad forming of the tubes.

**Topic 4.** Special stamping methods of semi-finished products and blanks of aircraft parts. Superplastic Forming (SPF) of Complex Sheet Metal Parts and Structures. High-energy methods of sheet metal stamping of aircraft parts – characteristics, existing shaping schemes, technological equipment and facilities.

**Individual Calculation and Graphical Work – Development of the technology elements for producing aircraft part by sheet metal stamping.**

*Typical Content:*

- 1. Structural and technological part analysis, choosing of a workpiece and scheme of stamping.*
  - 1.1. Examine the technological features of stamped parts (Structural and technological part analysis, choosing of a workpiece and scheme of stamping).*
  - 1.2. Allocate part on the workpiece-band and determine its dimensions (Consider the variety of allocation, using different dimensions of the sheet metal workpiece).*
  - 1.3. Determine the stamp scheme (Determine the number of technological steps required for stamping; provide sketches for stamp scheme and description for its operating features).*
- 2. Definition of energy-power parameters together with punch and die cavity executive dimensions.*
  - 2.1. Determine the total force for stamping (Evaluate the total force for stamping considering consumptions of energy for pushing out the part, sheet metal offcuts and losses on friction).*
  - 2.2. Evaluate the center of pressure of a stamp.*
  - 2.3. Evaluate the executive dimensions of punches and die cavities (Determine clearance between the punch and die cavity contour, evaluate their dimensions).*

### **Modular control 1**

**Content module 2.** *The technology of production of aircraft parts by dimensional processing.*

**Topic 1.** Theoretical bases of machining of parts. Basic principles of designing standard operations of machining and repair of aircraft parts. Types of technological processes of machining. Structural and technological features of standard parts machined on metal-cutting machines. The structure of the technological process of machining: operation, technological transition, working and auxiliary moves, institutions, position. Types of blanks and semi-finished products used for machining.

**Topic 2.** Evaluation of the efficiency of machining. Cutting modes, their definition, and selection methods. Accuracy of machining Operating allowance, its components, the order of its purpose, and the method of calculating the size of the workpiece. Basic principles of operation and structural elements of cutting tools. Cutting modes, their definition, and methods of selection, the impact on the efficiency of machining. Accuracy of machining, accuracy categories. Methods for assessing the accuracy of machining.

**Topic 3.** Features, methods, and types of mechanical surface treatment of aircraft parts with a blade tool in the repair of aircraft Features of processing on lathes of various surfaces. Cutting tools, types of lathes, and machine tools used for turning. Drilling. Features of the cutting process when drilling different holes. Technological features of processing of openings by countersinking, and development. Processing of parts by drawing. Milling, its types, and technological features.

**Topic 4.** Features, methods, and types of abrasive machining of surfaces of parts in the repair of aircraft. Grinding. Features of the grinding process, its types. Tools, equipment, and devices used for grinding. Honing and superfinishing. Significance of processes, their technological features, the tool used, and the edge of the application. Final and final methods of free abrasive treatment.

## **Modular control 2**

### **EVALUATION CRITERIA AND DISTRIBUTION OF POINTS**

Components of academic work	Points for one class (task)	Number of classes (tasks)	Total points
<b>Content module 1</b>			
Activity on lectures	0... 1	10	0... 10
Performing and defense of laboratory (practical) works	0... 5	3	0... 15
Implementation and protection of CGW	0...20	1	0...20
Modular control 1	0... 15	1	0... 15
<b>Content module 2</b>			
Activity on lectures	0... 1	10	0... 10
Performing and defense of laboratory (practical) works	0... 5	3	0... 15
Modular control 2	0... 15	1	0... 15
<b>Total for the semester</b>			<b>0... 100</b>

*The semester control (exam) is carried out in case of refusal of the student from points of current controls and in the presence of the permission to exam. During the semester controls the student has the opportunity to receive a maximum of 100 points. The exam ticket consists of two theoretical question. The maximum number of points for a complete answer to the first question - 50 points, and to the second question - 50 points, so totally - 100 points.*

*Grading scale: point and traditional*

Total points	Score on a traditional scale	
	Exam	credit
90 - 100	Excellent	Passed
75 - 89	Good	
60 - 74	Satisfactory	
0 - 59	Unsatisfactorily	Not Passed

### **CRITERIA FOR EVALUATING STUDENT WORK**

**Satisfactory (60-74).** Having a minimum of knowledge and skills. Work out and defend all laboratory works and individual tasks. Be able to independently determine the types of production. Know the basic operations of procurement and stamping production and dimensional processing. Know the rules of designing technological equipment.

**Good (75 - 89).** Firmly knowing and being able to perform the full range of tasks provided by the discipline. Demonstrate the ability to determine the quality of parts and assembly units by types of errors. Know the method of choosing the design parameters of stamped workpieces of aircraft parts. To be able to design technologies of sheet stamping and dimensional processing, and also means of technological equipment. To work out and defend all laboratory works and individual tasks in the term stipulated by the teacher with the substantiation of the decisions and actions which are offered in works.

**Excellent (90 - 100).** Fully knowing the basic and additional material of the discipline. Navigate in textbooks and manuals. Be able to determine the technological parameters of the production of parts by procurement and stamping production. It is reasonable to make constructive decisions about the type of stamp. Unmistakably perform and defend all laboratory work and individual tasks within the period specified by the teacher with a parted justification of the decisions and measures proposed in the works.

### **METHODOICAL SUPPORT**

1. Suchy, I. Handbook of Die Design, Second Edition. The McGraw-Hill Company (2005). – 711 p.
2. Boljanovic, V. Sheet metal forming processes and die design. Industrial Press Inc., New York (2004). – 219 p.
3. Hoffman, E. Jig and Fixture Design, Fifth Edition. Delmar, Cengage Learning, NY 12065 USA (2004). – 369 p.

4. Joshi, P. Jigs and Fixtures. Design Manual, Second Edition. The McGraw-Hill Company (2004). – 237 p.
5. Blanking processes in aircraft manufacturing. Part 2. Tutorial for laboratory work. Borysevykh V.V., Danchenko V.G., Zastela A.N., Mesheryakov A.N., Morgolenko A.S., Kharkiv, KhAI, 2009, 65p.

### **RECOMMENDED READING**

1. Basics of aircraft production technology (Lecture notes in English and Russian) / V.T. Sykul'sky, Yu.A. Boborykin, S.G. Vasilchenko et al. Kharkiv: KHAI, 2006. 205 p.
2. ASM Handbook. Volume 14B. Metalworking: Sheet forming, 2006. Printed in the United States of America. 1040p.
3. Manufacturing Solutions for The Aerospace Industry. Products Brochure // MAG IAS, LLC. 2015. [Electronic resource]. - Access mode: [http://exposant.technotheque.fr/files/docs/solutions-magdans-aeronautique\\_1294911440.pdf](http://exposant.technotheque.fr/files/docs/solutions-magdans-aeronautique_1294911440.pdf)

### **INFORMATION RESOURCES**

1. Educational and methodical support of the discipline [http://library.khai.edu/catalog?clear\\_all\\_params=0&mode=DocBibRecord&lang=ukr&caller\\_mode=BookList&themes\\_basket=&ttp\\_themes\\_basket=2099&ext=no&theme\\_path=0&author\\_fld=&docname\\_fld=&docname\\_cond=1&year\\_fld1=&year\\_fld2=&udc\\_fld=&isbn\\_fld=&lang\\_list=0&pubplace\\_fld=&publisher\\_fld=&bbc\\_fld=&issn\\_fld=&annotation\\_fld=&volume\\_fld=&part\\_fld=&responsibility\\_fld=&theme\\_cond=all\\_theme&littype\\_list=0&theme\\_list=0&disciplinesearch=yes&discipline\\_list=2099&tpage=1&step=20&faculty\\_list=0&department\\_list=4&speciality\\_list=0&knmz\\_doctype\\_list=39%2C40&speciality\\_knmz\\_list=27565&sillabus\\_list=0&knowledgearea\\_list=27554&qualificationlevel\\_list=27469&initiator\\_mode=KNMZ&full\\_searchfld=&ecopy=0&combiningAND=1&is\\_ttp=0&print\\_basket=%2C&docid=510530864&doctoselect=0](http://library.khai.edu/catalog?clear_all_params=0&mode=DocBibRecord&lang=ukr&caller_mode=BookList&themes_basket=&ttp_themes_basket=2099&ext=no&theme_path=0&author_fld=&docname_fld=&docname_cond=1&year_fld1=&year_fld2=&udc_fld=&isbn_fld=&lang_list=0&pubplace_fld=&publisher_fld=&bbc_fld=&issn_fld=&annotation_fld=&volume_fld=&part_fld=&responsibility_fld=&theme_cond=all_theme&littype_list=0&theme_list=0&disciplinesearch=yes&discipline_list=2099&tpage=1&step=20&faculty_list=0&department_list=4&speciality_list=0&knmz_doctype_list=39%2C40&speciality_knmz_list=27565&sillabus_list=0&knowledgearea_list=27554&qualificationlevel_list=27469&initiator_mode=KNMZ&full_searchfld=&ecopy=0&combiningAND=1&is_ttp=0&print_basket=%2C&docid=510530864&doctoselect=0)
2. Training course in the distance learning system Mentor: <https://mentor.khai.edu/course/view.php?id=2333>
3. Training course in the distance learning system Mentor: <https://mentor.khai.edu/course/view.php?id=885>
4. [https://t.me/aircraft\\_manufacturing](https://t.me/aircraft_manufacturing)
5. <https://www.esict.com/what-is-metal-stamping/>
6. <https://www.semanticscholar.org/paper/Cnc-Machining-Handbook%3A-Building%2C-Programming%2C-and-Overby/b343830ed1472b242fcb0726ad9ec8132e662f8a>
7. <https://www.esict.com/what-is-metal-stamping/>
8. Electronic library of the department №104: \\ Domik \ SHARED \ Methodical materials.