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

Head of EMC 1

_____ Serhii NYZNYK

«29» 08 year 2023

SILABUS OF ACADEMIC DISCIPLINE

«COMPUTER AIDED DESIGN OF TECHNOLOGICAL TOOLING (TERM PROJECT)»

MAJOR "Airplane Manufacturing Technologies"

(Discipline)

Field of Study: 13 «Mechanical Engineering»
(Code and Name of Field of Study)

Programme Subject Area: 134 «Aviation and aerospace technologies»
(Code and Name of Programme Subject Area)

Educational Program: «Design, Manufacture and Certification of Aircraft»
(Name of Educational Program)

Mode of study: Full-time

Level of Higher Education: First (bachelor)

Kharkiv 2023

Syllabus of academic discipline
«**COMPUTER AIDED DESIGN OF TECHNOLOGICAL TOOLING (TERM PROJECT)**»
(Name)
for students of the programme subject area 134 "Aviation and aerospace technologies",
the educational program "Design, production and certification of aviation equipment"

«_29_» ____08_____ 2023, – 12 p.

Developer:

Voronko I. O., PhD, Associate Professor of the Dep. #104
(surname and initials, position, academic degree, and academic title) (signature)
Myronova S. Yu., Senior Lecturer 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 (Sci. Degree and Acad. Title) (Signature) K. V. Maiorova (name and surname)

Agreed with the representative of the applicants for education:

_____ _____ _____
(Signature) (name and surname)

1. General information about the teacher

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

Myronova Svitlana, Senior Lecturer of the Department No. 104.
List of disciplines:
1. Introduction to the Major;
2. Aircraft Assembling;
3. Technologies of Aircraft Manufacturing;
4. Computer Aided Design of Technological Tooling;
5. Fundamentals of the Aircrafts Manufacturing Engineering;
6. Pre-Graduation Course;
7. Design-for-Manufacturing Systems in Aerospace Engineering.

Directions of scientific research:

1. Assembly and mounting work in aircraft manufacturing shops.
2. Development of the aircraft production in the modern aircraft industry.

Contact information – email: s.mironova@khai.edu

2. Description of the discipline

The semester in which the discipline is submitted is the 8th semester.
Volume of discipline:
2 ECTS credits (60 hours), including classroom – 12 hours, self-study – 48 hours.
Forms of education
full-time, remote, dual, part-time.
Discipline is elective.

Types of educational activities – practical work, self-study.

Types of control – final (semester) control (diff. test).

The language of instruction is English.

Mandatory preliminary disciplines (prerequisites) are required – Geometric Modelling and Graphic Information Technology, Fundamentals of 3D Modelling, Integrated Computer Aided Technologies, Theoretical Bases of Aircraft Manufacturing, Technologies of Aircraft Manufacturing (Stamping), Technologies of Aircraft Manufacturing (Machining).

Mandatory related disciplines (corrections) are required – CAD of Technological Tooling, Technologies of Aircraft Manufacturing (assembly unit).

3. The purpose and objectives of the discipline

The Purpose:

To teach how to reasonably apply the theoretical knowledge acquired by students while studying the course of disciplines in the Major "Airplane Manufacturing Technologies", to use the skills acquired by students during industrial practice, and also to develop skills in the practical application of computer-aided design systems for manufacturing technologies for aerospace parts.

The Task:

To develop the ability to independently analyze and make sound decisions about technology design issues in the manufacture of aerospace parts using computer-aided design (CAD) systems, the results of which are the development of prescriptive technological materials for the manufacture of aerospace parts by dimensional processing or sheet metal stamping.

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

C02. Ability to communicate in a foreign language.

C04. Skills in the use of information and communication technologies.

C05. Ability to work in a team.

C06. Ability to generate new ideas (creativity).

C07. Ability to make informed decisions.

C08. Ability to learn and master modern knowledge.

C16. Ability to develop and implement technological processes for the production of parts and objects of aviation equipment.

C17. Skills in the use of information and communication technologies and specialized software in training and 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.

PLO4. Own the means of modern information and communication technologies in an amount sufficient for training and professional activities.

PLO5. Explain your decisions and the decision's basis to specialists and non-specialists in a clear and unambiguous manner.

PLO6. Possess the skills of independent study and autonomous work to improve professional skills and solve problems in new or unfamiliar environments.

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.

PLO16. Use in professional activities modern methods of design, construction and production of elements and systems of aerospace and rocket engineering.

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.

4. The content of the discipline

Module 1.

Option 1. Term project «Developing of the sheet stamping technological process and designing of a cutting die».

Topic 1. Pre-designing of the die.

1.1 Designing of working elements of the die – die block and punches.

1.2 Arrangement of the die basic elements (guiding and fixing elements) in its working area. Selecting of die block parts (plates, columns, bushings).

1.3 Describing of die design and die operating.

1.4 Technology of die assembling.

Form of occupation: practical work, self-study.

Volume of classroom load: 4 hours.

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

Volume of self-study of applicants: 16 hours.

Topic 2. Die design in the selected CAD system, equipment selection.

2.1 Designing of die working area in CAD.

2.2 Designing of die block and die stack parts.

2.3 Press selecting.

2.4 Designing of die punches.

2.5 Designing of strip fixing system (stoppers, knives, additional punches) for die.

2.6 Designing of die parts fastening system (screws, pins, so on).

2.7 Designing of die auxiliary parts (like guiding pins in punches, tail shank, clamping and pushing devices).

Form of occupation: practical work, self-study.

Volume of classroom load: 6 hours.

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

Volume of self-study of applicants: 24 hours.

Topic 3. Documentation developing for the designed die and for sheet metal part technological process.

3.1 Development of working drawings of the die block and one of the punches in CAD, calculation of the die block and punches executive dimensions.

3.2 Creating and editing of die parts list in CAD.

Form of occupation: practical work, self-study.

Volume of classroom load: 2 hours.

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

Volume of self-study of applicants: 8 hours.

Option 2. Term project «Working out of a technological process of machining and designing of the special machining jig for the part».

Topic 1. Pre-designing of jig for machining.

1.1 Calculate the cutting force and the clamping force for the part in the jig for drilling/milling/turning operation.

1.2 Design special jig after calculating the locating errors of part in the jig.

1.3 Describe the jig design and jig operating.

Form of occupation: practical work, self-study.

Volume of classroom load: 4 hours.

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

Volume of self-study of applicants: 16 hours.

Topic 2. Working out of a technological route for part manufacturing by machining.

2.1 Calculate allowances for each processing step and determine the dimensions of the blank.

2.2 Selection of processing bases for each operation and work out the chart of sketches for locating the part during the processing.

2.3 Work out the technological route for the part processing.

2.4 Create the 3D models of the part and blank. Generate drawings of the part and blank using 3D models.

Form of occupation: practical work, self-study.

Volume of classroom load: 6 hours.

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

Volume of self-study of applicants: 20 hours.

Topic 3. Working out of the machining technological operations modes and designing of the special jig for the part machining.

3.1 Work out one of processing operations of the part machining in details. Develop technological chart for CNC processing.

3.2 Create a 3D model of special jig for drilling/milling/turning operation, describe its design and operating principles. Generate an assembly drawing of the jig using computer model.

Form of occupation: practical work, self-study.

Volume of classroom load: 2 hours.

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

Volume of self-study of applicants: 12 hours.

5. Individual tasks

Not included in the curriculum.

6. Teaching methods

Verbal, visual, practical, explanatory and illustrative. Conducting classroom practical classes, self-study of applicants based on materials collected during introductory and practical trainings and 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 carried out during practical lessons and consultations.

Assessment of applicants' knowledge is carried out on the basis of the results of current control and final control in the form of the differentiated test.

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 practical classes	0…1	16	0…16
Evaluation of reporting graphic material and drawings	0…34	-	0…34
Evaluation of the explanatory note	0…20	-	0…20
Term project defense	0…30	-	0…30
Total			**0…100**
Content module 2			
Work in practical classes	0…1	16	0…16
Evaluation of reporting graphic material and drawings	0…34	-	0…34
Evaluation of the explanatory note	0…20	-	0…20
Term project defense	0…30	-	0…30
Total			**0…100**

The final control (differentiated test) is carried out if there is an admission (graphic material, drawings, explanatory note). When defending the project, the student receives questions on the content of the prepared reporting material, the quality and completeness of the answers and the submitted materials are assessed. The effective assessment consists of the arithmetic mean of several assessments of the course teachers (members of the commission).

Criteria for assessing the work of the applicant during the semester.

Satisfactory (60-74). Have a minimum of knowledge and skills. Attend most of the practical and consulting classes. Be able to independently characterize the main composition of the operations of modern technological methods for manufacturing parts. Be able to draw up technical documentation for jig (die block) for the manufacture of aircraft parts by machining (stamping).

Good (75–89). Firmly know the minimum knowledge, complete all tasks. Be able to design the special machine jig (die block for sheet stamping) considering the technical requirements for the part and production conditions. To be able to choose the right methods for manufacturing the workpiece, depending on the production conditions and the design of the part.

Excellent (90-100). Full knowledge of basic and additional material. Know all topics. Focus on standards and guidelines. Know in detail all the technologies that are used in the manufacture of aircraft parts. Be able to use the composition of standards, reference books and methodological literature governing the design of technological processes, tools, jigs (die blocks) and the selection of equipment.

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

9. Course Policy

Consulting classes are held 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. Instructions for the course design of the departmental development (paper and electronic versions).
2. Training course in the distance learning system Mentor: https://mentor.khai.edu/course/view.php?id=713;
3. Design of special machine retaining devices: study guide for term paper and diploma designing / V.T. Sikul'sk iy, Yu.V. Dyachenko, S.D. Proskurin and others – Kharkiv: National aerospace university "Kharkiv aviation institute", 2010. – 64 p.
4. Ivana Suchy (2005). Handbook of Die Design 2nd edition. Sheet Metal Stamping and Die Design. Useful both for beginners and engineers. 712 p.
5. Special equipment and Technologies in Aviation Production [Electronic resource]: study guide / V. V. Kollierov, Yu. V. Diachenko, V. T. Sikulsky et al. – Kharkiv : National Aerospace University named after M. Ye. Zhukovsky "Kharkiv Aviation Institute", 2019. – 71 p.

6. Technology of Aircraft Parts Manufacturing by Dimensional Machining: навч. посібник з лаб. практикуму / В. Т. Сікульський, Ю. В. Д'яченко, В. П. Божко, В. В. Воронько, В. В. Борисевич, С.Д. Проскурін, І.О. Воронько; М-во освіти і науки України, Нац. аерокосм. ун-т ім. М. Є. Жуковського "Харк. авіац. ін-т". - Харків, 2017. - 180 с.

7. Технологія виготовлення деталей літальних апаратів з видаленням припуску. Ч. 1 [Електронний ресурс]: підручник / Ю. В. Д'яченко, В. Т. Сікульський, І. О. Воронько, О. К. Горлов, К. В. Майорова, С. Ю. Миронова, О. В. Шипуль. – Харків: Нац. аерокосм. ун-т ім. М. Є. Жуковського «Харків. авіац. ін-т», 2023. – 232 с.

8. Технологія виробництва деталей літальних апаратів розмірною обробкою [Електронний ресурс]: навч. посібник до лабораторного практикуму та практ. занять / Ю. В. Д'яченко, В. Т. Сікульський, І. О. Воронько, К. В. Майорова., С. Ю. Миронова – Харків: Нац. аерокосм. ун-т «Харк. авіац. ін-т», 2023. – 88 с.

9. Спеціальні технології, обладнання і оснащення авіаційного виробництва : навч. посіб. / В. В. Коллєров, Ю. В. Д'яченко, В. Т. Сікульський, А. С. Морголенко, І.О. Воронько, В.О. Гарін; М-во освіти і науки України, Нац. аерокосм. ун-т ім. М. Є. Жуковського "Харк. авіац. ін-т". - Харьков. - Нац. аэрокосм. ун-т им. Н. Е. Жуковского "Харьк. авиац. ин-т", 2017. - 72 с.

10. Штампи та прес-форми, конструювання та технологія виготовлення: навч. Посібник / С.В. Швець, Л.М. Сєдінкін; М-во освіти і науки України, СумДУ. - Суми, 2005. - 110 с.

11. Recommended resources

Basic

1. Design of special machine retaining devices: study guide for term paper and diploma designing / V.T. Sikul'sk iy, Yu.V. Dyachenko, S.D. Proskurin and others – Kharkiv: National aerospace university "Kharkiv aviation institute", 2010. – 64 p.

2. Ivana Suchy (2005). Handbook of Die Design 2nd edition. Sheet Metal Stamping and Die Design. Useful both for beginners and engineers. 712 p.

3. Special equipment and Technologies in Aviation Production [Electronic resource]: study guide / V. V. Kollierov, Yu. V. Diachenko, V. T. Sikulsky et al. – Kharkiv : National Aerospace University named after M. Ye. Zhukovsky "Kharkiv Aviation Institute", 2019. – 71 p.

4. Technology of Aircraft Parts Manufacturing by Dimensional Machining : навч. посібник з лаб. практикуму / В. Т. Сікульський, Ю. В. Д'яченко,

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Auxiliary

5. Технологія виготовлення деталей літальних апаратів з видаленням припуску. Ч. 1 [Електронний ресурс]: підручник / Ю. В. Д'яченко, В. Т. Сікульський, І. О. Воронько, О. К. Горлов, К. В. Майорова, С. Ю. Миронова, О. В. Шипуль. – Харків: Нац. аерокосм. ун-т ім. М. Є. Жуковського «Харків. авіац. ін-т», 2023. – 232 с.

6. Технологія виробництва деталей літальних апаратів розмірною обробкою [Електронний ресурс]: навч. посібник до лабораторного практикуму та практ. занять / Ю. В. Д'яченко, В. Т. Сікульський, І. О. Воронько, К. В. Майорова., С. Ю. Миронова – Харків: Нац. аерокосм. ун-т «Харк. авіац. ін-т», 2023. – 88 с.

7. Спеціальні технології, обладнання і оснащення авіаційного виробництва: навч. посіб. / В. В. Коллєров, Ю. В. Д'яченко, В. Т. Сікульський, А. С. Морголенко, І.О. Воронько, В.О. Гарін; М-во освіти і науки України, Нац. аерокосм. ун-т ім. М. Є. Жуковського "Харк. авіац. ін-т". - Харьков. - Нац. аэрокосм. ун-т им. Н. Е. Жуковского "Харьк. авиац. ин-т", 2017. - 72 с.

8. Штампи та прес-форми, конструювання та технологія виготовлення: навч. Посібник / С.В. Швець, Л.М. Сєдінкін; М-во освіти і науки України, СумДУ. - Суми, 2005. - 110 с.

9. Voronko, I.O. (2021). The main types of machining in the aircraft industry. In: European ways of the development of modern engineering research: Collective monograph. Riga, Latvia: “Baltija Publishing” pp. 55-87. [in Ukrainian]. https://doi.org/10.30525/978-9934-26-142-8-3

12. Informational resources

1. Electronic Library of the National Aerospace University "KhAI": http://library.khai.edu;

2. Google drive with teaching materials of the department: https://drive.google.com/drive/folders/1qKO8JqpayKrcHnIAutqKZTnk77uRSltj;

3. Department website: https://k104.khai.edu/