MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
«Igor Sikorsky Kyiv Polytechnic Institute»

APPROVED
Academic Council of
Igor Sikorsky Kyiv Polytechnic Institute
(Protocol №10 from 13.12. 2021)
Head of the Academic Council
Mykhailo ILCHENKO

Aerospace and Rocket Systems Engineering

EDUCATIONAL AND PROFESSIONAL PROGRAM

the first (Bachelor) level of higher education

specialty	**134 Aerospace and rocket-space technology**
field of knowledge	**13 Mechanical engineering**
qualification	**Bachelor in Aerospace and rocket-space technology**

Put into effect from 2022/2023 e.y.
by order of the Rector
Igor Sikorsky Kyiv Polytechnic Institute
from 15.02.2022 №НОН/75/2022

Kyiv – 2021

PREAMBLE

DEVELOPED by the project team:

The project team chairman

Oleksandr Arhipov, Doctor of Technical Sciences, Professor,
Professor of the Department of Space Engineering. Guarantor of Bachelor program «**Aerospace and Rocket Systems Engineering**»

The project team members:
Ivan Korobko Doctor of Technical Sciences, Director of the Institute of Aerospace Technologies

Vitaliy Suhov Doctor of Technical Sciences, Professor, Professor of the Department of Aircraft and Rocket Engineering

Oleksandr Marynoshenko PhD in Engineering sciences, Associate Professor , acting Head of the Department of Space Engineering,

Oleksandr Bondarenko, PhD in Engineering sciences, Associate Professor of the Department of Aircraft and Rocket Engineering

Petro Yakovenko Chief Designer, Leader of the Design Department State Enterprise “Derzh KKB “Luch”

Ihor Luchko Enginner of organization “AEROPRACT”

AGREED:
Scientific and methodical commission of Igor Sikorsky KPI on specialty
134 " Aerospace and rocket systems engineering":

Head SMC 134 **Volodymyr KABANYACHYI**
(Protocol №2 from 03.12.2021)

Methodical Council of Igor Sikorsky Kyiv Polytechnic Institute

Deputy Head of the Methodical Council **Anatolii MELNYCHENKO**
(Protocol №2 from 09.12.2021)

INCLUDED:

Propositions of the enterprises in the field of aviation and space engineering of Ukraine and main development trends in specialty, labor market, branch and regional context, experience of Ukrainian (KAI, DNU) and foreign (European and American) educational programs in the same field. The educational program was discussed with the students

Recommendations for educational program update and peculiarities of curriculum development of Bachelor training (Order of Igor Sikorsky Kyiv Polytechnic Institute № НОН/35 /2020 «Improvement of educational program of the first level (bachelor) of higher education") and change of compulsory and selective education components

The results of self-analysis of the 2021 education program are considered

Recommendations of regulation and specification of multi-credits education components in semesters are considered

Update of the education program was coordinated with the stakeholders; obtained positive references are actual

Petro Yakovenko chief designer, leader of the design department State Enterprise "Derzh KKB "Luch"; Ihor Luchko Engineer of organization "AEROPRACT"

The education program was discussed after receiving all the wishes and suggestions and approved at a meeting of the Department of space engineering (protocol №14/21 from 24.11.2021).

CONTENT

1. Profile of the education program……..…… 5
2. List of components of the education program…….....…… 10
3. Structural and logical scheme of the education program…….....…… 12
4. Form of certification of applicants for higher education..…….....……. 13
5. Matrix of program competences correspondence to the components of the education program…….....…… 13
6. Matrix for providing program learning outcomes with relevant components of the education program……..... 14

1. Profile of the educational program

1 – General information	
Full name of HEI and institute / faculty	National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Institute of Aerospace Technologies
Degree of higher education and title of qualification in the original language	Degree of HE – Bachelor Educational qualification –Bachelor in Aerospace and rocket-space technology
The official name of the EP	Aerospace and Rocket Systems Engineering
Type of diploma and scope of EP	Bachelor Diploma, single, 240 ECTS credits, training period 3 year and 10 months
Availability of accreditation	accreditation certificate of specialty UD 11010593, valid till 01.07.2029
Cycle/level of higher education	NQF of Ukraine – level 6 QF-EHEA – 1st cycle EQF-LLL – level 6
Prerequisites	The presence of senior secondary education
Language (s) of teaching	Ukrainian/ English
Validity of the EP	Until the next accreditation
Internet address of the permanent placement of the educational program	https://osvita.kpi.ua/op, http://iat.kpi.ua

2 – The purpose of the educational program

The purpose of the education program is to train specialists who able to solve difficult specialized and practical problems in the area of aerospace and rocket-space technology.

The purpose of the education program corresponds the development strategy of Igor Sikorsky Kyiv Polytechnic Institute for the period 2020-2025 based on the vision and mission.

Vision is to create conditions for training highly qualified specialists capable to formulate modern scientific knowledge and develop innovative technologies for the benefit of mankind and to ensure the proper position of Ukraine in the world community.

Mission is to make considerable contribution to the sustainable development of society by means of internationalization and integration of education, new scientific researches and innovative developments. It is necessary to create conditions for the comprehensive professional, intellectual, social and creative development of the person in the educational and scientific environment.

3 – Characteristics of the education program	
Subject area	**Objects of study** - phenomena and problems related to the stages of the life cycle of aerospace and rocket-space technology. **Purpose of study** - is to train specialists able to solve complex specialized and practical problems dealing with the development, manufacturing and certification of aerospace and rocket-space technology, its engines and power plants, structures and systems characterized by the uncertainty of conditions. **Theoretical content of subject area** are theoretical basics of development and manufacturing of aerospace and rocket-space objects and technologies.

	Methods, techniques and technologies - analytical, numerical and experimental methods of research of problems of the subject area, especially integrated computer technologies, techniques and technologies dealing with the stages of the life cycle of aerospace and rocket-space technology. **Tools and equipment** - laboratory measuring equipment with measuring facilities i.e. hydraulic stands, wind tunnels, equipment for investigation of materials properties, stress-strain state of constructions; tools and equipment for studying structure of airplanes, helicopters, rockets, engines and power plants, onboard, navigation, electric equipment; equipment for manufacturing, assembling and testing of aerospace and rocket-space objects, computers with information and specialized software for calculation and geometrical modelling, finite-element analysis, integrated design and production of aerospace and rocket-space technology.
Orientation of the EP	Educational and professional It is focused on rocket and space vehicles design and aerospace engineering.
The main focus of EP	The program is based on the common scientific statements including the current state of aerospace branch development. The program focuses on actual information and manufacturing technologies facilitating further professional and scientific career. Key words: rockets, space vehicles, airspace engineering
Features of EP	Program realization implies the engaging of practitioners and experts in the professional field, employer representatives to teach students. Practice and part-time employment starting from the 3rd year of study are conducted at profile enterprises. Some disciplines are taught in foreign language.
4 – Suitability of graduates for employment and further study	
Suitability for employment	SC 003:2010, Codes: 3115 Technical mechanic, 3121 Technician-programmer
Further training	Continuing study at the second (master) level of higher education and / or obtaining additional qualifications in post graduate study.
5 – Teaching and assessment	
Teaching and learning	Lectures, seminars, practical classes, computer practicums, laboratory work, course projects and works, practice and excursions, diploma project are the main forms of study.
Assessment	The accomplishment and defense of laboratory and practical work, calculation and graph work, reports, written and oral exams and the defense of qualification work are evaluated. The assessment of students' knowledge is performed according to the Rating system of assessment adopted by Igor Sikorsky Kyiv Polytechnic Institute including all forms practical and self-directed study. Final attestation is presented in the form of diploma project.
6 – Program competences	
Integral competence	Ability to solve complex specialized and practical problems dealing with the development, manufacturing and certification of aerospace and rocket-space technology, which implies the application of theories and methods of physics, mathematics and engineering sciences and characterized by the complexity and uncertainty of conditions.
General competences (GC)	
GC 1	Ability to use Ukrainian language for written and oral communication
GC 2	Ability to use foreign language for communication

GC3	Ability to carry out safe activity and aspiration to save environment.
GC 4	Ability to use information and communicative technology
GC 5	Ability to work in team
GC 6	Ability to generate new ideas (creativity)
GC 7	Ability to make reasonable decisions.
GC 8	Ability to study and master modern knowledge.
GC 9	Ability to realize duties and responsibilities as a member of society, values of free democratic society and the necessity of its sustainable development, supremacy of law, rights and freedoms of human and citizen of Ukraine.
GC 10	Ability to save and enrich moral, cultural, scientific values and achievements based on the knowledge of history and trends of subject area development, its place in the common system of knowledge about nature and society and society development, technics and technologies, apply different kinds and forms of physical activity for leisure and healthy life style.
GC 11	Ability to work autonomously.
GC 12	Ability to organize and use collaborative discussions of methods for solving unusual design problems.
GC 13	Ability to interpersonal relation.
Professional competences (PC)	
PC 1	Ability to use the theory of flight dynamics and control at designing of aerospace and rocket-space technology
PC 2	Ability to use knowledge of hydraulics, air and gas dynamics to describe the interaction of bodies with gas and hydraulic environment
PC 3	Ability to choose the optimal materials for the construction components of aircraft and rocket and space technology.
PC 4	Ability to calculate the strength of components of aircraft and rocket and space technology
PC 5	Ability to design and test the components of aircraft and rocket and space technology, its equipment, systems and subsystems
PC 6	Ability to develop and implement technological processes of aircraft and rocket and space technology manufacturing
PC 7	Skills to use information and communicative technologies and specialized software in studying and professional activity
PC 8	Ability to consider economic and managerial aspects of aircraft and rocket and space technology manufacturing in professional activity
PC 9	Ability to develop general construction of aircraft and rocket and space technology
PC 10	Ability to carry out diagnostics and testing of aircraft and rocket and space technology and its vibrational protection
PC 11	Ability to determine the optimal type and parameters of rocket and space vehicle power plant
PC 12	Ability to plan wind tunnel experiments and to control their implementation
PC 13	Ability to provide metrological support, standardization and certification of structural elements of rocket and space vehicles by means of calculation methods and considering technological and functional interchangeability
PC 14	Skills to use integral technologies of computer design and modeling of aircraft and rocket and space systems and elements
7 – Program results of learning	
PRL 1	Ability to know aerodynamic modeling and assess rocket parameters by means of specialized computer means and wind tunnel experiments
PRL 2	Knowledge of development methods of modern applied software for conducting quick nonstandard calculation or analyzing huge amounts of data
PRL 3	Understand environmentally dangerous and harmful factors of professional activity and regulate its content in order to avoid negative effect on environment

PRL 4	Understand the principles of gas and liquid mechanics, as well as, hydraulics, aerodynamics (gas dynamics)
PRL 5	Understand the features of working processes in hydraulic, pneumatic, electric and electronic systems, servo motors used in aircraft and rocket and space technology
PRL 6	Understand and reason the sequence in design, production, testing and/or certification of aircraft and rocket and space objects and elements at all stages of their life cycle.
PRL 7	Understand the structure and principles of operation of onboard and navigation equipment of aircraft and rocket and space technology
PRL 8	Understand and reason the features of structure based on main aspects of working processes in aircraft and rocket and space elements and systems
PRL 9	Understand the theoretical principles and practical methods of equipment support of components interchangeability of aircraft and rocket and space technology
PRL 10	Describe the models and stress-strain state of aircraft mechanical structures and elements by means of modern integral technologies of computer design
PRL 11	Develop the structure of rocket and space vehicles
PRL 12	Calculate the power plants of rockets and space vehicles: pulse engines, gas and gas turbine engines, flywheel engines, liquid and solid fuel rocket engines, solar batteries, generators, servo motors.
PRL 13	Conduct diagnostics and nondestructive control of flying vehicles elements.
PRL 14	Master the modern means of information and communicative technologies in the amount sufficient for studying and professional activity.
PRL 15	Acquire logics and methodology of scientific cognition based on understanding of modern state and methodology of subject area
PRL 16	Describe metals and nonmetals and know modification methods of their properties. Determine optimal materials for aircraft and rocket and space elements considering their structure, physical, mechanical, chemical and operational properties, as well as, economic factors
PRL 17	Describe experimental research methods of structural, physical and mechanical technological properties of materials and structures.
PRL 18	Apply modern methods of modeling, design and manufacturing of aircraft and rocket and space elements and systems
PRL 19	Acquire skills of determining structural elements stress of aircraft and rocket and space technology at all stages of their life cycle
PRL 20	Calculate stress-strain state, determine carrying capacity of structural elements and reliability of aircraft and rocket and space technology
PRL 21	Skills to develop technological processes using computer aided design to manufacture the structural components of aircraft and rocket and space technology
PRL 22	Explain the influence of structural parameters of rocket and space vehicles on their performance. Know methods of stability and controllability of aircraft and rocket and space technology
PRL 23	Ability to use Ukrainian and foreign languages for fluent oral and written communication in professional activity
PRL 24	Explain solutions and give arguments in their favor in reasonable and clear form
PRL 25	Skills for self-directed study and autonomous work for increasing professional qualification and solving the problems in new and unknown environment
PRL 26	Formulate the reasonable assessment of governmental organizations activity, political institutions from the point of view of mankind, democratic values, human rights and freedoms priority
PRL 27	Follow the requirements of branch documentation dealing with the design procedures, manufacturing, testing and/or certification of aircraft and rocket and space systems and their elements at all stages of life cycle
PRL 28	Assess economic efficiency of manufacturing of aircraft and rocket and space systems and elements

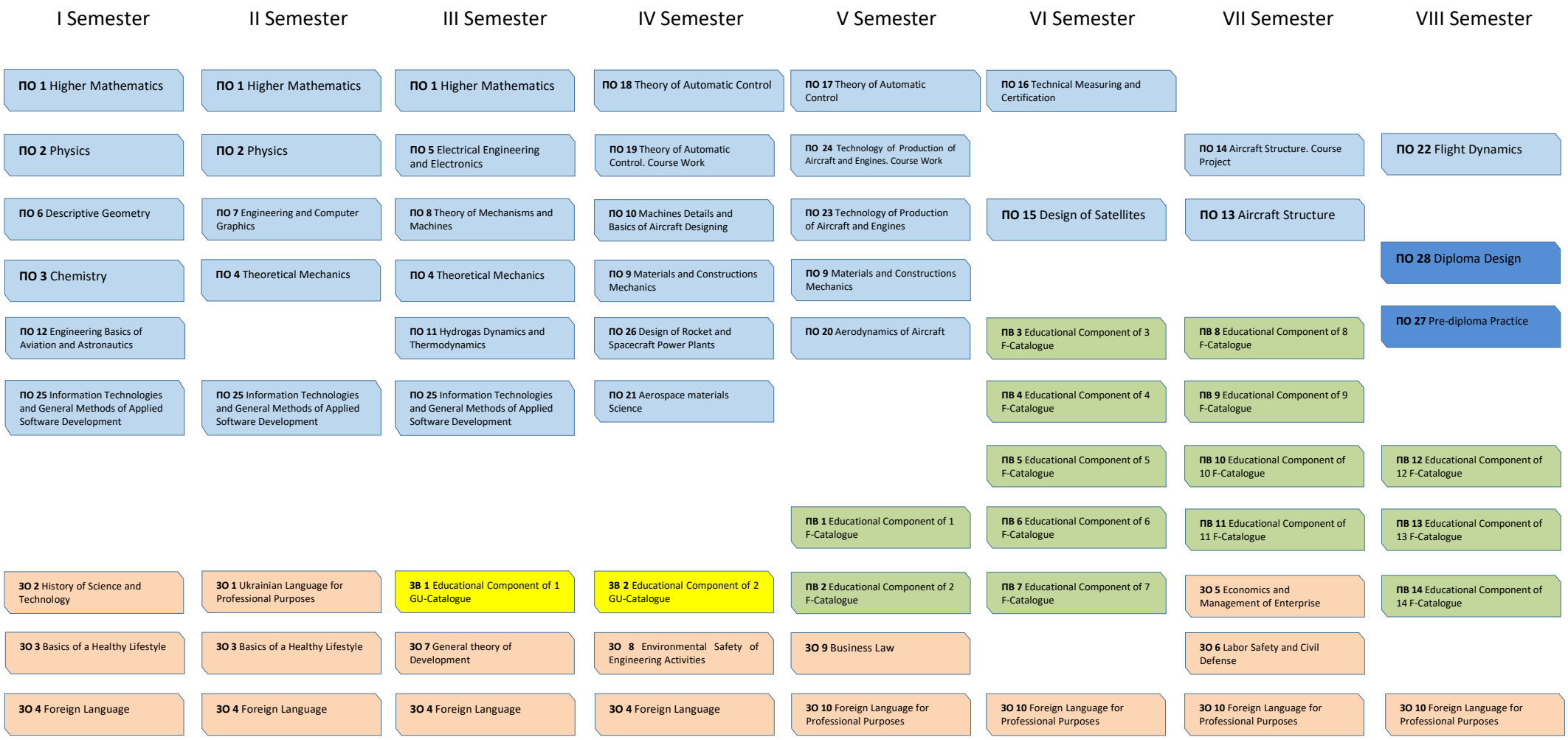
8 – Resource support for program implementation	
Staffing	Exchange programs of students and lecturers between partner universities, coordination of the content of disciplines with the related disciplines of profile educational institutions are possible. It meets the requirements of staffing of providing education activity for the particular level of higher education adopted by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 in the current version. The provision of education process is performed by the staff of the department consisting of 3 professors, Doctor of sciences; 4 assistant professors with PhD; 1 senior teacher and 1 assistant.
Material and technical support	In accordance with the technological requirements for material and technical support of education activities of the particular level of higher education, approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 in the current version. The education process of specialists training is fully provided of studying areas, necessary equipment, computer equipment, specialized laboratories, and access to information resources. Three computer laboratories such as diagnostic laboratory, laboratory of aviation technique samples with the military and transport airplanes, helicopter, units and mechanisms and laboratory for both students and organization "Firefly Aerospace" are used.
Information and education and methodical support	In accordance with the technological requirements for education and methodological and information support of education activities of the particular level of higher education approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187 in the current version. Applicants of higher education use information resources and studying environment of KPI library, Campus and education resources of Sikorsky platform, sites of the departments.
9 – Academic Mobility	
National credit mobility	Agreement on academic mobility is signed with Dnipro National University
International credit mobility	Students take part in the programs of academic mobility (Erasmus + KI) with the University of the Basque Country (Spain), Warsaw University of Technology (Poland), ENS Lyon (France).
Training of foreign applicants of higher education	Foreign students have the ability to study in separate groups in English with the studying of Ukrainian as a foreign language. In mixed groups they are trained in Ukrainian language.

2. List of components of education program

Code	Components of education program (academic disciplines, course projects / works, practices)	Number of ECTS credits	Form of final control
1	2	3	4
Compulsory (regulatory) components of the EP			
General training cycle			
ЗО 1	Ukrainian Language for Professional Purposes	2	Test
ЗО 2	History of Science and Technology	2	Test
ЗО 3	Basics of a Healthy Lifestyle	3	Test
ЗО 4.1	Foreign Language. Part 1	3	Test
ЗО 4.2	Foreign Language. Part 2	3	Test
ЗО 5	Economics and Management of Enterprise	4	Test
ЗО 6	Labor Safety and Civil Defense	4	Test
ЗО 7	General theory of Development	2	Test
ЗО 8	Environmental Safety of Engineering Activities	2	Test
ЗО 9	Business Law	2	Test
ЗО 10.1	Foreign Language for Professional Purposes. Part 1	3	Test
ЗО 10.2	Foreign Language for Professional Purposes. Part 2	3	Exam
Professional training cycle			
ПО 1.1	Higher Mathematics. Part 1. Differential Calculus. Analytic Geometry. Linea Algebra.	7	Exam
ПО 1.2	Higher Mathematics. Part 2. Integral Calculus	7	Exam
ПО 1.3	Higher Mathematics. Part 3. Differential Equations. Analytic Functions	4	Exam
ПО 2.1	Physics. Part 1. Mechanics. Molecular Physics.	5	Exam
ПО 2.2	Physics. Part 2. Electromagnetism. Optics. Atomic Physics.	5	Exam
ПО 3	Chemistry	3	Test
ПО 4.1	Theoretical Mechanics. Part 1. Statics. Kinematics.	6	Exam
ПО 4.2	Theoretical Mechanics. Part 2. Dynamics.	4	Exam
ПО 5	Electrical Engineering and Electronics	3	Test
ПО 6	Descriptive Geometry	4	Exam
ПО 7	Engineering and Computer Graphics	4	Test
ПО 8	Theory of Mechanisms and Machines	4	Test
ПО 9.1	Materials and Constructions Mechanics. Part 1. Basic Course	3	Test
ПО 9.1	Materials and Constructions Mechanics. Part 2. Stiffness and Stability of Complex Elastic Systems	4,5	Exam
ПО 10	Machines Details and Basics of Aircraft Designing	5	Exam
ПО 11	Hydrogas Dynamics and Thermodynamics	6,5	Exam
ПО 12	Engineering Basics of Aviation and Astronautics	3	Test
ПО 13	Aircraft Structure	4	Exam
ПО 14	Aircraft Structure. Course Project	1,5	Test
ПО 15	Design of Satellites	5	Exam
ПО 16	Technical Measuring and Certification	4	Exam
ПО 17	Metrology and Standardization	4	Exam
ПО 18	Theory of Automatic Control	5	Exam
ПО 19	Theory of Automatic Control. Course Work	1	Test
ПО 20	Aerodynamics of Aircraft	4,5	Test
ПО 21	Aerospace materials Science	4	Test

Code	Components of education program (academic disciplines, course projects / works, practices)	Number of ECTS credits	Form of final control
1	2	3	4
ПО 22	Flight Dynamics	3,5	Exam
ПО 23	Technology of Production of Aircraft and Engines	4	Exam
ПО 24	Technology of Production of Aircraft and Engines. Course Work	1	Test
ПО 25.1	Information Technologies and General Methods of Applied Software Development. Part 1. Basics of Programming	3	Test
ПО 25.2	Information Technologies and General Methods of Applied Software Development. Part 2. General methods of Applied Software Development	3	Test
ПО 25.3	Information Technologies and General Methods of Applied Software Development. Part 3. Microprocessor Technique.	3	Test
ПО 26	Design of Rocket and Spacecraft Power Plants	6,5	Exam
ПО 27	Pre-diploma Practice	6	Test
ПО 28	Diploma Design	6	Defense
Selective components of EP			
General training cycle			
ЗВ 1	Educational Component of 1 GU-Catalogue	2	Test
ЗВ 2	Educational Component of 2 GU-Catalogue	2	Test
Professional training cycle			
ПВ 1	Educational Component of 1 F-Catalogue	4	Test
ПВ 2	Educational Component of 2 F-Catalogue	4	Test
ПВ 3	Educational Component of 3 F-Catalogue	4	Test
ПВ 4	Educational Component of 4 F-Catalogue	4	Test
ПВ 5	Educational Component of 5 F-Catalogue	4	Test
ПВ 6	Educational Component of 6 F-Catalogue	4	Test
ПВ 7	Educational Component of 7 F-Catalogue	4	Test
ПВ 8	Educational Component of 8 F-Catalogue	4	Test
ПВ 9	Educational Component of 9 F-Catalogue	4	Test
ПВ 10	Educational Component of 10 F-Catalogue	4	Test
ПВ 11	Educational Component of 11 F-Catalogue	4	Test
ПВ 12	Educational Component of 12 F-Catalogue	4	Test
ПВ 13	Educational Component of 13 F-Catalogue	4	Test
ПВ 14	Educational Component of 14 F-Catalogue	4	Test
Total amount of compulsory education components:		**180**	
The total amount of selective education components:		**60**	
The volume of educational components **that ensure the acquisition of competencies of certain CSOs**		**147**	
TOTAL AMOUNT OF EDUCATION PROGRAM COMPONENTS		**240**	

3. Structural and logical scheme of education program



4. Form of certification of applicants for higher education

Graduation certification of higher education applicants in the education program " Aerospace and rocket systems engineering" specialty 134 " Aerospace and rocket-space technology" is carried out in the form of defense of the qualification work and ends with the issuance of a standard document conferred Bachelor degree with qualification: Bachelor in Aerospace and rocket-space technology. The qualification work is checked for plagiarism and is placed in the repository of the NTB of the University for free access after the defense.

Graduation certification is open and public.

5. Matrix of program competences correspondence to the components of education program

	ЗО 1	ЗО 2	ЗО 3	ЗО 4	ЗО 5	ЗО 6	ЗО 7	ЗО 8	ЗО 9	ЗО10	ПО1	ПО2	ПО3	ПО4	ПО5	ПО6	ПО7	ПО8	ПО9	ПО10	ПО11	ПО12	ПО 13	ПО 14	ПО 15	ПО 16	ПО 17	ПО 18	ПО 19	ПО 20	ПО 21	ПО 22	ПО 23	ПО 24	ПО 25	ПО 26	ПО 27	ПО 28
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6. Matrix for providing program learning outcomes with relevant components of education program

	ЗО 1	ЗО 2	ЗО 3	ЗО 4	ЗО 5	ЗО 6	ЗО 7	ЗО 8	ЗО 9	ЗО10	ПО1	ПО2	ПО3	ПО4	ПО5	ПО6	ПО7	ПО8	ПО9	ПО10	ПО11	ПО12	ПО 13	ПО 14	ПО 15	ПО 16	ПО 17	ПО 18	ПО 19	ПО 20	ПО 21	ПО 22	ПО 23	ПО 24	ПО 25	ПО 26	ПО 27	ПО 28
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