

**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 № 5 from 30.06. 2020)
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

Kyiv – 2020

PREAMBLE

DEVELOPED by the project team:

The project team chairman

Anna Pysarets, PhD in Engineering sciences, Associate Professor, associate professor of the instrument engineering department of the instrument engineering faculty, 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 Bondarenko, PhD in Engineering sciences, Associate Professor of the Department of Aircraft and Rocket Engineering

Acting Head of the Department of Aviation and Rocket Engineering,
Volodymyr Kabanyachyi, Doctor of Technical Sciences

AGREED:

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

Head SMC

Volodymyr KABANYACHYI

(Protocol № 1 from 13.01.2020)

Methodical Council of Igor Sikorsky Kyiv Polytechnic Institute

Head of the Methodical Council

Yurii YAKYMENKO

(Protocol № 10 from 28.06.2020)

INCLUDED:

Propositions of the enterprises in the field of aviation and space engineering of Ukraine:

- Director of Firefly Aerospace Ukraine Company Dondyk O.V.
- Deputy Director of State Kyiv Design Bureau “Luch” Ykovenko P.O.

as well as trends in the development of the specialty, labor market, industry and regional context, experience of related domestic (KHAI, DNU) and foreign (European, USA) educational programs. The content of the program was discussed at meetings with students of higher education.

1. Profile of the educational program

from specialty 134 "Aviation and Rocket and Space Technology"

1 – General information	
Full name of HEI and institute / faculty	National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute», Mechanical Engineering Institute
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	Order of the Ministry of Education and Science of Ukraine dated June 12, 2019 №821. Accreditation period: until July 1, 2029
Cycle/level of higher education	NQF of Ukraine – level 7, 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	http://arb.kpi.ua , section "Educational programs"
2 – The purpose of the educational program	
<p>The purpose of the education program is to train specialists who able to solve difficult specialized and practical problems, related to the development, production and certification of aviation and rocket-space technology, its engines and power plants, structures and systems characterized by complexity and uncertainty of conditions.</p> <p>The mission of the educational program: to make a significant contribution to ensuring the sustainable development of society through the internationalization and integration of education, the latest scientific research and innovative developments. To create conditions for the comprehensive professional, intellectual, social and creative development of the individual at the highest levels of excellence in the educational and scientific environment.</p> <p>The strategy of the educational program: to create all the conditions for the training of highly qualified specialists capable of creating modern scientific knowledge and innovative technologies for the benefit of humanity and ensuring a worthy place for Ukraine in the world community. The educational program takes into account the positions of enterprises in the aviation and space rocket industry of Ukraine. The educational program takes into account trends in the development of the specialty, the labor market, the industry and regional context, as well as the experience of related domestic and foreign educational programs.</p>	
3 – Characteristics of the education program	
Subject area	<p>Objects of study - phenomena and problems related to the stages of the life cycle of aerospace and rocket-space technology.</p> <p>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.</p> <p>Theoretical content of subject area are theoretical basics of development and manufacturing of aerospace and rocket-space objects and technologies.</p>

	<p>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.</p> <p>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.</p>
Orientation of the EP	<p>Educational and professional</p> <p>It is focused on rocket and space vehicles design and aerospace engineering.</p>
The main focus of EP	<p>General education in specialty 134 "Aviation and rocket and space engineering". Special education in the engineering of aviation and rocket-space systems, specialty 134 "Aviation and rocket-space engineering". 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.</p> <p>Key words: rockets, space vehicles, airspace engineering</p>
Features of EP	<p>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.</p>
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	All participants of the educational process are provided with timely, accessible and understandable information about the goals, content and program results of training, the order and criteria of evaluation within the limits of individual educational components. For evaluation, a rating system, oral and written exams, testing, etc. The final certification is carried out in the form of a 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

GC 3	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	The ability to determine the structure and main parameters of the elements of the mechanical systems of rockets and spacecraft, based on their purpose and operating conditions
PC 10	The ability to perform calculations of elements of rocket and space vehicles taking into account elasticity, to carry out their vibration 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	The ability to analyze thermodynamic processes in a gas environment and choose means of thermal protection and thermal compensation
PC 14	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 15	Skills to use integral technologies of computer design and modeling of aircraft and rocket and space systems and elements
7 – Program results of learning	
KNOWLEDGE	
PRL 1	Ability to use Ukrainian and foreign languages for fluent oral and written communication in professional activity
PRL 2	Explain solutions and give arguments in their favor in reasonable and clear form

PRL 3	Knowledge of development methods of modern applied software for conducting quick nonstandard calculation or analyzing huge amounts of data
PRL 4	Develop the structure of rocket and space vehicles
PRL 5	Conduct diagnostics and nondestructive control of flying vehicles elements.
PRL 6	Describe experimental research methods of structural, physical and mechanical technological properties of materials and structures.
PRL 7	Apply modern methods of modeling, design and manufacturing of aircraft and rocket and space elements and systems
PRL 8	Acquire skills of determining structural elements stress of aircraft and rocket and space technology at all stages of their life cycle
PRL 9	Calculate stress-strain state, determine carrying capacity of structural elements and reliability of aircraft and rocket and space technology
SKILL	
PRL 10	Describe the stress-strain state of the mechanical structure of its elements using modern CAE systems using finite element models
PRL 11	Describe the design and principles of functioning of mechanical systems of rocket and space vehicles
PRL 12	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 13	Understand environmentally dangerous and harmful factors of professional activity and regulate its content in order to avoid negative effect on environment
PRL 14	Understand the structure and principles of operation of onboard and navigation equipment of aircraft and rocket and space technology
PRL 15	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 16	Master the modern means of information and communicative technologies in the amount sufficient for studying and professional activity.
PRL 17	Acquire logics and methodology of scientific cognition based on understanding of modern state and methodology of subject area
PRL 18	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 19	Skills to develop technological processes using computer aided design to manufacture the structural components of aircraft and rocket and space technology
PRL 20	Understand the theoretical principles and practical methods of equipment support of components interchangeability of aircraft and rocket and space technology
COMMUNICATION	
PRL 21	Ability to know aerodynamic modeling and assess rocket parameters by means of specialized computer means and wind tunnel experiments
PRL 22	Understand the principles of gas and liquid mechanics, as well as, hydraulics, aerodynamics (gas dynamics)
AUTONOMY	
PRL 23	Understand the features of working processes in hydraulic, pneumatic, electric and electronic systems, servo motors used in aircraft and rocket and space technology
RESPONSIBILITY	
PRL 24	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 25	Understand and reason the features of structure based on main aspects of working processes in aircraft and rocket and space elements and systems

PRL 26	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
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 (Appendix 2 to the License Terms) adopted by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187
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, (Appendix 4 to the License Terms) approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187
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 (Appendix 5 to the License Terms) approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187
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			
ZO 1	Ukrainian Language for Professional Purposes	2	Test
ZO 2	History of Science and Technology	2	Test
ZO 3	Physical education Basics of a Healthy Lifestyle	5	Test
ZO 4	Foreign Language	6	Test
ZO 5	Economics and Management of Enterprise	4	Test
ZO 6	Labor Safety and Civil Defense	4	Test
ZO 7	Higher Mathematics	18	Exam
ZO 8	Physics	10	Exam
ZO 9	Chemistry	3	Test
ZO 10	Theoretical Mechanics	11	Exam
ZO 11	Thermodynamics and heat exchange	4	Test
ZO 12	Electrical Engineering and Electronics	4	Test
ZO 13	Descriptive Geometry	3	Test
ZO 14	Engineering and Computer Graphics	6,5	Test
ZO 15	Theory of Mechanisms and Machines	4,5	Exam
ZO 16	Materials and Constructions Mechanics	9	Exam
ZO 17	Machines Details and Basics of Designing	7,5	Exam
ZO 18	Aircraft Construction Mechanics	6	Exam
ZO 19	Aerohydraulics	7,5	Exam
Professional training cycle			
PO 1	Basics of Aviation and Cosmonautics and the General Structure of Aircraft	2,5	Test
PO 2	Aircraft Structure	6	Exam
PO 3	Course Project on Aircraft Structure	1,5	Test
PO 4	Diagnostics and testing of aviation and space rocket systems	5	Exam
PO 5	Course Project on Diagnostics and testing of aviation and space rocket systems	1,5	Test
PO 6	Thermo and Gas Dynamics of Space Rockets	2	Test
PO 7	Rocket Aerodynamics	5	Exam
PO 8	Course Work on Rocket Aerodynamics	1	Test
PO 9	Applied and Experimental Aerodynamics	4	Exam
PO 10	Flight Dynamics	5,5	Exam
PO 11	Technology of Production of Rockets and Space Vehicles	6	Test
PO 12	Course Work on Technology of Production of Rockets and Space Vehicles	1	Test
PO 13	Information Technologies and General Methods of Applied Software Development	9	Exam
PO 14	Pre-diploma Practice	6	Test
PO 15	Diploma Design	6	Defense
Selective components of EP			
General training cycle			
ZV 1	Educational Component of 1 GU-Catalogue (Philosophical Educational Disciplines)	2	Test
ZV 2	Educational Component of 2 GU-Catalogue	2	Test

	(Psychological Educational Disciplines)		
ZV 3	Educational Component of 3 GU-Catalogue (Environmental Discipline)	2	Test
ZV 4	Educational Component of 4 GU-Catalogue (Law Academic Discipline)	2	Test
ZV 5	Foreign Language for Professional Purposes	6	Test
Professional training cycle			
PV 1	Educational Component of 1 F-Catalogue (Educational discipline in metrology and standardization)	2,5	Test
PV 2	Educational Component of 2 F-Catalogue (Educational discipline on the basics of interchangeability)	3,5	Test
PV 3	Educational Component of 3 F-Catalogue (Systems and drives of rocket and space vehicles)	5	Test
PV 4	Educational Component of 4 F-Catalogue (Educational disciplines on the theory of oscillations and vibration protection)	6	Test
PV 5	Educational Component of 5 F-Catalogue (Design of energy installations of rockets and space vehicles)	4	Exam
PV 6	Educational Component of 6 F-Catalogue (Special questions of higher mathematics)	4	Test
PV 7	Educational Component of 7 F-Catalogue (Study discipline on automation of experimental research)	4	Test
PV 8	Educational Component of 8 F-Catalogue (Design of aircraft)	4	Test
PV 9	Educational Component of 9 F-Catalogue (Fundamentals of aviation materials science)	2,5	Test
PV 10	Educational Component of 10 F-Catalogue (Aviation materials and their technologies)	4	Exam
PV 11	Educational Component of 11 F-Catalogue (Designing aircraft elements in CAE systems)	2,5	Test
PV 12	Educational Component of 12 F-Catalogue (Designing elements of aircraft in CAD systems)	5	Exam
Total amount of compulsory education components:		179	
The total amount of selective education components:		61	
TOTAL AMOUNT OF EDUCATION PROGRAM COMPONENTS		240	

3. Structural and logical scheme of education program

1 semester	2 semester	3 semester	4 semester	5 semester	6 semester	7 semester	8 semester
Foreign Language				Foreign Language for Professional Purposes			
History of Science and Technology	Engineering and Computer Graphics	Machines Details and Basics of Designing		Thermo and Gas Dynamics of Space Rockets	Rocket Aerodynamics	Economics and Management of Enterprise	Technology of Production of Rockets and Space Vehicles
Physical education Basics of a Healthy Lifestyle				Applied and Experimental Aerodynamics	Course Work on Rocket Aerodynamics	Labor Safety and Civil Defense	Course Work on Technology of Production of Rockets and Space Vehicles
Ukrainian Language for Professional Purposes	Electrical Engineering and Electronics	Materials and Constructions Mechanics		Aircraft Structure	Aircraft Construction Mechanics	Diagnostics and testing of aviation and space rocket systems	Educational Component of 7 F-Catalogue
Higher Mathematics				Course Project on Aircraft Structure	Educational Component of 4 GU-Catalogue	Course Project on Diagnostics and testing of aviation and space rocket systems	Educational Component of 12 F-Catalogue
Physics		Information Technologies and General Methods of Applied Software Development		Aerohydro-mechanics	Educational Component of 9 F-Catalogue	Flight Dynamics	
Theoretical Mechanics		Educational Component of 1 GU-Catalogue	Thermodynamics and heat exchange	Educational Component of 4 F-Catalogue	Educational Component of 10 F-Catalogue	Educational Component of 3 F-Catalogue	Pre-diploma Practice
Chemistry	Theory of Mechanisms and Machines	Educational Component of 2 GU-Catalogue	Educational Component of 1 F-Catalogue	Educational Component of 6 F-Catalogue	Educational Component of 11 F-Catalogue	Educational Component of 5 F-Catalogue	Diploma Design
Descriptive Geometry	Basics of Aviation and Cosmonautics and the General Structure of Aircraft	Educational Component of 3 GU-Catalogue	Educational Component of 2 F-Catalogue	Educational Component of 8 F-Catalogue			

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

	ZO 1	ZO 2	ZO 3	ZO 4	ZO 5	ZO 6	ZO 7	ZO 8	ZO 9	ZO 10	ZO 11	ZO 12	ZO 13	ZO 14	ZO 15	ZO 16	ZO 17	ZO 18	ZO 19	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PO 13	PO 14	PO 15	
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6. Matrix for providing program learning outcomes with relevant components of education program

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