

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
_____ Mikhail ILCHENKO

MANUFACTURING ENGINEERING

EDUCATIONAL AND PROFESSIONAL PROGRAM

first (bachelor's) level of higher education

Specialty **131 Applied Mechanics**
Areas of knowledge **13 Mechanical engineering**
Qualification **Bachelor of Applied Mechanics**

It was put into operation from
2022/2023. Year
Rector's of Igor Sikorsky Kyiv
Polytechnic Institute order
from 5.02.2022 NoHOH/75/2022

Kyiv – 2021

PREAMBLE

DEVELOPED by the project team:

Project Team Leader:

Head of working group

Oleksandr Okhrimenko – Doctor of Technical Sciences, Associate Professor, Head of the Department of Mechanical Engineering

Members of the working group:

Yuriy Petrakov – Doctor of Technical Sciences, Professor,

Professor of the Department of Mechanical Engineering

Korenkov Volodymyr– Ph.D., Associate Professor, Associate Professor of the Department of Mechanical Engineering

Lashyna Yulia– Ph.D., Associate Professor of the Department of Mechanical Engineering

Maksym Melnychenko – Head of the PJSC "VKF "AS" ,

DAKH Artem, Kyiv

Makarytsky Yuri, student gr. MT-81, OS Baccalaureate

Khomenko Kyrylo, graduate 2021

The Department of Mechanical Engineering Technology is responsible for the preparation of higher education applicants for the educational program

AGREED:

Scientific and methodological commission of the University in the specialty 131 Applied mechanics (protocol # ___ from _____ 2022)

Head of NMCU 131 _____ Mykola BOBIR

Methodical Council kpi them. Igor Sikorsky

Chairman of the Methodical Council _____ Yuriy YAKYMENKO

(protocol # ___ from _____ 2022)

CONSIDERED:

1. 865 20 June 2019 Order of the Ministry of Education and Science of Ukraine of June 20, 2019 No. 865 "About approval of the standard of higher education in the specialty 131 "Applied mechanics" for the first (bachelor's) level of higher education. <https://mon.gov.ua/ua/npa/pro-zatverdzhennya-standartu-vishoyi-osviti-za-specialnistyu-131-prikladna-mehanika-dlya-pershogo-bakalavrskogo-rivnya-vishoyi-osviti>
2. Regulations on the development, approval, monitoring and revision of educational programs in the KPI. Igor Sikorsky <https://osvita.kpi.ua/node/137>
3. Comments and suggestions of stakeholders based on the results of public discussion:
 - SE "Abplanalp Ukraine" (Kozatska Str. 120/4, 03022, Kyiv, Ukraine)
 - Enterprise LLC "PROGRESSTECH-UKRAINE" (Sholudenka Str. 3, 04116, Kyiv, Ukraine)

According to the results of the monitoring, taking into account the proposals of the participants of the educational process involved in the implementation of the educational program (OP), the proposals of graduates, employers and other external stakeholders, its renewal was carried out. The project team reviewed the balance, rationality of credit assignment, the ability of education applicants to master individual disciplines (educational components) and the OU in general when forming competencies for a certain period of study, completeness of documentary, personnel, information and methodological and other provision of the OU and compliance of the educational program with licensing conditions. In order to ensure the possibility of forming an individual educational trajectory, including through the individual choice of disciplines to the extent provided for by law, and in order to ensure compliance with the Standard of Higher Education, it was decided to update the educational program.

The educational program was discussed after receiving all wishes and proposals was approved at an extended meeting of the Department of Mechanical Engineering Technology (Protocol No. 4 of November 3, 2021).

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1. PROFILE OF THE EDUCATIONAL PROGRAM

1 – General information	
Full name of higher education institution and institute/faculty	National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", Educational and Scientific Mechanical Engineering Institute
Higher education degree and title of qualification in the original language	The degree is a bachelor's degree. Qualification – Bachelor of Applied Mechanics
Official name of op	Mechanical engineering
Type of diploma and volume of OU	Bachelor's degree, single, 240 credits, term of study 3 years 10 months
Availability of accreditation	Certificate of accreditation of the specialty ND 1192553, valid until 01.07.2023, issued by the Ministry of Education and Science of Ukraine
Cycle/Level OF	NRC of Ukraine – Level 6 QF-EHEA – First Cycle EQF-LLL – Level 6
Prerequisites	Availability of complete secondary education
Language(s) of teaching	Ukrainian / English
Validity period of op	Until the next accreditation
Internet address of permanent placement of the educational program	https://osvita.kpi.ua http://tm-mmi.kpi.ua/
2 – The purpose of the educational program	
<p>Training of highly qualified specialists capable of solving basic scientific and technical problems in the field of applied mechanics and mechanical engineering in the conditions of sustainable innovative scientific and technical development of society and the formation of high adaptability of higher education applicants in the conditions of transformation of the labor market through interaction with employers and other stakeholders. Create conditions for comprehensive professional, intellectual, social and creative development of the individual at the highest levels of excellence in the educational and scientific environment in accordance with the development strategy of the KPI. Igor Sikorsky Kyiv Polytechnic Institute for 2020-205: https://kpi.ua/2020-2025-strategy.</p>	
3 – Characteristics of the educational program	
Subject Area	<ul style="list-style-type: none"> - object of activity: structures, machines, equipment, mechanical and biomechanical systems and complexes, processes of their design, manufacture, research and operation; - training objectives: professional engineering activities in the field of design, production and operation of technical systems, machinery and equipment, robotics and complexes, development of technologies of machine-building industries; - theoretical content of the subject area: general laws of theoretical mechanics and their applied applications, theoretical foundations of machinery design, technologies of machine-building industries, mechanics of liquid and gases, parts of machines and structures, forecasting of operational properties of technical systems; - methods, methods and technologies: physical and mathematical methods for calculating statics, dynamics and stability of elements and structures; analytical, numerical and algorithmic

	<p>methods of modeling kinematics and dynamics of machines, analysis of stress-deformed state of structural elements; design, control, research, development of technologies for manufacturing and assembling elements of machines and structures; information technologies in engineering research, design and production; methods and means; numerical software control of technological equipment; technologies of automated machine-building industries;</p> <p>- tools and equipment: machine tools, tools, technological and control devices, control and measuring instruments, numerical control systems, drives of machine and robotic systems.</p>
Op orientation	<p>Educational and professional</p> <p>The structure of the program involves the modern mastery of the methodology of existing methods for solving complex specialized problems and practical problems in mechanical engineering and applied mechanics and related fields, which involves the use of certain theories and methods of the relevant sciences.</p>
The main focus of the OP	<p>Special education in the field of applied mechanics and machine-building. That involves deep knowledge of processing on CNC machines and management of processing processes in production.</p> <p>Keywords: applied mechanics, mechanical engineering</p>
Features of op	<p>The implementation of the program involves the involvement of professionals – practitioners, industry experts, representatives of employers in classroom classes: individual special courses of applied mechanics and mechanical engineering can be taught in English</p>
4 – Suitability of graduates for employment and further study	
Suitability for employment	<p>According to the classifier of professions DK 003:2010 graduates can work in the positions of professionals in mechanics, in particular:</p> <p>2145 – Professionals in the field of engineering mechanics</p> <p>2149 – Professionals in other fields of engineering, and others in accordance with the current classifier of professions</p>
Further training	<p>The possibility of continuing training at the second (master's) level of higher education and / or acquiring additional qualifications in the system of postgraduate education.</p>
5 – Teaching and evaluation	
Teaching and learning	<p>The program provides a student-centered type of education. Teaching methods: explanatory and illustrative, practical, receptive-reproductive, problem-search, research. Forms of organization of training: lectures, practical and seminar classes, computer workshops and laboratory work; course projects and works; technology of mixed learning, practice and excursions; individual tasks, consultations, independent work of students, group work, student research activities; dual training in certificate programs; distance learning on individual educational components and attestation work</p>
Evaluation	<p>Assessment of students' knowledge is carried out in accordance with the Regulations on the system of evaluation of learning outcomes at the KPI. Igor Sikorsky Kyiv Polytechnic Institute for all types of classroom and non-classroom work (current, calendar, semester control), https://osvita.kpi.ua/node/37. The evaluation system provides for oral and written examinations, tests, separate evaluation of course projects and works, testing, semester</p>

	certifications, defense of the diploma project.
6 – Software competencies	
Integral competence	The ability to solve complex specialized problems and practical problems in applied mechanics, or in the learning process, which involves the use of certain theories and methods of mechanical engineering and is characterized by complexity and uncertainty of conditions.
General Competences (ZK)	<p>ZK1. Ability to abstract thinking, analysis and synthesis.</p> <p>ZK2. Knowledge and understanding of the subject area and understanding of professional activity.</p> <p>ZK3. Ability to identify, set and solve problems.</p> <p>ZK4. Ability to apply knowledge in practical situations.</p> <p>ZK5. Ability to work in a team.</p> <p>ZK6. Certainty and perseverance regarding the tasks and responsibilities taken.</p> <p>ZK7. The ability to learn and master modern knowledge.</p> <p>ZK8. Ability to communicate in a foreign language.</p> <p>ZK9. Skills in the use of information and communication technologies.</p> <p>ZK10. Skills in carrying out safe activities.</p> <p>ZK11. Ability to act socially responsibly and consciously.</p> <p>ZK12. Ability to search, process and analyze information from different sources.</p> <p>ZK13. Ability to evaluate and ensure the quality of work performed.</p> <p>ZK14. The ability to realize their rights and obligations as a member of society, to realize the values of civil (free democratic) society and the need for its sustainable development, the rule of law, human and citizen rights and freedoms in Ukraine.</p> <p>ZK15. The ability to preserve and increase the moral, cultural, scientific values and achievements of society on the basis of understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and technology, to use different types and forms of motor activity for active rest and conducting a healthy lifestyle.</p>
Professional competencies (FC)	<p>FC1. The ability to analyze materials, structures and processes based on the laws, theories and methods of mathematics, natural sciences and applied mechanics.</p> <p>FC2. The ability to assess the performance parameters of materials, structures and machines in operational conditions and find appropriate solutions to ensure a given level of reliability of structures and processes, including in the presence of some uncertainty.</p> <p>FC3. The ability to carry out technological and technical and economic assessment of the effectiveness of the use of new technologies and technical means.</p> <p>FC4. The ability to make the optimal choice of technological equipment, complete set of technical complexes, have basic ideas about the rules of their operation.</p> <p>FC5. The ability to use analytical and numerical mathematical</p>

	<p>methods to solve the problems of applied mechanics, in particular, to make calculations for strength, endurance, stability, durability, rigidity in the process of static and dynamic load in order to assess the reliability of parts and structures of machines.</p> <p>FC6. Ability to perform technical measurements, receive, analyze and critically evaluate the results of measurements.</p> <p>FC7. The ability to apply computerized design systems (CAD), manufacturing (CAM), engineering research (CAE) and specialized application software to solve engineering problems in applied mechanics.</p> <p>FC8. Ability to spatial thinking and reproduction of spatial objects, structures and mechanisms in the form of projection drawings and three-dimensional geometric models.</p> <p>FC9. The ability to present the results of their engineering activities in compliance with generally accepted norms and standards.</p> <p>FC10. The ability to describe and classify a wide range of technical objects and processes, based on a deep knowledge and understanding of basic mechanical theories and practices, as well as basic knowledge of related sciences.</p> <p>FC11 Ability to choose the optimal typical technological processes in the manufacture of products and structures</p> <p>FC12 Ability to conduct research of existing technological processes, their system analysis and find on the basis of this analysis new methods of processing and assembly</p> <p>FC13 The ability to reasonably choose typical components when designing a snap-in for a developed technological process</p> <p>FC14 The ability to make decisions on the choice of instrumental support for automated production.</p> <p>FC15 The ability to use modern mathematical methods to control technological processes, find analogues and correct existing processing schemes</p> <p>FC16 The ability to justify the choice, determine the working parameters of the equipment of automated production of machine-building enterprises and design their typical nodes</p> <p>FC17 The ability to create new technical objects of mechanical engineering, taking into account the principles of design and ergonomics</p> <p>FC18 Ability to design functionally oriented technological processes for the manufacture of aircraft parts</p> <p>FC19 Ability to ensure the manufacturability of products and processes of their manufacture, to monitor compliance with technological discipline in the manufacture of products</p> <p>FC20 Ability to choose typical components of equipment when equipping technological processes</p> <p>FC21 Ability to apply typical methods of quality control of products and objects in the field of professional activity</p> <p>FC22 Ability to design separate technological operations for cutting difficult-profile surfaces and assembling aircraft and using</p>
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	<p>computer-aided design systems</p> <p>FC23The ability to use robotics in technological systems of automated engineering.</p> <p>FC24The ability to use professionally profiled knowledge and skills in the field of theoretical foundations of informatics and the practical use of computer technologies and programming basics to solve experimental and practical problems in the field of mechanical engineering.</p> <p>FC25Ability to carry out technological and technical and economic assessment of the effectiveness of the use of new technologies and technical means.</p>
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7 – Programmatic learning outcomes

- RN1. Choose and apply for solving problems of applied mechanics suitable mathematical methods.
- RN2. Use knowledge of the theoretical foundations of fluid and gas mechanics, heat engineering and electrical engineering to solve professional problems;
- RN3. Perform calculations for strength, endurance, stability, durability, rigidity of machine parts.
- RN4. Evaluate the reliability of machine parts and structures in the process of static and dynamic load.
- RN5. Perform geometric modeling of parts, mechanisms and structures in the form of spatial models and projection images and design the result in the form of technical and working drawings.
- RN6. Create and theoretically justify the designs of machines, mechanisms and their elements on the basis of methods of applied mechanics, general principles of design, theory of interchangeability, standard methods for calculating machine parts.
- RN7. Apply regulatory and reference data to monitor compliance of technical documentation, products and technologies with standards, technical specifications and other regulatory documents.
- RN8. Know and understand the basics of information technology, programming, practically use application software to perform engineering calculations, information processing and experimental research results.
- RN9. Know and understand related industries (fluid and gas mechanics, heat engineering, electrical engineering, electronics) and be able to detect interdisciplinary connections of applied mechanics at the level necessary to meet other requirements of the educational program.
- RN10. Know the designs, methods of selection and calculation, the basics of maintenance and operation of machine and robotic equipment drives;
- RN11. Understand the principles of automated control systems for technological equipment, in particular microprocessor, to choose and use optimal automation tools.
- PH12. Skills in the practical use of computerized design systems (CAD), production preparation (SAM) and engineering research (CAE).
- PH13. Evaluate the technical and economic efficiency of production;
- PH14. To carry out the optimal choice of equipment and equipment of technical complexes.
- PH15. Take into account the main factors of technogenic impact on the environment and the main methods of environmental protection, labor protection and life safety when making decisions.
- PH16. Freely communicate on professional issues orally and in writing in the state and foreign language, including knowledge of special terminology and interpersonal skills.
- Complicate algorithms and computer programs in programming languages using modern

information technologies.	
RN18 Prepare the initial data to justify technical solutions, apply standard calculation methods when designing or choosing purchased equipment.	
RN19 Use the means of information technology design in the tasks of technical preparation of production.	
RN20 To conduct information and analytical research on a given topic.	
RN21 Perform observations, measurements, make a report on the studies conducted, analyze the results of research, prepare data for reviews and scientific publications.	
RN22 Conduct experiments according to given methods with processing and analysis of results.	
RN23 Choose the necessary equipment for the specified production conditions, perform according to known methods the calculation of structural elements and parameters of setting metal cutting machines, choose the necessary equipment for the specified production conditions, perform the calculation of structural elements and parameters of setting metal cutting machines according to known methods.	
RN24 Perform calculations of parameters of design objects and performance indicators of mechanisms, machines, structures	
RN25 Project separate technological cutting operations and technological processes of processing parts of machines of different classes, including with the use of computer-aided design systems	
RN26 Develop control programs for CNC machines for processing complex surfaces of machine parts blanks and means of mechanization and automation of technological processes	
RN27 Develop working design and technical documentation, draw up completed design work with verification of compliance of development projects and technical documentation with standards, technical specifications and other regulatory documents	
8 – Resource support for the implementation of the program	
Staffing	In accordance with the personnel requirements for ensuring the implementation of educational activities for the appropriate level of THE approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 No. 1187 in the current version.
Material and technical support	In accordance with the technological requirements for logistical support of educational activities of the relevant level of THE approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 No. 1187 in the current version. Use of equipment for lectures in the format of presentations, network technologies, in particular using the Sikorsky distance learning platform.
Information and educational-methodical support	In accordance with the technological requirements for educational, methodological and informational support of educational activities of the relevant level of THE approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 No. 1187 in the current version. Use of scientific and technical library kpi named after Igor Sikorsky.
9 – Academic mobility	
National Credit Mobility	The program provides for the possibility of concluding agreements on academic mobility and double certification
International Credit Mobility	The program provides for the possibility of concluding agreements on international academic mobility (Erasmus + K1), double certification, on long-term international projects that provide for the included training of students. Agreements on double diploma with universities are concluded: <ul style="list-style-type: none"> • University of Otto-von-Gericke, Magdeburg, Germany, https://gfm.kpi.ua/ • Poznan Polytechnic, Poznan, Republic of Poland., https://mmi.kpi.ua/studentu/spilnyi-fakultet/navchannia-poznan
Training of foreign applicants	The possibility of teaching in Ukrainian in general training groups or in English with ensuring the study of Ukrainian as a foreign language

2. LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

Code	Components of the educational program (disciplines, course projects / works, practices, qualification work)	Number of ECTS credits	Final control form
Mandatory (regulatory) components of the OU			
I.1. Basic training			
ZO1	Ukrainian for Professional Purposes	2	Final tests
ZO2	Ukraine History	2	Final tests
ZO3	Physical Education	3	Final tests
ZO4-1	Foreign language. Part 1. Practical course of foreign language I	3	Final tests
ZO4-2	Foreign language. Part 2. Practical course of foreign language II	3	Final tests
ZO5	Economics and Production Organization	4	Final tests
ZO6	Labor protection	2	Final tests
ZO7	Philosophy	2	Final tests
ZO8	Law	2	Final tests
ZO9-1	Foreign Language for Professional Purposes. Practical foreign language course for professional communication I	3	Final tests
ZO9-2	Foreign Language for Professional Purposes. Practical foreign language course for professional communication II	3	Exam
I.2. Professional training			
P1-1	Higher mathematics. Part 1. Differential and integral calculus of functions of one variable.	4,5	Exam
P1-2	Higher mathematics. Part 2. Differential and integral calculus of functions of many variables. Differential equations.	8,5	Exam
P1-3	Higher mathematics. Part 3. Rows. Theory of the complex function of the variable	4	Exam
P2	Linear algebra	3,5	Final tests
P3	Chemistry	3	Final tests
P4	Construction Materials Engineering	4,5	Exam
P5-1	Physics. Part 1. Mechanics. Basics of electrodynamics	5,5	Exam
PO5-2	Physics. Part 2. Electricity and Magnetism. Optics. Atomic physics	4,5	Final tests
P6	Engineering and computer graphics	4	Final tests
PO7	Materials Science	4,5	Exam
PO8-1	Theoretical mechanics. Part 1. Statics	4,5	Exam
PO8-2	Theoretical mechanics. Part 2. Kinematics	5	Exam
PO8-3	Theoretical mechanics. Part 3. Dynamics	3,5	Final tests
P9	Electrical engineering and electronics	3	Final tests
P10	Informatics	4	Final tests
P11-1	Mechanics of materials and structures. Part 1. Simple load	6,5	Exam
P11-2	Mechanics of materials and structures. Part 2. Complex load, stability and dynamics	6,5	Exam
P12	Mechanics of materials and structures Coursework	1	Final tests
P13	Theoretical foundations of heat engineering	3	Final tests
P14	Metrology, standardization and certification	4,5	Exam
P15	Theory of mechanisms and machines	3,5	Final tests
P16	Theory of machines and machines. Coursework	1	Final tests
P17	Mechanics of liquid and gas	3,5	Final tests
P18	Machine parts and design basics	6	Exam
P19	Machine parts and design basics. Course project	1,5	Final tests
PO20-1	Manufacturing Engineering. Part 1	5	Exam
PO20-2	Manufacturing Engineering. Part 2	5	Exam
PO20-3	Manufacturing Engineering. Part 3	6,5	Exam

Code	Components of the educational program (disciplines, course projects / works, practices, qualification work)	Number of ECTS credits	Final control form
PO20-4	Manufacturing Engineering. Part 4	3	Exam
P21	Manufacturing Engineering course project	1,5	Final tests
P22	Automated control systems	4,5	Exam
P23	Jig and Fixture Design	4	Exam
P24	Jig and Fixture Design coursework	1	Final tests
P25	Programming of CNC machines	5	Exam
P23	Diploma Practice	6	Final tests
P24	Diploma Project Preparation	6	Assessment
Sample components			
I.3. Educational components from the University Catalog			
ZV1	Educational component 1 (ZU-Catalogue)	2	Final tests
ZV2	Educational component 2 (ZU-Catalogue)	2	Final tests
I.4. Vocational and practical training			
PV1	Educational component 1 (F-Catalogue)	4	Final tests
PV2	Educational Component 2 (F-Catalogue)	4	Final tests
PV3	Educational Component 3 (F-Catalogue)	4	Final tests
PV4	Educational Component 4 (F-Catalogue)	4	Final tests
PV5	Educational Component 5 (F-Catalogue)	4	Final tests
PV6	Educational component 6 (F-Catalogue)	4	Final tests
PV7	Educational Component 7 (F-Catalogue)	4	Final tests
PV8	Educational component 8 (F-Catalogue)	4	Final tests
PV9	Educational Component 9 (F-Catalogue)	4	Final tests
PV10	Educational Component 10 (F-Catalogue)	4	Final tests
PV11	Educational component 11 (F-Catalogue)	4	Final tests
PV12	Educational component 12 (F-Catalogue)	4	Final tests
PV13	Educational Component 13 (F-Catalogue)	4	Final tests
PV14	Educational component 14 (F-Catalogue)	4	Final tests
Total required components :		180 cd.	
Total number of selective components :		60 cd.	
The volume of educational components that ensure the acquisition of competencies of certain CSOs		144.5 cd.	
THE TOTAL SCOPE OF THE EDUCATIONAL PROGRAM		240 cd.	

3. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



