

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"

APPROVED

by the Academic Council
of Igor Sikorsky Kyiv Polytechnic Institute
(meeting protocol No 10 dated 13.12.2021)

Chairman of the Academic Council
Mykhailo ILCHENKO

ENGINEERING AND COMPUTER SIMULATION
IN MATERIALS SCIENCE

Educational and Professional program
second (master's) level of high education

Specialty	132 Materials Science
Area of knowledge	13 Mechanical engineering
Qualification	Master in Materials Science

The educational program is introduced
from 2022/2022 academic year by order of the Rector
of Igor Sikorsky Kyiv Polytechnic Institute
from 15,02,2022 No HOH/75/2022

Kyiv – 2022

PREAMBLE

DEVELOPED by the project group:

Project team leader:

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Konorev Sergiy Ihorovych, Candidate of Engineering Sciences (Ph. D.), associate professor at the Department of Physical Materials Science and Heat Treatment;

AGREED:

Scientific and Methodological Commission of the University, specialty 132 Materials Science

Head of SMCU 132 Petro LOBODA

(Meeting protocol № 3 from 06.12.2021)

Methodical council of Igor Sikorsky Kyiv Polytechnic Institute

Deputy Chairman of Methodical Council Anatolii MELNYChENKO

(Meeting protocol № 2 from 09.12.2021)

TAKE INTO ACCOUNT:

- *requirements of normative documents of the National Agency for Quality Assurance in Higher Education;*
- *recommendations on updating educational programs (appendix to the order of Igor Sikorsky Kyiv Polytechnic Institute "On improvement of educational programs of the second (master's) level of higher education");*
- *wishes and comments from reviews;*
- *results of discussions with students and graduate students;*
- *results of discussions with employers;*
- *results of discussions at Department of Physical Materials Science and Heat Treatment meetings;*
- *results of discussions at SMCU 132 meetings.*

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1. PROFILE OF THE EDUCATIONAL PROGRAM (EP) in the specialty 132 Materials Science

1 – general information	
Full name of IHE and institute / faculty	National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute", E.O. Paton Institute of Materials Science and Welding
Degree of higher education and title of qualification	Degree HE- Master Educational qualification - Master of Materials Science
Higher education cycle / level	NQF Ukraine – 7 level; QF-EHEA – second cycle; EQF-LLL – 7 level
The official name of the educational program	Engineering and computer simulation in materials science
Type of diploma and scope of educational program	Master's degree, single, 90 ECTS credits, term of study 1 year, 4 months
Availability of accreditation	Certificate of accreditation series ND № 1192552 issued by the Ministry of Education and Science of Ukraine on 25.09.2017 Validity of the certificate until 01.07.2023
Prerequisites	Having a bachelor's degree
Language (s) of instruction	Ukrainian / English
Term of the educational program	Until the next accreditation
Internet address of the permanent placement of the educational program	https://osvita.kpi.ua/ section "Educational programs" https://mto.kpi.ua/osvitni-programi/ , https://kpm.kpi.ua/osvitnya-diyalnist/
2 – The purpose of the educational program	
Training of specialists capable of solving complex specialized and practical problems in the field of materials science, in the field of engineering and to carry out innovative professional activity. The purpose of the educational program corresponds to the development strategy of KPI. Igor Sikorsky for 2020-2025 (https://data.kpi.ua/sites/default/files/files/2020-2025-strategy.pdf)	
3 – Characteristics of the educational program	
Subject area	<p>Object: phenomena and processes associated with the formation of the structure and properties of metallic, non-metallic, composite and functional materials, technologies for their manufacture, processing, operation and certification.</p> <p>Objectives of training: training of specialists capable of effectively performing professional activities, which involves solving complex problems and problems associated with the development, research, application, production, processing and testing of modern materials and products based on them.</p> <p>Theoretical content of the subject area: creation and application of new materials, the influence of production conditions and various factors (temperature, pressure, irradiation, environment, conditions of use, etc.) on their structure, physical, chemical, technological, operational and functional properties, methods of material properties management.</p> <p>Methods, techniques and technologies: forecasting methods, theoretical and experimental methods of materials science research, in particular mathematical and physical modeling, research of structure, physical, mechanical, functional and technological properties of materials. Technologies of manufacturing, processing, control of structure</p>

	<p>and properties of materials, production of products from them.</p> <p>Modern methods and technologies of organizational, informational, marketing, legal support of production and research.</p> <p>Tools and equipment: equipment for the study of chemical and phase composition, structure and fine structure, mechanical, physical, technological and functional properties of materials, mechanical and heat treatment. Specialized software.</p>
Orientation of the educational program	Educational and professional
The main focus of the educational program and specialization	<p>Special education in the field of materials science with the possibility of acquiring the necessary competencies for further professional activities in the field of materials engineering, related to the composition, structure, properties, technologies of manufacture, research, operation and disposal.</p> <p>Keywords: material; nanomaterial; materials science; chemical composition; structure; properties; research; analysis; synthesis; computer simulation; technologies; nanotechnology; materials engineering; functional materials.</p>
Features of the program	<p>The possibility of studying not only in Ukrainian, but also in English provides conditions for the implementation of international mobility in the world's leading universities.</p> <p>In-depth fundamental training and interdisciplinary orientation of the content of educational components are an effective basis for implementing the concept of "lifelong learning" and allow quick adaptation to changes in professional activity, which is a guarantee of high competitiveness of specialists.</p> <p>Mastering modern information technologies, including mathematical and simulated computer modeling, using modern software environments allow computer engineering of new materials.</p> <p>The participation of VO graduates in student scientific circles lays the scientific foundations for their further implementation of international and startup projects, strengthens their practical training.</p> <p>Acquisition of practical engineering skills in the field of materials science, experimental research using high-tech research equipment (laboratories of electron microscopy, X-ray structural analysis, mass spectrometry, etc.), practice at industrial enterprises (SE "Antonov", DAHK "ARTEM", etc.), involvement of specialists and resources of leading institutions of the National Academy of Sciences of Ukraine (FTIMS, IMF named after G.V. Kurdyumov, IPM named after I.M. Frantsevich, IEZ named after E.O. Paton, etc.) allow to form the competencies necessary for successful professional and innovative activity in the field of materials science.</p>
4 – Suitability of graduates for employment and further study	
Suitability for employment	<p>Graduates can hold positions (according to the Classifier of professions of Ukraine DK 003: 2010)</p> <p>2149.2 Engineers (materials science)</p> <p>2310.2 Other teachers of universities and higher educational establishments.</p>
Further training	Continuation of education at the third (educational and scientific) level of higher education and / or acquisition of additional qualifications in the system of adult education.
5 – Teaching and assessment	
Teaching and learning	Lectures, practical and seminar classes, computer workshops and laboratory works, term papers, individual assignments, independent student work, technology of blended learning, internships and excursions, research and master's dissertation.

Evaluation	According to the rating system, oral and written exams, tests, tests, results of individual tasks, defense of term papers and master's dissertation are evaluated.
6 – Program competencies	
Integral competence	Ability to solve complex problems and problems in materials science in professional activities and / or in the learning process, which involves research and / or innovation and is characterized by uncertainty of conditions and requirements KI.01
General competencies (GC)	
GC.01	Ability to abstract thinking, analysis and synthesis.
GC.02	Ability to apply knowledge in practical situations.
GC.03	Ability to develop and manage projects.
GC.04	Ability to communicate in a foreign language.
GC.06	Ability to work autonomously.
GC.07	Ability to work in a team.
GC.08	Ability in an international context.
GC.09	The desire to preserve the environment.
Special (professional) competencies (SC)	
SC.01	Ability to identify and pose problems in the field of materials science, to make effective decisions to solve them.
SC.02	Ability to plan and conduct research in the field of materials science in laboratory and production conditions at the appropriate level using modern methods and experimental techniques.
SC.03	Ability to develop new research methods and techniques, based on knowledge of research methodology and features of the problem to be solved.
SC.04	Ability to evaluate and ensure the quality of work performed.
SC.05	Ability to critically analyze and predict the characteristics of new and existing materials, the parameters of the processes of their production and processing and use in products (or in production conditions).
SC.06	Ability to understand and use mathematical and numerical methods for modeling properties, phenomena and processes.
SC.07	Ability to assess the technical and economic efficiency of research, technological processes and innovative developments, taking into account the uncertainty of conditions and requirements.
SC.08	Ability to clearly and unambiguously convey one's own knowledge, conclusions and arguments on materials science and related issues to specialists and non-specialists, in particular to students.
SC.09	Ability to reasonably choose the technology of manufacture, processing, testing of materials and products for specific operating conditions.
SC.10	Ability to organize and perform comprehensive testing of materials and products.
SC.11	Ability to apply a systematic approach to solving applied problems of manufacturing, processing, operation and disposal of materials and products
SC.12	Ability to develop and implement projects in the field of materials science, as well as related interdisciplinary projects.
SC.13	Ability to develop and model new and improve existing technologies of thermal, chemical-thermal, radiation treatments to ensure the required properties of products.
SC.14	Ability to develop programs for the introduction of new equipment, organizational and technical measures for the timely development of production capacity.
SC.15	Ability to monitor the operation of equipment, the condition of complex and accurate

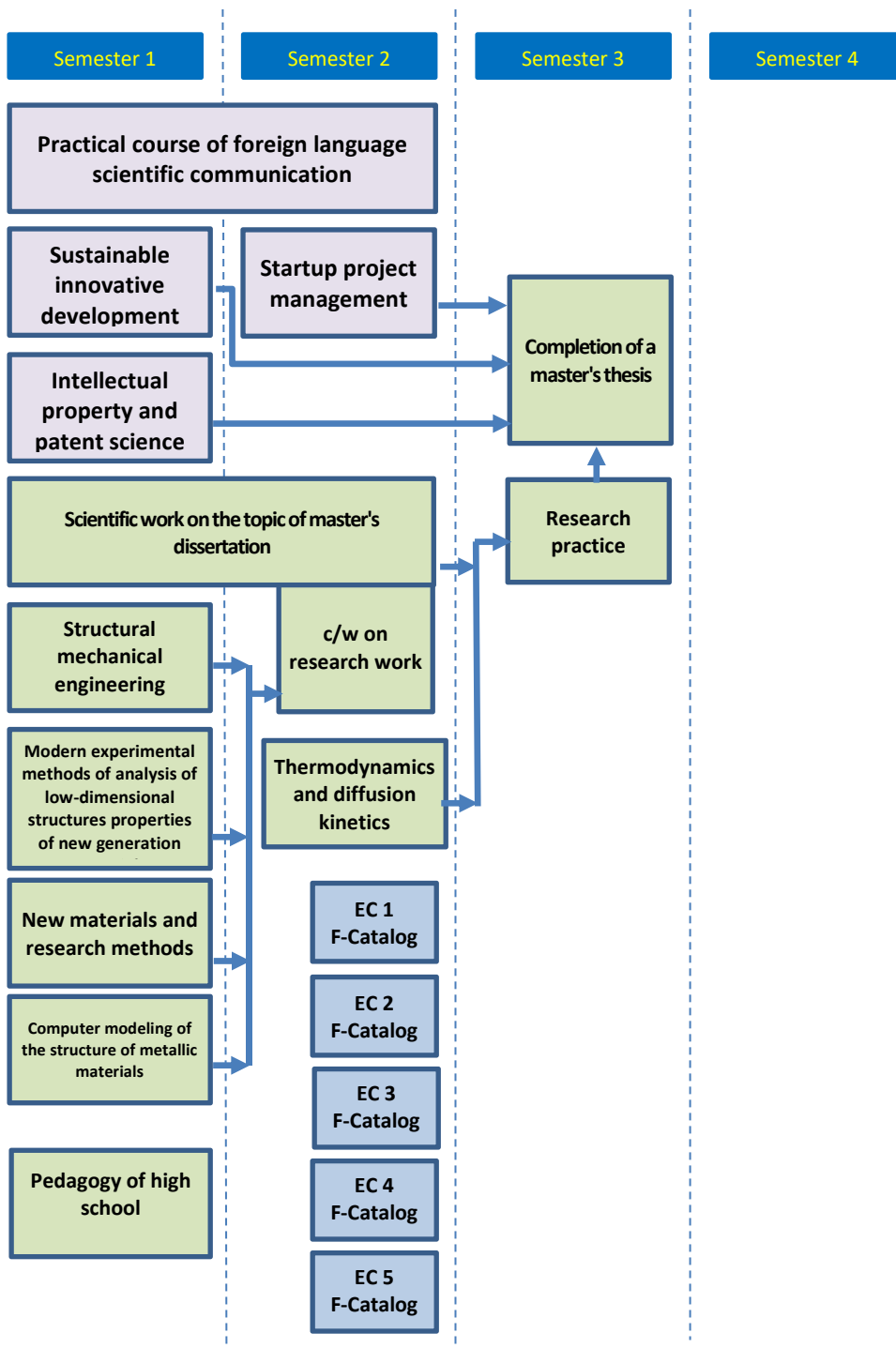
	equipment and its proper use.
SC.16	Ability on the basis of the analysis of the task on research of materials, products and coverings from them to choose necessary methods, techniques and a hardware complex.
SC.17	Ability to conduct expert research of destroyed products, draw conclusions (technical reports) and develop proposals to improve the reliability and durability of products.
7 – Program learning outcomes (LO)	
LO1	Understand and apply the principles of systems analysis, causal relationships between significant factors and scientific and technical solutions in the context of existing theories.
LO2	Identify, formulate and solve materials science problems and problems.
LO3	Fluent in state and English orally and in writing to discuss professional issues and results in the field of materials science and a wider range of engineering issues, presentation of research results and innovative projects.
LO4	Use modern information technologies and specialized software to solve complex problems of materials science.
LO5	Make effective decisions in new situations or unforeseen conditions, taking into account their possible consequences, evaluate and compare alternatives, assess technical, economic, environmental and legal risks.
LO6	Scientific skills in the field of engineering in order to successfully conduct research under both guidance and independently.
LO7	Develop and implement projects in the field of materials science and interdisciplinary areas related to materials science, define goals and necessary resources, plan work, organize the work of the team of performers, protect intellectual property.
LO8	Be able to apply methods of protection of intellectual property created in the course of professional (scientific and technical) activities.
LO9	Apply methods of LCA-analysis, eco-audit, sustainable development approaches when developing new materials and implementing new technologies.
LO10	Skills of presentation of scientific material and arguments for a well-informed audience.
LO11	Use modern methods to identify, formulate and solve inventive problems in the field of materials science.
LO12	Formulate and solve scientific and technical problems for the development, manufacture, testing, certification, disposal of materials, creation and application of effective manufacturing technologies.
LO13	Plan and perform experimental materials research, select appropriate equipment and techniques, perform statistical processing and statistical analysis of experimental results, substantiate conclusions.
LO14	It is reasonable to assign and control quality indicators of materials and products.
LO15	Design new materials, develop, research and use physical and mathematical models of materials and processes.
LO16	Ability to effectively use in practice theoretical concepts of management and business administration.
LO17	Solve applied problems of manufacturing, processing, operation and disposal of materials and products.
LO18	Collect the necessary information using scientific and technical literature, databases and other sources, analyze and evaluate it.
LO19	Develop a comprehensive design of new materials and products based on them, taking into account the performance properties and conditions of use.
LO20	To be able to convey one's own knowledge, conclusions and arguments on issues of materials science and tangential problems to non-specialists, in particular to studying persons.
LO21	Apply the methods of structural and chemical analysis for the study of multi-layered low-dimensional structures, take into account the nanoscale factor during research.

8 – Resource support for program implementation	
Staffing	In accordance with the personnel requirements for ensuring the implementation of educational activities for the relevant level of HE (Annex 2 to the License Conditions), approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187
Logistics	In accordance with the technological requirements for material and technical support of educational activities of the appropriate level of HE (Annex 4 to the License Conditions), approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187
Information and educational and methodical support	In accordance with the technological requirements for educational and methodological and informational support of educational activities of the appropriate level of HE (Annex 5 to the License Conditions), approved by the Resolution of the Cabinet of Ministers of Ukraine dated 30.12.2015 № 1187
9 – Academic mobility	
National credit mobility	Possibility of concluding agreements on academic mobility and double diplomacy
International credit mobility	Under the Erasmus + KA1 program, there are agreements with the Catholic University (Leuven, Belgium) and the National School of Chemistry (Lille, France), in 2018 an academic mobility project was submitted with the University of Transylvania (Brasov, Romania). Under the Mevlana program, an agreement on academic mobility has been signed with Dumlupinar University (Kutahya, Turkey). Agreement on a double degree with the Technical University of Magdeburg (Germany).
Training of foreign applicants for higher education	Can be done in Ukrainian or English, provided that the level of studying language is not lower than B2

LIST OF COMPONENTS OF THE EDUCATIONAL PROGRAM

Code	Components of the educational program (academic disciplines, course projects / works, practices, qualification work)	Number of ECTS credits	Form of final control
1	2	3	4
MANDATORY (normative) components of EP			
General training cycle			
ZO1	Intellectual property and patent science	3	Final test
ZO2	Sustainable innovative development	2	Final test
ZO3	Practical course of foreign language professional communication	3	Final test
ZO4	Startup project management	3	Final test
Cycle of professional training			
PO1	Structural engineering of mechanical properties of new generation materials	4	Final test
PO2	Modern experimental methods of analysis of low-dimensional structures	4.5	Final test
PO3	New materials and research methods	5	Examination
PO4	Computer modeling of the structure of metallic materials	6	Examination
PO5	Pedagogy of high school	2	Examination
PO6	Thermodynamics and diffusion kinetics	3.5	Examination
PO 07	Scientific work on the topic of master's thesis		
PO 07.01	Scientific work on the topic of master's thesis. Part 1. Basics of the scientific research	2	Final test
PO 07.02	Scientific work on the topic of master's thesis. Part 2. Scientific research work on the topic of master's thesis.	2	Final test
PO8	Scientific work on the topic of master's thesis/ Coursework	1	credit
PO9	Practice	14	Final test
PO10	Preparation and defense of a master's thesis	12	Speech and discussing
Optional educational components			
Vocational training cycle (Optional subjects from Faculty catalogue)			
PV1	Educational Component 1 from Faculty Catalogue	5	credit
PV2	Educational Component 2 from Faculty Catalogue	5	credit
PV3	Educational Component 3 from Faculty Catalogue	5	credit
PV4	Educational Component 4 from Faculty Catalogue	4	credit
PV5	Educational Component 5 from Faculty Catalogue	4	credit
Total required components:			67
The total amount of sample components:			23
The scope of educational components that ensure the acquisition of competencies of certain SVO:			45
Total:			90

2. STRUCTURAL AND LOGICAL SCHEME OF THE EDUCATIONAL PROGRAM



4. FORM OF GRADUATE CERTIFICATION OF HIGHER EDUCATION APPLICANTS

Graduation certification of applicants for higher education in the educational program *Engineering and computer modeling in materials science specialty 132 Materials science* is carried out in the form of public defense of the qualification work and ends with the issuance of a standard document for awarding a master's degree with a qualification: Master of Materials Science.

Qualification work is checked for plagiarism and after defense is placed in the repository of NTB University for free access. Graduation certification is carried out openly and publicly.

**5. MATRIX OF SOFTWARE COMPETENCE COMPETENCES
COMPONENTS OF THE EDUCATIONAL PROGRAM**

	Z01	Z02	Z03	Z04	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
GC.01								+	+					
GC.02	+		+	+	+	+	+		+		+	+	+	+
GC.03				+										
GC.04			+											
GC.06												+		+
GC.07				+							+		+	+
GC.08														
GC.09		+					+							
SC.01				+	+	+	+	+		+	+	+	+	+
SC.02					+	+	+	+			+	+	+	+
SC.03					+	+	+	+		+	+	+	+	+
SC.04					+	+	+				+	+	+	+
SC.05							+				+	+	+	+
SC.06								+						
SC.07				+										+
SC.08									+					
SC.09					+	+	+	+			+	+	+	+
SC.10											+	+		+
SC.11				+							+	+	+	+
SC.12				+										
SC.13											+	+	+	+
SC.14				+										
SC.15											+	+	+	+
SC.16					+	+	+	+			+	+	+	+
SC.17					+	+	+	+			+	+	+	+

6. MATRIX OF PROVIDING SOFTWARE LEARNING RESULTS BY RELEVANT COMPONENTS OF THE EDUCATIONAL PROGRAM

	Z01	Z02	Z03	Z04	P01	P02	P03	P04	P05	P06	P07	P08	P09	P010
LO 1				+	+	+	+	+		+	+	+	+	+
LO 2					+	+	+	+		+	+	+	+	+
LO 3			+	+								+	+	+
LO 4								+		+	+	+	+	+
LO 5	+	+		+						+				
LO 6										+	+	+	+	+
LO 7	+			+										+
LO 8	+													
LO 9		+		+										
LO 10				+					+			+	+	+
LO 11					+	+	+	+		+	+	+	+	+
LO 12											+	+	+	+
LO 13					+	+	+	+			+	+	+	+
LO 14												+	+	+
LO 15							+	+		+				
LO 16				+										
LO 17					+		+	+			+	+	+	+
LO 18				+							+	+	+	+
LO 19							+	+						
LO 20									+					
LO 21						+						+	+	+