MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

KYIV NATIONAL UNIVERSITY OF TECHNOLOGIES AND DESIGN

APPROVED BY THE ACADEMIC COUNCIL

Head of the Academic Council of KNUTD

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(protocol from «____» _____ 2021 №___)

EDUCATIONAL AND PROFESSIONAL PROGRAM

Nano- and Microtechnology in Design

Level of Higher Education First

Degree of higher education Bachelor

Field of knowledge 10 Natural Sciences

Specialty 105 Applied Physics and Nanomaterials

Qualification Bachelor of Applied Physics and Nanomaterials

Kyiv 2021

1. Profile of the educational and professional program «Nano- and Microtechnology in Design»

1 – General information	
Full name of higher educational institution and structural unit	Kyiv National University of Technologies and Design Department of Applied Physics and Higher Mathematics
Degree of higher education and qualification in the language of the original	Higher education level - the first (Bachelor's) level Higher education degree Bachelor's degree Branch of knowledge - 10 Natural Sciences Specialty - 105 Applied physics and nanomaterials
Type of diploma and scope of the educational program	Bachelor's degree, single, 240 ECTS credits / 180 ECTS credits for a reduced period of study
Availability of accreditation	-
Cycle/level	National Qualifications Framework of Ukraine - level 6
Prerequisites	Complete general secondary education, professional higher education or junior bachelor's degree (junior specialist). According to the Standard of Higher Education for obtaining a bachelor's degree on the basis of a bachelor's degree (educational qualification level "junior specialist"), a higher education the University has the right to recognize and recalculate learning outcomes obtained within the previous junior bachelor (junior specialist) training program, but no more than 60 ECTS credits; to obtain a bachelor's degree on the basis of a professional junior bachelor's degree, a higher education institution has the right to recognize and recalculate learning outcomes obtained within the previous professional bachelor's degree training program, but not more than 30 ECTS credits.
Language	Ukrainian
The validity of the study program	-
Internet address of the permanent placement of the description of the educational program	http://knutd.edu.ua/ekts/
2 – The purpose of the educational program	
The purpose of the educational program is to combine a high level of professional training with the formation of the student's scientific worldview and providing a broad outlook in the social, humanitarian, fundamental and professional spheres. Achieving this goal is based on the principles of continuity and individualization of learning, fundamentality and integrity of knowledge, practical orientation and awareness of the place of acquired competencies, the symbiosis of scientific and aesthetic-artistic approaches and more. *The main objectives of the program are:* training of specialists capable of independently developing product designs taking into account technological, economic, environmental and aesthetic parameters; to carry out the correct substantiation of the choice of hardware and software for the decision of the set	

tasks in the field of technology of nanostructures; to carry out research work in the field of energy efficient technologies with the use of nanomaterials and nanotechnologies, which will help reduce the consumption of different types of fuel, increase environmental safety; improving the visual and aesthetic perception of design developments without reducing their functionality; to carry out design works with the use of hardware and software for the development, manufacture and research of nanostructures.	
3 – Characteristics of the educational program	
Subject area	The program is focused on formation of applicants' competencies for the acquisition of deep knowledge, skills and abilities in the specialty. Compulsory training modules – 75%, of which: disciplines of general training – 35%, professional training – 39%, practical training – 13%, learning a foreign language – 13%. Disciplines of free choice of the student – 25%, are chosen from the general university catalog according to the approved procedure at the University.
Orientation of the educational program	Educational and professional program for bachelor's degree. The program focuses on acquiring knowledge regarding: properties, features of use and manufacture of nanomaterials; information technology in the development and design of new products; determination of technical and economic indicators; improvement of design solutions using nanotechnologies.
The main focus of the educational program	The emphasis is on the formation and development of professional competencies in the field of natural sciences with the possibility of acquiring the necessary engineering and design skills, the study of theoretical and practical provisions, practical tools for computer modeling of processes and products.
Features of the educational program	The peculiarity of the program is that students have the opportunity to simultaneously learn both the theoretical foundations of physics and peculiarities of properties of nanomaterials and the basics of design, as well as to acquire practical skills to combine aesthetic and cultural values and the latest advances in science and technology in one object.
4 – Eligibility of graduates for employment and further training	
Eligibility for employment	The graduate is suitable for employment in enterprises, organizations and institutions operating in the field of design and creation of design solutions using the latest nano- and micro-dimensional structures. Professional titles of works that can be performed by the graduate: research engineer in nanotechnology; design engineer; nanoparticle production engineer; nanotechnology engineer-technologist; nanomaterials design engineer; engineer for the introduction of new equipment and technology; design engineer. Working places: - in design studios specializing in the introduction of modern materials and technologies in the production of goods and services; - at enterprises and organizations engaged in the development and implementation of "smart" technologies in the construction industry, in the production of furniture and interior; - at the enterprises and the organizations which are engaged in designing, manufacture and introduction of the heat power, fuel- and heat-consuming equipment.
Further training	Possibility of studying according to the educational-scientific and / or educational-professional program of the second (master's) level of higher education.
5 – Teaching and assessment	

Teaching and training	Student-centered, problem-based and professionally oriented learning, learning through training and production practice and self-study are used. The system of teaching methods is based on the principles of purposefulness, communication, binarity – active direct participation of research and teaching staff and applicant for the highest education. Forms of organization of the educational process: lecture, seminar, practical, laboratory lessons, practical training, independent work, consultation, development of professional projects (works).	
Assessment	Tests, presentations, reports, essays, control works, project works, oral and written exams.	
6 – Program competencies		
Integral competence (IC)	Ability to solve complex specialized problems and practical problems of applied physics and nanomaterials, which involves the application of theories and methods of physics, mathematics and engineering and is characterized by complexity and uncertainty of conditions.	
General competencies (GC)	**GC 1**	Ability to apply knowledge in practical situations.
	GC 2	Knowledge and understanding of the subject area and understanding of professional activity.
	GC 3	Ability to communicate in the state language both orally and in writing.
	GC 4	Ability to communicate in a foreign language.
	GC 5	Skills in the use of information and communication technologies.
	GC 6	Ability to conduct research at the appropriate level.
	GC 7	Ability to search, process and analyze information from various sources.
	GC 8	Interpersonal interaction skills.
	GC 9	Ability to work independently.
	GC 10	Skills for safe activities.
	GC 11	The ability to exercise their rights and responsibilities 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 civil rights and freedoms in Ukraine.
	GC 12	Ability to preserve and multiply moral, cultural, scientific values and achievements of society based on 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, techniques and technologies. active recreation and a healthy lifestyle.
Professional competencies (PC)	**PC 1**	Ability to participate in the planning and implementation of scientific and scientific-technical projects.
	PC 2	Ability to participate in the planning and execution of experiments and laboratory studies of the properties of physical systems, physical phenomena and processes, processing and presentation of their results.
	PC 3	Ability to participate in the production of experimental samples, other objects of study.
	PC 4	Ability to participate in the implementation of research and development results.
	PC 5	Ability to constantly develop competencies in the field of applied physics, engineering and computer technology.

	PC 6	Ability to use modern theoretical concepts in the field of physics for the analysis of physical systems.
	PC 7	Ability to use methods and tools of theoretical research and mathematical modeling in professional activities.
	PC 8	Ability to work in teams of performers, including in interdisciplinary projects.
	PC 9	Ability to participate in the planning of methods of conducting and material support of experiments and laboratory studies of the properties of physical systems, physical phenomena and processes, processing and presentation of their results.
	PC 10	Ability to perform theoretical and experimental research independently and as part of a research team.
	PC 11	Ability to demonstrate the results of experimental studies of the properties of the physical system, physical phenomena and processes.
	PC 12	Ability to demonstrate knowledge of the characteristics and properties of nanomaterials and their production processes.
	PC 13	Ability to investigate and identify problems and identify constraints, including those related to conservation, sustainable development, health and safety, and risk assessments for the use of nanomaterials.
	PC 14	Ability to analyze the possibilities of using nanostructured materials to ensure the functional properties of design objects.
	PC 15	Ability to select and substantiate certain nanotechnologies in the process of working on innovative projects.
	PC 16	Ability to perform economic justification of the need for scientific research and to promote the product of scientific development on the market.
	PC 17	Ability to participate in the development of schemes of physical experiments and the selection of the necessary equipment and devices for the experiment.
	PC 18	Developed a sense of personal responsibility for the accuracy of research results and adherence to the principles of academic integrity along with professional flexibility.
	PC 19	Ability to implement design requirements through the use of the latest materials with properties that are not typical of classical materials.
7 – Program learning outcomes		
Knowledge and understanding:		
SLO 1	Know and understand modern physics at a level sufficient to solve complex specialized problems and practical problems of applied physics.	
SLO 2	Understand the patterns of development of applied physics, its place in the development of technology, technology and society, including in solving environmental problems.	
SLO 3	To know the basics of philosophy and psychology, which contribute to the development of general culture and socialization of the individual, the tendency to ethical values, to understand the causal links of society.	
SLO 4	Know the basics of general and applied ecology, the principles of protection and conservation of nature from harmful effects in the production of nanomaterials. Know the basics of working with personal protective equipment, fire safety and labor protection.	
SLO 5	Know the properties and methods of obtaining and using nanomaterials and nanostructured objects.	
SLO 6	Know the goals of sustainable development and the opportunities of their professional sphere to achieve them, including in Ukraine.	
Application of knowledge and understanding (skills):		

SLO 7	Search for the necessary scientific and technical information in the scientific literature, electronic databases, other sources, assess the reliability and relevance of information.
SLO 8	Classify, analyze and interpret scientific and technical information in the field of applied physics.
SLO 9	Apply modern mathematical methods for the construction and analysis of mathematical models of physical processes.
SLO 10	Assess the financial, material and other costs associated with the implementation of projects in the field of applied physics, social, environmental and other potential consequences of project implementation.
SLO 11	Apply effective technologies, tools and methods of experimental study of the properties of substances and materials, including nanomaterials, in solving practical problems of applied physics.
SLO 12	Evaluate the impact of cutting-edge achievements and new discoveries in the design of design objects using nanotechnology.
SLO 13	Apply physical, mathematical and computer models for the study of physical phenomena, development of devices and science-intensive technologies.
SLO 14	Have the skills to work with modern computer technology, be able to use standard application packages and program at a level sufficient for numerical solutions of physical problems and modeling of physical phenomena.
SLO 15	Demonstrate laboratory and technical skills, be able to plan and perform experimental research using tools (measuring instruments), assess the errors of research and draw conclusions.
SLO 16	Choose effective methods and tools for research in the field of applied physics.
SLO 17	Present the results of research and development to specialists and non-specialists and argue their own position.
SLO 18	Be able to use practical skills to solve problems involving the implementation of projects using nanostructured materials and conducting the necessary research.
SLO 19	Be able to apply knowledge of conceptual design techniques and carry out the design process taking into account modern technologies and design solutions, as well as functional and aesthetic requirements for design objects.
SLO 20	Analyze the impact of the inclusion of nanoobjects in classical materials on the fundamentally new functional properties of these materials.
SLO 21	Assess non-technical (society, health and safety, environment, economy and industry) consequences of scientific and engineering practice.
Forming judgments:	
SLO 22	To form judgments about the need to preserve and increase the moral, cultural and scientific values and achievements of society.
SLO 23	To manage professional activities, participate in project work, taking responsibility for decision-making.
SLO 24	Develop skills of effective communication (written and oral) on information, ideas, problems and solutions with the engineering and scientific community and society in Ukrainian and one of the foreign languages.
SLO 25	Be able to select and apply suitable typical analytical, calculation and experimental methods; correctly interpret the results of such studies.
SLO 26	Have the skills to make independent decisions about their educational trajectory and professional development.
SLO 27	Communicate freely on professional issues in the state and English languages orally and in writing.
SLO 28	Plan and organize effective professional activities individually and as a team member in the development and implementation of scientific and applied projects.
8 – Resource support for program implementation	

Personnel support	All scientific and pedagogical workers who provide the educational program on qualification correspond to a profile and a direction of the educational components, which are taught; have the necessary experience of pedagogical work and experience of practical work. In the process of organizing training, professionals with experience in research / management / innovation / creative work and / or work in the specialty are involved.
Material and technical support	Logistics allows to fully ensuring the educational process throughout the training cycle of the educational program. The condition of the premises is certified by sanitary and technical passports that comply with current regulations.
Information and educational support	The program is fully equipped with an educational and methodological complex of all components of the educational program, the availability of which is presented in the modular environment of the educational process of the University.
9 – Academic mobility	
National Credit mobility	Provides for the possibility of national credit mobility for some educational components that provide the acquisition of general competencies.
International Credit Mobility	The program develops prospects for participation and internships in research projects and academic mobility programs abroad.
Training of foreign applicants for higher education	Training of foreign applicants for higher education is carried out according to accredited educational programs.

2. List of components of the educational and professional program and their logical sequence

2.1 List of components of the educational and professional program of the first (bachelor's) level of Higher Education

Code	Components of the educational program (academic disciplines, term papers (projects), practices, qualification work)	Number of credits	Final control form
1	2	3	4
Mandatory components of the educational program			
General training cycle			
MEC 1	Ukrainian and foreign culture	3	credit
MEC 2	Business Ukrainian language	3	credit
MEC 3	Philosophy, political science and sociology	6	exam
MEC 4	Foreign language (English, German, French)	12	exam
MEC 5	Higher mathematics	12	exam
MEC 6	Probability theory and mathematical statistics	3	exam
MEC 7	Physics	12	exam
MEC 8	Entrepreneurial business	3	credit
MEC 9	Interchangeability, standardization and technical measurements	3	exam
MEC 10	Basics of labor protection	3	exam
MEC 11	Physical Education [1]	3/9	credit
MEC 12	Engineering and computer graphics	6	exam
Total from the cycle		**69**	
Professional training cycle			
MEC 13	Innovative technologies in industrial design	9	exam

MEC 14	Special technologies in design - designing	9	exam
MEC 15	Mathematical apparatus of physics	3	credit
MEC 16	Foreign language of professional orientation (English)	12	exam
MEC 17	Concepts of using nanomaterials in design	3	exam
MEC 18	Computer modeling in nanotechnology	3	exam
MEC 19	Modern technologies of design activity	6	exam
MEC 20	Elements of quantum mechanics	3	exam
MEC 21	Carbon nanostructures	6	exam
MEC 22	Fundamentals of spectral analysis	3	exam
MEC 23	Methods of obtaining nanomaterials	3	exam
MEC 24	Electrical materials with nanoparticles	3	exam
MEC 25	Advanced laser technology	6	exam
MEC 26	Investigation of physical properties of materials with nanostructured coating	3	exam
MEC 27	Modification of optical parameters of materials for design	3	exam
MEC 28	Educational practice	12	credit
MEC 29	Internship	6	credit
MEC 30	Pre-diploma practice	6	credit
MEC 31	Bachelor's thesis (project)	12	certification
Total from the cycle		**111**	
Total number of compulsory components:		**180**	
Selective components of educational program			
DFCS	Disciplines of free choice of the student	60	credit
Total number of selective components:		**60**	
TOTAL AMOUNT OF THE EDUCATIONAL PROGRAM		**240**	

[1] – non-credit discipline in 2, 3, 4 semester

3. Form of certification of higher education applicants

Forms of certification of higher education applicants	Certification of graduate of higher educational program is carried out in the form of Bachelor's thesis (project).
Document on higher education	Bachelor's degree with educational qualification: Bachelor of Applied Physics and Nanomaterials