Ministry of Education and Science of Ukraine
V.N. Karazin Kharkiv National University

Educational-scientific program
(educational-professional / educational-scientific)

Medical physics (the English language of instruction)
(title of program)

Second (Master of Science) degree of higher education
(the first (Bachelor), the second (Master of Science), the third (Doctor of Philosophy))

Area of knowledge 10 – natural sciences
(code, title)

Speciality 105 – Applied physics and nanomaterials
(code, title of speciality)

Approved by the Scientific Council of V.N. Karazin Kharkiv National University
"29" 05 2023, minutes №9
It is put in an operation from 2023/2024 s.y.
by an order "01" 06 2023.
№ 0114-1/227

Vice-rector on scientifically-pedagogical work
_____ Oleksandr HOLOVKO

Kharkiv 2023.

APPROVAL

of educational-scientific program

The educational program is considered and approved on:

1.1. Scientifically-methodical council of V.N. Karazin Kharkiv national university
minutes № dd. «16» 05 2023.

Chairman of scientifically-methodical council,
Vice-rector on scientifically-pedagogical work _____ Oleksandr HOLOVKO

1.2. Scientific council of Educational and Research Institute "School of physics and Technology":
minutes № 2 dd. « 15 » February 2023.

Chairman of Scientific Council of the Institute _____ Sergiy LYTOVCHENKO

1.3. Scieynific and methodic committee of Educational and Research Institute "School of Physics and Technology":
minutes № 6 dd. « 14 » February 2023.

Chairman of Methodic Committee of the Institute _____ Mykola YUNAKOV

1.4. Department of Medical Physics and Biomedical Nanotechnologies:
minutes №_ dd. «__» _____ 2023.

Head of Department _____ Valeriya TRUSOVA

INTRODUCTION

Developed by the workgroup consisting of:

Name and surname	Position	Scientific degree, scientific title, by which department (speciality) given
Head of the workgroup:		
Valeriya Trusova	Head of Department of Medical Physics and Biomedical Nanotechnologies	D.Sc., Associate Professor, Department of Medical Physics and Biomedical Nanotechnologies, Corresponding Member of NAS of Ukraine
Members of the workgroup		
Igor Girka	Director of Educational and Research Institute “School of physics and Technology” V.N. Karazin Kharkiv National University	D.Sc., professor, Department of General and Applied Physics, Corresponding Member of NAS of Ukraine
Kostiantyn Sereda	Vice Head of Educational and Research Institute “School of physics and Technology” V.N. Karazin Kharkiv National University, Associate professor of Department of Applied Physics and Plasma Physics	Ph.D., Senior Researcher, speciality 01.04.08 – Plasma Physics
Yevhen Barannyk	Professor of the Department of Medical Physics and Biomedical Nanotechnologies	D.Sc., Professor, Department of Medical Physics and Biomedical Nanotechnologies
Galyna Horbenko	Professor of the Department of Medical Physics and Biomedical Nanotechnologies	D.Sc., Professor, Department of Medical Physics and Biomedical Nanotechnologies

Developed according to the Interim Standard of Higher Education for the second level of higher education "Master" in specialty 105 "Applied Physics and Nanomaterials", approved by the Academic Council of the University on May 29, 2017, minutes № 8.

1. Profile of the educational program
"Medical physics" (the English language of instruction)

speciality 105 – Applied Physics and Nanomaterials

1 – General information	
Full name of higher education institution and structural unit	V.N. Karazin Kharkiv National University, Educational and Research Institute "School of Physics and Technology"
Degree of higher education and qualification	Level of higher education: Master of Science Speciality: 105 – Applied physics and nanomaterials Educational qualification: master in applied physics and nanomaterials, medical physics
Official title of the educational program	Medical physics (the English language of instruction)
Type of diploma and the scope of the educational program	Diploma of Master of Science, single, 120 ECTS-credits, apprenticeship 1 year 9 months.
Accreditation availability	
Cycle/level	National Qualification Frame of Ukraine – level 8, FQ-EHEA – the second cycle, EQF-LLL – level 8
Prerequisites	Diploma of Bachelor of Science
Language of instruction	English
Validity period	31.05.2025
Permanent web address of the educational program	http://start.karazin.ua/programs/7/15/105/ http://physics-technology.karazin.ua/academics
2 – Aims of the educational program	
Aim of the program	Forming and development of general and professional competences in medical physics, which contribute to the social stability and mobility of the graduate in the labour-market; gaining of higher professional education, which allows the graduate to perform successfully the functions and the regular tasks of a medical physicist in various fields of human activity, medical instrumentation and scientific research.
3 – Characteristics of the educational program	
Subject area (area of knowledge, speciality, specialization (if applicable))	Area of knowledge: 10 – Life sciences Speciality: 105 – Applied physics and nanomaterials
Orientation of the educational program	Educational-scientific, academic. Guarantees the attainment of the complex of general and professional competences, essential for performance of professional tasks in the interdisciplinary field of medical physics, focused on training of scientific personnel for solving problems of modern medicine and conducting scientific research in the process of developing new physical methods and medical equipment for treatment and diagnosis with a predominant professional orientation for further work in scientific institutions, medical institutions and higher educational institutions.

Main focus of the educational program and specialization	Special education and professional training in the field of modern methods of medical and biological research, medical visualization, physical principles of radiotherapy and radiology, tomography with ionizing radiation, clinical dosimetry and radiation safety, computational modelling in biology and medicine, physics of biomolecules, molecular biology and genetics, physics of biomembranes and bionanotechnologies, as well as information systems for science intensive physical technologies and medical equipment, with the opportunity to acquire the necessary research skills for a scientific career. ***Key words:*** research methods, medical visualization, radiotherapy, tomography, clinical dosimetry, computational modelling, bionanotechnologies, molecular biology.
Peculiarities	
4 – Work placement availability and further education aptitude	
Work placement availability	Types of economic activity (according to ДК 009:2010): 2111.1 – Junior researcher, 2111.1 – Researcher, 2111.1 – Researcher-consultant, 2111.2 – Radiation safety engineer, 2111.2 – Reactor control engineer (accelerator, nuclear physics unit), 2111.2 – Radiological engineer, 2111.2 – Radiation safety inspector, 2132.2 – Engineer (database), 2132.2 – Applied programmer 2143.1 – Junior researcher (electrical engineering), 2143.1 – Researcher (electrical engineering), 2143.1 – Researcher-consultant (electrical engineering), 2144.1 – Junior researcher (electronics), 2144.1 – Researcher (electronics), 2144.1 – Researcher-consultant (electronics), 2144.2 – Engineer for repair and maintenance of automation and measuring instruments of a nuclear power plant, 2146.2 – Engineer for accounting and storage of nuclear materials of a nuclear power plant, 2149.2 – Nuclear power plant equipment engineer.
Further education	Further education on the third (educational-research) level of higher education.
5 – Instruction and evaluation	
Instruction and training	The main approaches to education are competent, active, student friendly and problem oriented ones. Main methods of instruction are problematic, partially exploring and research ones. Instruction has the forms of lections, including interactive and multimedia lectures, seminars, self-preparation and research work. Design, graphic modeling and interactive communicative technologies of instruction are used
Evaluation	Four-level and two-level, 100-score grading system by means of the following methods of monitoring with accumulation of scores: *current* (oral and written quiz), *interim* (tests), *final* (written tests, training records), *certification* (Master's thesis defence)

6 – Program competences	
Integral competences	Ability to solve scientific and scientific-technological tasks and problems in the field of Medical and Applied Physics, in particular, Medical Radiation Physics and Medical Biophysics, to carry out research activities in this area, which involves deep understanding of existing knowledge, creation of new knowledge, mastering methodology scientific activity, practical implementation of the obtained results (**ІК-1**).
General competences	1. Ability for self-development and self-realization (**ЗК-1**); 2. Ability for abstract thinking, analysis and synthesis on the corresponding levels (**ЗК-2**); 3. Information and communication technology user skills (**ЗК-3**); 4. Ability for written and oral communication in foreign language (state language as a foreign language for international students) (**ЗК-4**); 5. Ability for working in the special cases (**ЗК-5**); 6. Knowledge and understanding of the subject area and professional activity (**ЗК-6**).
Special (professional, subject) competences	1. Ability to conduct independently the scientific research, make the plan of research and obtain novel fundamental and applied results (**ФК-1**); 2. Ability to use the modern equipment during the research (**ФК-2**); 3. Ability to manage the strategy development of a team in the professional process (**ФК-3**); 4. Ability to develop new and improve present mathematical methods of analysis, modelling, prediction, solving problems from new areas of knowledge (**ФК-4**); 5. Ability to use the obtained knowledge for the development and realization of the working capacity of modern systems of medical and biological research and diagnostics according to the rules of regulatory activities of their exploitation. (**ФК-5**).
7 – Program results of training	
Knowledge (Зн.)	1. Ability to demonstrate the knowledge and understanding of scientific and mathematical principles necessary for solving the engineering tasks and conduct the research in the field of theoretical and applied physics, medical radiation physics, medical biophysics, etc. (**Зн-1**); 2. To have language skills, sufficient for communication in foreign sociocultural environment with a view to performing communication tasks, to have formed language competence of a foreign student on the elementary level (**Зн-2**); 3. Ability to demonstrate the in-depth knowledge in the field under study (**Зн-3**); 4. To know classification and essence of contemporary global problems and ways to solve them. To have skills in application of this knowledge and methods to investigation of contemporary political, economic, and social processes (**Зн-4**).

Skills (Ум.)	1. Ability to choose the methods and to model the phenomena and processes in dynamical systems and to analyze the obtained results (**Ум-1**); 2. Ability to plan and conduct independently the experiments and to evaluate the obtained results (**Ум-2**); 3. Ability to use the informational-community technologies and programming skills for solving the typical engineering tasks (**Ум-3**); 4. Ability to use the acquired knowledge and practical skills, to adapt the results of scientific research during the design of the novel medical diagnostics, therapeutic and surgery equipment, including the equipment which utilizes the sources of ionizing irradiation and radioactive materials (**Ум-4**); 5. Ability to use the knowledge for solving the problems of synthesis and analysis of the elements and systems specific for Medical Physics (**Ум-5**); 6. Ability to search, analyze and evaluate critically the information from different sources (**Ум-6**); 7. Ability to work both individually and as a team member (**Ум-7**); 8. Ability to combine the theory and experiments as well as to make the decisions, develop the strategy for solving the tasks of speciality (**Ум-8**); 9. Ability to conduct independently the experimental research (**Ум-9**); 10. Ability to analyze critically the main parameters of system functioning (**Ум-10**); 11. Ability to use the systematic approach, integrating the knowledge of other disciplines (**Ум-11**); 12. Ability to argue the choice of the methods of task solving, evaluate critically the obtained results (**Ум-12**).
Communication (Ком.)	1. Ability of communicate effectively at professional and social levels including oral and writing communication in foreign language (**Ком-1**); 2. Ability to present and discuss the obtained results and to transfer the acquired knowledge (**Ком-2**).
Autonomy and responsibility (AiB)	1. Ability to adapt to the new conditions and to make the decision (**AiB-1**); 2. Ability to understand the necessity of the study during the lifetime (**AiB-2**); 3. Ability to be responsible for the actions and to achieve the goal in terms of professional ethics (**AiB-3**); 4. Ability to demonstrate the understanding of the occupational safety (**AiB-4**).
8 – Program realization resources	
Staffing	Meets the license requirements. All lecturers are members of the staff of V.N. Karazin Kharkiv National University and hold D.Sc. or Ph.D. degrees and/or academic titles in the corresponding specialities. Existing staff undergoes retraining every five years. Practical-oriented pattern of the program suggests the

	participation of the high-level specialists from the leading institutions of Ukraine, which enhances the synergetic connection between theoretical and applied education.
Equipment and facilities	Medical Radiation Physics education is conducted in conjunction with S.P. Grigoriev Institute of Medical Radiology of the National Academy of Medical Sciences of Ukraine and the Institute of Scintillation Materials of the National Academy of Sciences of Ukraine using the following equipment: medical linear electron accelerator, 6 MeV Varian Clinac 600C; rotational-convergent gamma-therapeutic apparatus, Co-60 (1.25 MeV) ROKUS-AM; gamma therapy device, Co-60 (1.25 MeV) Eckert & Ziegler BEBIG Multisourse; X-ray simulator with computed tomography function Varian Acuity; mobile X-ray diagnostic equipment Radius R-9; two universal dosimeters for clinical dosimetry PTW UNIDOS-E; two sealed ionization chambers for megavolt beams of photon ionizing radiation PTW 30013; two sealed ionization chambers for megavolt beams of photon ionizing radiation PTW 30010; semiconductor detectors PTW T9112 and PTW T9113 for in-vivo dosimetry of the rectum and bladder with built-in dosimetry system Multisourse; dosimetric water phantom PTW MP1 PhantomTank; dosimetric water phantom PTW MP3-M Phantom; universal radiotherapy planning system Varian Eclipse; planning system for brachytherapy Eckert & Ziegler BEBIG SagiPlan; PTW Mephysto MC2 clinical dosimetry system. The following main equipment is available in Medical Biophysics laboratories: ShimadzuRF-6000 spectrofluorimeters (ShimadzuCorp., Japan) and Perkin Elmer LS-55 (UK) for determining the fluorescence and excitation intensities (spectra and 3D spectra) of solutions molecules; spectrophotometers Shimadzu-UV-2600 (ShimadzuCorp., Japan), Unispesc 2 (Germany / China) and SF-46 (JSC LOMO, Russia) with automatic scanning modes in a given range of wavelengths; pH meter Mettle Toledo El20-kit for measuring the pH of biological samples; LUMAM-I fluorescence microscope with Cigeta digital eyepiece; Biolam 70-D1 optical microscope with Cigeta digital eyepiece and MBS-9 optical microscope; apparatus for rapid mixing of solutions (homogenization) of organic Vortex molecules; analytical scales AB623 CE Vibra and AS 220.R2 Radwag of a high class of accuracy with a special table; apparatus for extrusion of lipid nanovesicles LiposoFast-Basic LF-1, Avestin (UK); equipment for measuring microelectrophoresis, which consists of a generator, ammeter, voltmeter, optical microscope, a special chamber for liquid samples and electrodes; two laboratory centrifuges; a supercomputer for molecular dynamics simulations, which has an NVIDIA GeForce graphics processor, which allows calculations of microsecond dynamics of proteins; equipment for gel filtration (separation of proteins by molecular weight); equipment (cuvettes) for microdialysis - measurement of constants of binding of small ligands with proteins; Dameco and DE-10 water distillers; fume hoods. The equipment of the laboratories of Educational and Research

	Institute “School of Physics and Technology” is used to perform qualification works of students. During the production and undergraduate internships, students have an opportunity to acquire skills of scientific work on modern scientific and technological equipment of Kharkiv leading scientific institutions, specifically, the S.P. Grigoriev Institute of Medical Radiology of the National Academy of Medical Sciences of Ukraine, the Institute of Scintillation Materials of the National Academy of Sciences of Ukraine and the National Research Center "Kharkiv Institute of Physics and Technology" of the National Academy of Sciences of Ukraine, which is working to create new detectors for medical purposes,developed "hot chambers" for the production of medical radioisotopes on charged particle accelerators and completed the construction of unique equipment "neutron source" based on subcritical assembly, controlled by an electron accelerator and with the help of neutron channels can be used in medical radiotherapy.
Dataware	Official site of V.N. Karazin Kharkiv National University, unlimited Internet access, printed (Central Scientific Library of V.N. Karazin Kharkiv National University resources, repository, libraries of laboratories) and Internet resources (including Internet Education Center of V.N. Karazin Kharkiv National University); educational and working plans of courses and trainings (with explanatory notes), educational programs, sets of teaching resources, including lectures, practical tasks, tasks for self-preparation, tasks for current and final monitoring. Meets the license requirements, 100%.
9 – Academic mobility	
National credit mobility	
International credit mobility	Based on the contract between V.N. Karazin Kharkiv University and educational institutions of the partner countries. Specifically, European Nuclear Education Network (ENEN) and European Fusion Education Network (FuseNet)).
Instruction of international students	Foreign citizens are accepted on the basis of international contracts, on terms stated in these contracts, contracts between V.N. Karazin Kharkiv National University and foreign universities and organizations and individual contracts.

10. List of the components of the educational-research program and their logical order

10.1. List of the components of the educational-research program

Code of the course	Components of the educational program (courses, research projects (works), trainings, thesis)	Number of credits	Grading
1	2	3	4
Compulsory components of the educational program			
ОК 1	Foreign language for professional purposes	3	Four-level evaluation scale
ОК 2	Ukrainian as a foreign language	6	Four-level

			evaluation scale
OK 3	Methods of medical and biological research	6	Four-level evaluation scale
OK 4	Physical principles of radiotherapy	6	Four-level evaluation scale
OK 5	Tomography with ionizing radiation	5	Four-level evaluation scale
OK 6	Dosimetry of ionizing radiation	6	Two-level evaluation scale
OK 7	Physics of biomolecules	6	Four-level evaluation scale
Scientific part			
OK 8	Internship training	18	Two-level evaluation scale
OK 9	Thesis scientific research training	24	Two-level evaluation scale
OK 10	Thesis preparation	3	Four-level evaluation scale
Total compulsory components		**83**	
Elective components of the educational program			
BK 1	Medical visualization / Methods of biomembrane research	6	Four-level evaluation scale
BK 2	Computational modelling in medicine and biology / Computational analysis of biomolecules	6	Four-level evaluation scale
BK 3,4	Molecular biology and genetics / Methods of bioengineering	6	Four-level evaluation scale
BK 4,5	Physics of biomembranes and bionanotechnologies / Probing nanotechnologies in electronics	6	Two-level evaluation scale
BK 5,6	Master's seminar “Medical radiation physics” / Master's seminar “Biomedical nanotechnologies”	8	Two-level evaluation scale
BK 6,7	Term scientific research work in Medical radiation physics / Term scientific research work in Biomedical nanotechnologies	5	Two-level evaluation scale
Total elective components		**37**	
TOTAL		**120**	

10.2. Structural logical scheme of the educational program

Term	Components of the educational program	Number of credits
	Foreign language for professional purposes	1
	Ukrainian as a foreign language	2
	Physics of biomolecules	6
1	Dosimetry of ionizing radiation	6
	Physical principles of radiotherapy	3
	Elective course from BK 1	6
	Elective course from BK 2	6
	Total in the 1st term	30

	Foreign language for professional purposes	2
	Ukrainian as a foreign language	2
	Methods of medical and biological research	6
	Physical principles of radiotherapy	3
	Tomography with ionizing radiation	5
2	Elective course from BK 3	6
	Elective course from BK 4	6
	Total in the 2nd term	30
	Ukrainian as a foreign language	2
3	Elective course from BK 5	8
	Elective course from BK 6	5
	Intership training	18
	Total in the 3d term	33
	Thesis scientific research training	24
	Thesis preparation	3
	Total in the 4th term	27

11. Form of certification of master's candidates

Certification of master's candidates in the speciality has the form of defence of master's thesis, which is a result of the scientific research work of a candidate. Certification is carried out by the Examining board, approve by an order of the President of V.N. Karazin Kharkiv National University. The Examining board makes a decision on awarding the master's degree in speciality "Applied physics and nanomaterials" according to educational-scientific program "Medical Physics" to a candidate and issues a state diploma. Only students who successfully performed all requirements of educational plan are admitted to the certification.

Master's thesis is a completed consistent scientific research, which is an evidence of preparedness of a candidate to performing professional tasks using gained integral knowledge and skills. Analysis and applied research of the problems in the field of medical physics are expected. Size and structure of master's thesis is determined by the university. Theses undergo plagiarism checking, according to the procedure, determined by the education quality ensuring system. For the sake of persuasiveness and support of conclusions and suggestions, the talk of a candidate can have a form of a presentation with the use of multimedia equipment. Certification is held publicly.

12. Matrix of correspondence of program competences to the components of the educational program

	ОК 1	ОК 2	ОК 3	ОК 4	ОК 5	ОК 6	ОК 7	ОК 8	ОК 9	ОК 10	ВК 1	ВК 2	ВК 3	ВК 4	ВК 5	ВК 6
ЗК-1	●	●	●	●	●	●	●	●	●	●	●	●	●	●		●
ЗК-2			●	●	●	●	●	●	●	●	●	●	●	●	●	●
ЗК-3	●		●	●	●	●	●				●	●	●	●	●	●
ЗК-4	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
ЗК-5			●	●	●	●	●	●			●					●
ЗК-6		●	●	●	●	●	●	●	●	●	●					
ФК-1	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
ФК-2	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
ФК-3	●		●				●	●	●	●		●	●	●		●
ФК-4	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
ФК-5		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

13. Matrix for providing program results of training (ПРН) with correspondent components of educational program

ПРН	ОК 1	ОК 2	ОК 3	ОК 4	ОК 5	ОК 6	ОК 7	ОК 8	ОК 9	ОК10	ВК 1	ВК 2	ВК 3	ВК 4	ВК 5	ВК 6
Зн-1	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Зн-2	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Зн-3	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Зн-4		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Ум-1			●	●	●		●	●	●	●	●	●	●	●	●	●
Ум-2				●	●	●		●	●	●	●				●	●
Ум-3	●			●	●			●	●	●	●	●		●	●	●
Ум-4			●	●	●	●	●	●	●	●	●	●	●	●	●	●
Ум-5			●	●	●	●	●	●	●	●	●		●	●	●	●
Ум-6	●		●	●	●	●	●	●	●	●	●	●	●	●	●	●
Ум-7		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Ум-8	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●
Ум-9				●		●		●	●	●				●	●	●
Ум-10	●		●	●	●			●	●	●	●		●		●	●
Ум-11	●	●	●	●	●	●	●	●	●	●	●		●		●	●
Ум-12	●	●	●	●	●	●	●	●	●	●	●		●	●	●	●
Ком-1	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Ком-2	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
АіВ-1		●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
АіВ-2	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
АіВ-3			●	●	●	●	●	●	●	●	●	●	●	●	●	●
АіВ-4	●		●	●	●	●	●	●	●	●	●		●	●	●	●