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ФИО: Ястребов Олег Александрович
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**Federal state autonomous higher education institution « Peoples' Friendship
University of Russia name after Patrice Lumumba»**

Medical institute

(Name of main training unit (GMS), developer of OPS BO)

WORK PROGRAM OF DISCIPLINE

BASICS OF HADRON THERAPY AND NUCLEAR MEDICINE

(name of discipline/module)

Recommended by ISSC for the direction of training/specialty:

06.04.01 Biology

(Code and name of training/specialization)

The development of the discipline is carried out within the framework of the implementation of the basic professional educational program of higher education (OP B):

Radiation biomedicine

(name (profile/specialization) OP BO)

1. PURPOSE OF DISCIPLINE DEVELOPMENT

The goal of development of discipline « Basics of hadron therapy and nuclear medicine» is acquisition of knowledge on theoretical and practical aspects of application of methods of nuclear medicine and particle radiotherapy in the treatment of oncological and non-oncological diseases, formation of skills of practical application of the acquired knowledge.

2. REQUIREMENTS TO THE RESULTS OF DISCIPLINE DEVELOPMENT

Mastering the discipline «Basics of nuclear medicine and particle therapy» is aimed at forming the following competencies of students:

Table 2.1. List of competencies formed by students in the development of the discipline (results of the development of the discipline)

Cipher	Competency	Competence Achievement Indicators (within this discipline)
OPK-2	Able to creatively use knowledge of fundamental and applied sections of disciplines (modules) that determine the orientation of the master's program	OPK-2.1. Has an idea of the theoretical foundations of biological disciplines and uses this knowledge to solve professional problems. OPK-2.2. He is able to creatively use special theoretical and practical knowledge to form new solutions by integrating various methodological approaches. OPK-2.3. Proficient in critical analysis of proposed solutions.
OPK-7	Able to define strategy and issues independently research, decision making, incl. innovative, choose and to modify methods, to be responsible for the quality of work and the implementation of its results, to ensure safety measures in the solution of a specific task	OPK-7.3. Able to choose and modify methods of solving tasks
PC-2	Able to perform fundamental and applied research aimed at developing and improving methods of diagnostics of pathological processes and technologies of personalized medicine	PC-2.3. Applies modern biophysical, physico-chemical and medico-biological methods of research of living matter at different levels of organization. PC-2.4. Analyzes, interprets, evaluates, presents and protects the results of the conducted research with reasoned conclusions

PC-3	Able to search and analyze regulatory and scientific information to solve professional problems	PC-3.1. Collects regulatory and scientific information necessary for solving professional problems using various sources. PC-3.2. Systematizes and analyzes information to solve a specific problem.
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3. PLACE OF DISCIPLINE IN THE STRUCTURE OF

The discipline « Basics of hadron therapy and nuclear medicine» refers to the variable part of the block B1 OP BO.

Within the framework of OT B, students also master other disciplines and/or practices that contribute to the achievement of the planned results of the discipline «Basics of nuclear medicine and radiation therapy».

Table 3.1. List of OT components contributing to the achievement of planned discipline learning results

Competence Code:	Competence Name:	Preceding Disciplines/Modules, Practices:	Subsequent Disciplines/Modules, Practices:
OPK-2	Able to creatively apply knowledge from fundamental and applied disciplines (modules) in professional activities, determining the focus of the master's program.	History and Methodology of Biology Molecular Radiobiology Cellular Radiobiology Radiation Biology and Medicine	Scientific Research Practice Scientific Research Work
OPK-7	Able to independently define the strategy and issues of research, make decisions (including innovative decisions), choose and modify methods, ensure the quality of work, and implement results. Also, responsible for ensuring industrial safety when solving specific tasks.	Organization of Experimental Research in Biology, Medicine, and Pharmacy Radiation Safety Radiation Epidemiology and Hygiene	Introductory Practice Scientific Research Practice Scientific Research Work
PC-2	Able to conduct fundamental and applied scientific research aimed at developing and improving methods of diagnosing pathological processes and personalized medicine technologies.	Introduction to Nuclear Physics Molecular Radiobiology Cellular Radiobiology Dosimetry Course	Pre-diploma Practice Cell Technologies in Medicine and Biology Genetic Technologies in Medicine and Biology Scientific Research Practice Scientific Research Work
PC-3	Able to search for and analyze regulatory and	Radiation Safety	Pre-diploma Practice Scientific Research Practice

	scientific information to solve professional tasks.		Scientific Research Work Biodosimetry Radioecological Expertise
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The asterisk (*) - filled in accordance with the competency matrix and the State Educational Standard for Higher Education (CYII OPI BO).

4. VOLUME OF THE DISCIPLINE AND TYPES OF EDUCATIONAL WORK

The total workload of the discipline "Basics of hadron therapy and nuclear medicine" is 4,5 credit units.

Table 4.1. Types of Educational Work by Stages of Implementing the Higher Education Program for Full-Time Study

Type of Educational Work Contact Work, ECTS		TOTAL, ECTS	Semester(s)			
				3		
Including:		32		32		
- Lectures (LK)		16		16		
- Laboratory Work (LR)		16		16		
- Practical/Seminar Classes (SZ)						
Independent Student Work, ECTS						
Assessment (Exam/Credit with Grade), ECTS		31		31		
Total Workload of the Discipline, ECTS		9		9		
Credit Units (Zach. Ed.), ECTS		2		2		
Type of Educational Work	TOTAL, ECTS	72		72		

5. DISCIPLINE CONTENT

Table 5.1. Discipline (Module) Content by Types of Educational Work

Discipline Section	Content of the Section (Topics)	Type of Educational Work*
Section 1: Introduction to Nuclear Medicine and Radiation Therapy - Topic 1.1 - Topic 1.2 - Topic 1.3		
	The Role of Nuclear Technologies in the Treatment of Oncological and Non-Oncological Diseases. Problems and Development Perspectives	Lecture (LK)
	Radiobiological Foundations of Hadron Therapy	Lecture (LK), Practical/Seminar Classes (SZ)
	Technical Support for Radiation Therapy	Lecture (LK)
- Topic 1.4 Section 2: Radiation Therapy of Oncological	Dosimetric Planning in Particle Therapy. Tumor Control Probability. Use of Radiosensitizers and Radioprotectors in Radiation Therapy	Lecture (LK), Practical/Seminar Classes (SZ)

and Non-Oncological Diseases - Topic 2.1 - Topic 2.2		
	Hadron Therapy of Abdominal and Pelvic Organs	Lecture (LK), Practical/Seminar Classes (SZ)
	Hadron Therapy of Head and Neck Tumors. Hadron Therapy of Central and Peripheral Nervous System Tumors. Stereotactic Particle Radiosurgery	Lecture (LK), Practical/Seminar Classes (SZ)
- Topic 2.3 - Topic 2.4 Section 3: Alternative Radiation Therapy Options. Brachytherapy - Topic 3.1 - Topic 3.2 - Topic 3.3	Hadron Therapy of Chest Tumors. Hadron Therapy of Lymphoproliferative Diseases	Lecture (LK), Practical/Seminar Classes (SZ)
	Side Effects and Long-Term Consequences of Hadron Therapy	Lecture (LK), Practical/Seminar Classes (SZ)
	Conventional Radiotherapy in the Treatment of Oncological Diseases	Lecture (LK), Practical/Seminar Classes (SZ)
	Electron Therapy in the Treatment of Malignant Neoplasms	Lecture (LK), Practical/Seminar Classes (SZ)
	Brachytherapy in the Treatment of Malignant Neoplasms	Lecture (LK), Practical/Seminar Classes (SZ)
- Topic 3.4 - Topic 3.5 - Topic 3.6	Fast Neutron Therapy in the Treatment of Malignant Neoplasms	Lecture (LK), Practical/Seminar Classes (SZ)
	Binary Technologies in Radiation Therapy. Neutron Capture Therapy	Lecture (LK), Practical/Seminar Classes (SZ)
	Photon Capture Therapy. Application of Nanoparticles in Radiation Therapy	Lecture (LK), Practical/Seminar Classes (SZ)
Section 4: Radiological Diagnosis - Topic 4.1 - Topic 4.2 - Topic 4.3		
	Methods of Radiological Diagnosis of Oncological Diseases. CT and MRI in Oncology	Lecture (LK), Practical/Seminar Classes (SZ)

	PET/CT in the Diagnosis of Oncological Diseases	Lecture (LK), Practical/Seminar Classes (SZ)
	PET/MRI in the Diagnosis of Oncological Diseases	Lecture (LK), Practical/Seminar Classes (SZ)

* - filled in only for full-time study: LK – lectures; LR – laboratory work; SZ – seminar classes." indicates that the information designated with an asterisk should be completed or specified specifically for the full-time form of study and should include details about lectures (LK), laboratory work (LR), and seminar classes (SZ).

6. MATERIAL AND TECHNICAL SUPPORT OF THE DISCIPLINE

Table 6.1. Material and Technical Support of the Discipline

Type of Classroom	Equipment of the Classroom	Specialized Educational/Laboratory Equipment, Software, and Materials for Discipline Mastery (if necessary)
Specialized Classroom	Classroom for conducting laboratory work, individual consultations, ongoing control, and intermediate certification, equipped with a set of specialized furniture and equipment. (Room 328)	Set of specialized furniture, Wall screen with electric drive Cactus MotoExpert 150x200cm (CS-PSME-200X150-WT), BenQ MN550 Projector, Software: Microsoft products (Operating System, Office Suite, including MS Office/Office 365, Teams)
Classroom for Independent Student Work	Classroom for independent student work (can be used for laboratory sessions and consultations), equipped with a set of specialized furniture (Room 342)	Set of specialized furniture, Wall screen with electric drive Cactus MotoExpert 150x200cm (CS-PSME-200X150-WT), BenQ MN550 Projector, Software: Microsoft products (Operating System, Office Suite, including MS Office/Office 365, Teams)

* - classroom for independent student work must be specified!

7. EDUCATIONAL-METHODICAL AND INFORMATION SUPPORT FOR THE DISCIPLINE

Primary Literature:

Electronic and print full-text materials:

1. Radiobiology: a textbook for universities / N.P. Lysenko, Z.G. Kusurova; Ed. by N.P. Lysenko, V.V. Paka. - 2nd ed., rev. ; 4th ed., corr. ; Electronic text data. - St. Petersburg: Lan, 2012, 2017. - 576 p. Radiotherapy (radiation therapy): a textbook / Ed. by G.E. Trufanov. - 3rd ed., rev. and add. - M.: GEOTAR-Media, 2018 [link to text]
2. Radiotherapy (radiation therapy): a textbook / Ed. by G.E. Trufanov. - 3rd ed., rev. and add. - M.: GEOTAR-Media, 2018. - 208 p. - ISBN 978-5-9704-4420-7. [link to text]

3. Fundamentals of Radiological Diagnosis and Therapy: National Guide / Ed. by S.K. Ternova. - M.: GEOTAR-Media, 2013. - 1000 p. - (National Guidelines for Radiological Diagnosis and Therapy). - ISBN 978-5-9704-2564-0. [link to text]
4. Ternovoy Sergey Konstantinovich. Radiation Diagnostics and Therapy: Textbook in 2 Volumes. Vol. 1: General Radiological Diagnostics / S.K. Ternovoy, V.E. Sinitsyn, A.I. Shekhter. - M.: GEOTAR-Media, 2014. - 232 p. - ISBN 978-5-9704-2989-1. [link to text]

Additional Literature:

Electronic and print full-text materials:

1. General and Medical Radiology: Radiation Technologies: a textbook for universities / V.N. Kulakov [et al.]; edited by A.N. Usenko. - 2nd ed. - Moscow: Publishing House Yurait, 2022. - 217 p. - (Higher education). - ISBN 978-5-534-15184-8. [link to text]
2. Petrukhin O.D. Radiation and chemo-radiation treatment of inoperable patients with malignant neoplasms / O.D. Petrukhin. - M.: Khristosom, 2001. - 448 p.: Ill. - ISBN 5-87372-092-4: 0.00. [link to text]
3. Simulators (imitators) for radiation therapy. Guidelines for checking operational characteristics [Electronic resource] = Radiotherapy simulators (imitators). Guidelines for functional performance characteristics: state standard of the Russian Federation / All-Russian Research and Testing Institute of Medical Equipment; State Standard of Russia. - Moscow: IPC Publishing Standards, 2000. [link to text]
4. Maximova N.A., Karpun V.G., Arzamasceva M.A., Ilchenko M.G., Shlyk O.S. Optimization of planning of radionuclide diagnostic studies during scintigraphy // Southern Russian Oncological Journal. 2021. №1. [link to text]
5. Finogenova Yulia Andreevna, Lipengoltz Alexey Andreevich, Smirnova Anna Vyacheslavna, Grigorieva Elena Yurevna The use of in vivo methods of radionuclide visualization in experimental oncology // Siberian Oncological Journal. 2020. №3. [link to text]
6. Kotina Elena Dmitrievna, Leonova Ekaterina Borisovna, Ploskikh Viktor Aleksandrovich Processing of radionuclide images using discrete systems // Vestnik SPbGU. Series 10. Applied Mathematics. Computer science. Control processes. 2019. №4. [link to text]
7. Klimanov, V. A. Nuclear Medicine. Radionuclide Diagnostics: a textbook for universities / V. A. Klimanov. - 2nd ed., rev. and add. - Moscow: Yurait Publishing House, 2022. - 307 p. - (Higher education). [link to text]
8. Bekman, I. N. Nuclear Medicine: Physical and Chemical Foundations: a textbook for universities / I. N. Bekman. - 2nd ed., rev. and add. - Moscow: Yurait Publishing House, 2022. - 400 p. - (Higher education). [link to text]
9. Bekman, I. N. Atomic and Nuclear Physics: Radioactivity and Ionizing Radiation: a textbook for universities / I. N. Bekman. - 2nd ed., rev. and add. - Moscow: Yurait Publishing House, 2022. - 493 p. - (Higher education). [link to text]

Information and telecommunication network resources "Internet":

Educational and methodological materials for independent student work during the study of the discipline/module*:

1. Methodological instructions for students on mastering the discipline "Fundamentals of Nuclear Medicine and Radiation Therapy".

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- All educational and methodological materials for independent student work are placed in accordance with the current procedure on the discipline page in the UIS!

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8. ASSESSMENT MATERIALS AND POINT-RATING SYSTEM OF ASSESSMENT OF THE LEVEL OF FORMATION OF COMPETENCIES IN THE DISCIPLINE

Assessment materials and the point-rating system* for evaluating the level of competence formation (parts of competencies) based on the results of mastering the discipline "Fundamentals of Nuclear Medicine and Radiation Therapy" are presented in the Appendix to this Working Program of the Discipline.

Assessment materials (OM) and the point-rating system (PRS) are developed in accordance with the requirements of the relevant local regulatory act of RUDN.