

Ministry of Science and Higher Education of the Russian Federation
Federal State Autonomous Institution of Higher Education
“National Research Nuclear University “MEPhI”

INSTITUTE OF ENGINEERING PHYSICS FOR BIOMEDICINE

DEPARTMENT OF FUNDAMENTAL MEDICINE

APPROVED HTC ИФИБ

Protocol No. 3.1

dated 30.08.2024

ACADEMIC COURSE OUTLINE

RADIOBIOLOGY

Educational program track (speciality) [1] 31.05.01 General Medicine

Semester	Labour input, credits	Total course academic, hours	Lectures, hrs.	Practical sessions, hrs.	Laboratory sessions, hrs.	In the form of practical studies, hrs.	Independent studies, hrs.	Independent studies monitoring, hrs.	Course progress, Exam/Pass-fail exam/Term
3	3	108	16	38	0		54	0	PFE
Total	3	108	16	38	0	0	54	0	

ABSTRACT

The academic discipline "RADIOBIOLOGY" is aimed at acquiring knowledge in the field of radiation biology and nuclear medicine.

The discipline "Radiobiology" is an introduction to radiobiology, in particular those aspects of the subject that have practical applications. Radiation is used to treat cancer, but it can also cause it. Radiation is also used in medical diagnostics and in nuclear power plants. In these areas, where questions about the benefits and harms arise, it is now possible to predict the biological effects of radiation. The discipline is aimed at studying the mechanisms by which ionizing radiation causes damage to molecules and cells. It will be useful for medical students interested in radiation therapy, nuclear medicine, and diagnostic radiography. This discipline provides an excellent opportunity to fill the gap in the biological effects of radiation on humans.

1. ACADEMIC COURSE GOALS AND OBJECTIVES

The main goal of studying the academic discipline "RADIOBIOLOGY" is development of professional competence in the field of radiobiology and nuclear medicine.

2. PLACE OF THE ACADEMIC COURSE IN THE MAIN HIGHER EDUCATION CURRICULUM

The academic discipline "RADIOBIOLOGY" belongs to the cycle of the variable part. It is the basis for the study of such academic disciplines as Radio diagnostics, Radiotherapy and Medical physics that medical students will study in their senior years.

3. DEVELOPED COMPETENCIES AND INTENDED LEARNING OUTCOMES

Universal and/or general professional competencies:

Competency code and title	Code and title of competency-based rubrics
ОПК-5 [1] – Capable of assessing morphofunctional and physiological states, as well as pathological processes in the human body to solve professional tasks.	3-ОПК-5 [1] – Know: - basic medical, pharmaceutical, and morphofunctional terminology, including Latin terms; - structure and functions of the human body, age-related, gender-specific, and individual characteristics of the structure and development of a healthy organism; - physical and chemical nature of processes occurring in a living organism; - patterns of vital activity of the organism, mechanisms of self-regulation and regulation; - features of regulation of the functioning of human body systems in pathological conditions; - patterns of occurrence, development, and outcome of typical pathological processes, the concept of sanogenesis; - etiology and pathogenesis of the most common diseases; - the concept of nosology, principles of disease classification; - principles of microorganism classification, their morphology, physiology, and impact on human health; - structure and functions of the human immune system.

	Y-OIHK-5 [1] – Be able to: - analyze mechanisms of disease development and manifestation; - recognize morphological and functional changes in cells, tissues, organs, and systems of the human body; - use basic physical-chemical and other natural science concepts and methods in solving professional tasks; - determine the cause of death and formulate a pathological diagnosis. B-OIHK-5 [1] – Possess skills in: - conducting microscopy and analyzing microscopic specimens; - correlating morphological and clinical manifestations of diseases; - assessing morphofunctional, physiological states, and pathological processes in humans; - clinical-anatomical analysis of autopsy results.
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4. PEDAGOGIC POTENTIAL OF THE COURSE

Pedagogic tracks/objectives	Pedagogic goals (code)
Intellectual education	Establishing conditions for: formation of culture of intellectual work (B11)
Vocational and labor education	Establishing conditions for: formation of a deep understanding of the profession's social role, a positive and active commitment to the values of the chosen specialty, and a responsible attitude towards professional activity and work (B14)

5. ACADEMIC COURSE STRUCTURE AND CONTENT

Academic course sections, their scope, terms of study and assessment:

No.	Academic course section name	Weeks	Lectures/ Practical (seminars)/ Laboratory sessions, hrs.	Compulsory current assessment (form*, week)	Maximum grade per section**	Section assessment (form*, week)	Competency-based rubrics
	<i>3 Semester</i>						
1	Unit	1-8	8/18/0		25	SA-8	3-ОПК-5, Y-ОПК-5
2	Unit	9-15	8/20/0		25	SA-15	Y-ОПК-5, B-ОПК-5
	<i>Totals for 3 Semester</i>		16/38/0		50		
	Assessment events for 3 Semester				50	PFE	3-ОПК-5, Y-ОПК-5, B-ОПК-5

* – abbreviated name of assessment

** – 100 maximum points per semester including a pass/fail exam and (or) an exam

Abbreviated current assessment forms and section assessment

Abbreviation	Full name
SA	Summative assessment
PFE	Pass/fail examination

SYLLABUS

Weeks	Topics / Content	Lect., hrs.	Pr./sem., hrs.	Lab., hrs.
	<i>3 Semester</i>	16	38	0
1-8	Unit	8	18	0
1 - 4	Fundamentals of radiobiology Accidental exposure6 Occupational exposure	All		
		0	0	0
		Online		
		4	8	0
5 - 8	Basic radiobiology and radiotherapy Medical exposure, Exposure from natural sources	All		
		0	0	0
		Online		
		4	8	0
9-15	Unit	8	20	0
9 - 12	Acute Radiation Syndrome. Clinical picture, diagnosis and treatment Clinical picture, diagnosis and treatment	All		
		0	0	0
		Online		
		4	8	0
13 - 16	Radiation safety of ionizing radiation Chromosome aberrations & exposure to mutagens	All		
		0	0	0
		Online		
		3	7	0

Abbreviated names of online options:

Abbreviation	Full name
EC	E-course
FtM	Full-text material
FtL	Full-text lectures
VM	Video materials
AM	Audio materials
Prs	Presentations
T	Tests
ERM	E-reference materials
IS	Interactive site

PRACTICAL SESSIONS TOPICS

Weeks	Topics / Content
	<i>3 Semester</i>
1 - 4	Exposure to environmental mutagens.

	Cancer & environmental mutagens.
5 - 8	Fundamentals of radiobiology Occupational exposure
9 - 12	Acute Radiation Syndrome. Clinical picture, diagnosis and treatment
13 - 16	Radiation safety of ionizing radiation Chromosome aberrations & exposure to mutagens

6. EDUCATIONAL TECHNOLOGIES

Teaching methods include the use of multimedia, interactive teaching methods and laboratory equipment to acquire theoretical knowledge and practical skills.

For self-preparation for practical classes and exams, students are given access to full-text textbooks and articles from electronic databases:

1. www.isir.ras.ru/ - Integrated Information Resources System of the Russian Academy of Sciences.
2. www.merlot.org/merlot/materials.htm?category=2608&&sort.property=overallRating - MERLOT - Multimedia Educational Resource for Learning and Online Teaching. Section "Biology"
3. www.nature.ru - Textbooks, scientific monographs, reviews, laboratory workshops in free access on the website of the journal Nature.
4. Test tasks on topics on electronic media.

7. ASSESSMENT TOOLKIT

The assessment toolkit ensures verification of the intended learning outcomes achievement (competency-based rubrics) using current, midterm and interim assessment of the course.

The link between developed competencies and their assessment is presented in the following table:

Competency	Achievement rubrics	Assessment activity (Syl 1)
ОПК-5	3-ОПК-5	PFE, SA-8
	У-ОПК-5	PFE, SA-8, SA-15
	В-ОПК-5	PFE, SA-15

Educational achievement rubrics scales

The scale of each assessment activity varies from 0 to the maximum established point, inclusive. The final assessment of the course is performed on a 100-point scale and represents the sum of the points earned by the student in the section assessments, framework of current and interim assessment.

Sections and interim assessments are considered passed when the student achieves a minimum score equal to 60% of the maximum. The final grade is assigned only upon passing all sections and the interim assessment.

The final grade is assigned in accordance with the following scale:

Total score	Rating on a 4-point scale	Pass/fail examination	ECTS assessment
90-100	5 – « <i>excellent</i> »	« <i>pass</i> »	A
85-89	4 – « <i>good</i> »		B
75-84			C
70-74			D
65-69	E		
60-64	3 – « <i>satisfactory</i> »		
below 60	2 – « <i>fail</i> »	« <i>fail</i> »	F

An “excellent” grade indicates a deep and solid mastery of the program material by a student who presents their answers consistently, clearly, and logically, is able to closely link theory with practice, and uses materials from monographic literature in their answers.

A “good” grade corresponds to a student’s solid knowledge of the material, who presents their answers competently and to the point, without any significant inaccuracies.

A “satisfactory” grade corresponds to the basic level of mastery of the material by the student, in which the main material has been mastered, but its details have not been assimilated, the answers contain inaccuracies, insufficiently correct wording and logical inconsistencies.

A grade “pass” corresponds to at least a basic level of mastery of the program material, in which the student possesses the necessary knowledge, skills, and abilities, and is able to apply theoretical principles to solve typical practical problems.

A grade “fail” is given to a student who lacks a significant understanding of the curriculum material, makes significant errors in their answers, or fails all required assignments. These students are generally unable to continue their studies without additional classes.

8. ACADEMIC COURSE EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT

CORE READING:

1. ЭИ L35 Laser-Driven Particle Acceleration Towards Radiobiology and Medicine : , , Cham: Springer International Publishing, 2016
2. ЭИ S15 Physics and Radiobiology of Nuclear Medicine : , Saha, Gopal B. , New York, NY: Springer New York,, 2006
3. ЭИ R13 Radiobiology of Glioblastoma : Recent Advances and Related Pathobiology, , Cham: Springer International Publishing, 2016

FURTHER READING:

1. ЭИ H99 Applications of Synchrotron Radiation : Micro Beams in Cell Micro Biology and Medicine, Ide-Ektessabi, Ari. , Berlin, Heidelberg: Springer Berlin Heidelberg,, 2007

SOFTWARE:

1. Microsoft Office 2016+ ()
2. Microsoft Word (K64-303)

LMS AND ONLINE RESOURCES

1. Radiation biology (<https://online.mephi.ru>)

<https://online.mephi.ru/>

<http://library.mephi.ru/>

9. LOGISTICAL SUPPORT

1. Персональный компьютер: Моноблок Lenovo V540-24IWL All-In-One 23,8" i3-8145U 8Gb 256GB_SSD_M.2 Intel (64-304)
2. Мышь, клавиатура (64-304)
3. Проектор SMART P109 (64-304)
4. Мебель лабораторная, стулья, шкафы для хранения (64-304)
5. Шкаф лабораторный вытяжной "Лабтех" ШВ202 (64-304)
6. Бинокулярные микроскопы "Микромед 2" (64-304)
7. Тринокулярный микроскоп "Микромед 1" (64-304)
8. Видеоокуляр TourCam 10,0 MP (64-304)
9. Интерактивная доска SMART SBM 685 (64-401)

10. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR STUDENTS

5-point rating-ECTS score $90 \div 100$ a student is rated as "excellent" if he has thoroughly and firmly mastered the program material, presents it comprehensively, consistently, clearly and logically harmoniously, is able to closely correlate theory with practice, and uses the material of monographic literature in his answer.

D, C, B "good" $70 \div 89$ a student is rated "good" if they have a solid knowledge of the material, correctly and substantially present it, avoiding significant inaccuracies in the answer to the question.

D, d "satisfactory" $60 \div 69$ a student is rated "satisfactory" if he / she only knows the main material, but has not mastered its details, admits inaccuracies, insufficiently correct wording and violations of the logical sequence in the presentation of the program material.

F "unsatisfactory" less than 60 the "unsatisfactory" rating is given to a student who does not know a significant part of the program material and makes significant mistakes. As a rule, the rating "unsatisfactory" is assigned to students who cannot continue their studies without additional classes in the relevant discipline.

11. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR TEACHERS

Градация и критерии тестовых работ, контрольных работ с развернутым ответом, выполнения домашнего задания и финального теста:

1) - Тестовые работы оцениваются по схеме 1 балл – 1 правильный ответ. Студент не приступал к работе – (-1) балл

2) - Контрольные работы с развернутым ответом оцениваются по схеме: полный ответ – 2 балла, неполный ответ – 1 балл, нет ответа – 0 баллов, студент не приступал к работе – (-2) балла.

3) – Домашнее задание должно быть выполнено всеми студентами для допуска к финальной аттестации. За не вовремя сданную работу следует вычит из финального балла (-1) балл.

4) - Критерии оценивания доклада-презентации. Перерасчет со 100-бальной на 10 (5)-бальную систему

5) - Критерии оценивания реферата. Максимум 10 баллов. Возможен перерасчет на 5-бальную систему

10 баллов выставляются, если выполнены все требования к написанию реферата: обозначена проблема и обоснована ее актуальность, сделан краткий анализ рассматриваемой проблемы и логично изложена собственная позиция, сформулированы выводы, статья проанализирована полностью, выдержан объем, соблюдены требования к оформлению.

9 баллов выставляются, если выполнены следующие требования к написанию реферата: обозначена проблема и обоснована ее актуальность, сделан краткий анализ рассматриваемой проблемы и логично изложена собственная позиция, сформулированы выводы, статья проанализирована полностью, но не выдержан объем и не соблюдены требования к оформлению.

8 баллов – основные требования к реферату выполнены, но при этом допущены недочеты. В частности, имеются неточности в изложении материала; отсутствует логическая последовательность в суждениях; не выдержан объем реферата; имеются упущения в оформлении.

7 баллов – основные требования к реферату выполнены, но при этом допущены следующие недочеты: имеются неточности в изложении материала; отсутствует логическая последовательность в суждениях; не сформулированы выводы, не выдержан объем реферата; имеются упущения в оформлении

6 баллов – имеются существенные отступления от требований к реферированию; тема освещена лишь частично; допущены фактические ошибки в содержании реферата, отсутствуют выводы и личная точка зрения по проблеме.

5 баллов – имеются существенные отступления от требований к реферату: тема освещена лишь частично; допущены фактические ошибки в изложении материалов и методов, отсутствуют выводы и личная точка зрения по проблеме, формат не выдержан.

4 балла – имеются существенные отступления от требований к реферату: актуальность темы не раскрыта; допущены фактические ошибки в изложении материалов и методов, отсутствуют выводы и личная точка зрения по проблеме, формат не выдержан

3 балла – отсутствует анализ актуальности темы исследования, используемых подходов и методов, при этом формально соблюден объем реферата.

2 балла – тема реферата не раскрыта, обнаруживается существенное непонимание проблемы. При этом объем реферата и формальные требования выполнены.

1 балл – тема реферата не раскрыта, обнаруживается существенное непонимание проблемы.

0 баллов – реферат студентом не представлен.

6) Чтобы студент был допущен к экзамену, он должен

1. Сдать все домашние задания в соответствии с учебным планом

2. Успешно пройти тесты и набрать не менее 15 баллов за каждый раздел семестра.

3. Набрать не менее 30 баллов из 50 в итоговом тесте (для допуска к устному экзамену).

4. Изучите микропрепарата паразитов, зарисовать их в альбом, обозначить подписью все структуры на рисунке и предоставить альбом на проверку.

7) Чтобы сдать экзамен, студент должен:

1. Получите допуск к экзамену (смотрите выше)

2. Прийти на экзамен в соответствии с расписанием

3. Имейте при себе только ручку и лист бумаги! Запрещается брать с собой телефоны, компьютеры, тетради и учебники!

4. На экзамене необходимо набрать не менее 30 баллов из 50 возможных.

5. Экзаменационный билет по биологии содержит 4 задания:

1 Общая биология и генетика – 15 баллов

2 Паразитология:- 20 баллов

3 Решение задачи по генетике или паразитологии – 10 баллов

4 Идентификация паразита на «слепом» микропрепарате – 5 баллов

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