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

ACADEMIC COURSE OUTLINE

УЧЕБНАЯ ПРАКТИКА (НАУЧНО-ИССЛЕДОВАТЕЛЬСКАЯ РАБОТА (ПОЛУЧЕНИЕ ПЕРВИЧНЫХ НАВЫКОВ НАУЧНО-ИССЛЕДОВАТЕЛЬСКОЙ ДЕЯТЕЛЬНОСТИ)) / RESEARCH WORK

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
7	3	108	0	72	0		36	0	PFE
Total	3	108	0	72	0	72	36	0	

ABSTRACT

During the practice, students acquire the skills and abilities to conduct scientific research on assigned topics, define goals and objectives of the studies, and select appropriate research methods. Students expand their knowledge of the capabilities of experimental and theoretical research methods and learn about modern achievements and approaches in their field of study. Students acquire skills in processing and analyzing data using modern information technologies, modern equipment, and develop skills in organizing and conducting scientific research and innovative projects. Students also acquire skills in working with scientific literature. During this course, students learn to apply the results of scientific medical research to the benefit of patients, based on the principles of evidence-based medicine.

1.   ACADEMIC COURSE GOALS AND OBJECTIVES

Main goals of the scientific research training practice course are the formation of competencies in scientific research field and, based on this, deep and creative mastering of the specialty educational program; the developing of the competencies for the implementation of scientific research results in routine healthcare to improve diagnostics, treatment, medical rehabilitation and prophylactics of the diseases.

Objectives:

-Development of analytical and presentation skills in medical research information;

- Providing knowledge and developing of practical skills in the creation/conducting of theoretical and experimental researches;

- Developing skills for project management at all stages of its life cycle;

-Developing skills for implementation of scientific research results in routine healthcare to improve diagnostics, treatment, medical rehabilitation and prophylactics of the diseases.

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

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-11 [1] – Capable of preparing and applying scientific, research-production, project-related, organizational-managerial, and regulatory documentation within the healthcare system.	З-ОПК-11 [1] – Know: - the purpose of various types of documentation in medicine and healthcare; У-ОПК-11 [1] – Be able to: - search for and select scientific, project-related, organizational-managerial, and regulatory documentation in accordance with assigned tasks in professional activities; - analyze and apply scientific, project-related, organizational-managerial, and regulatory documentation to solve professional tasks;

	В-ОПК-11 [1] – Possess skills in: - preparing work plans and activity reports according to specified formats; - drafting organizational-administrative documents and preparing proposals for amendments to regulatory legal documents in the field of healthcare and medical sciences, as well as local regulatory acts of healthcare organizations
УК-2 [1] – Capable of managing a project at all stages of its life cycle	З-УК-2 [1] – Know: project life cycle stages; project development and implementation stages; project development and management methods У-УК-2 [1] – Be able to: develop projects considering analysis of alternative implementation options, define target stages and main work directions; explain goals and formulate tasks related to project preparation and implementation; manage projects at all stages of their life cycle В-УК-2 [1] – Possess: project development and management methodologies; methods for assessing resource requirements and effectiveness

Professional competencies in compliance with the goals and professional knowledge areas:

Professional activity goal	Professional activity knowledge area	Professional competency code and title; Based on the professional standard, experience analysis	Code and title of competency-based rubrics
research			
Analysis of scientific literature and official statistical reviews, participation in statistical analysis and public presentation of the results obtained.	Individuals (patients); the population; the set of means and technologies aimed at creating conditions for preserving and strengthening the health of the adult population	ПК-3.6 [1] - Able to analyze and publicly present medical research information *The base:* Professional standard: 02.019	З-ПК-3.6[1] - Know: - essence of research activities in medicine and healthcare, stages of medical research, design options; - types of scientific information sources, requirements for scientific text formatting and numerical data presentation; - main methods of statistical analysis.; У-ПК-3.6[1] - Be able to: - plan medical research and create databases for subsequent statistical processing; - search, select and analyze scientific information according to research objectives.;

			В-ПК-3.6[1] - Possess skills in: - preparing informational and analytical materials, including for public presentation of research results (presentation, report, abstract, article); - analyzing research results, their generalization and critical evaluation.
Solution of certain scientific research problems and scientific and applied tasks in the field of healthcare related to diagnosis, treatment, medical rehabilitation, and prevention.	Individuals (patients); the population; the set of means and technologies aimed at creating conditions for preserving and strengthening the health of the adult population	ПК-3.7 [1] - Able to participate in implementing research results into practical healthcare activities regarding diagnosis, treatment, medical rehabilitation and prevention. *The base:* Professional standard: 02.019	З-ПК-3.7[1] - Know: - main provisions of regulatory framework for research activities in healthcare; - principles of evidence-based medicine.; У-ПК-3.7[1] - Be able to: - apply results of medical research for patient benefit based on evidence-based medicine.; В-ПК-3.7[1] - Possess skills in: - using research results in practical healthcare activities regarding diagnosis, treatment, medical rehabilitation and prevention.

4.   PEDAGOGIC POTENTIAL OF THE COURSE

Pedagogic tracks/objectives	Pedagogic goals (code)
Intellectual education	Establishing conditions for: formation of culture of intellectual work (B11)
Intellectual education	Establishing conditions for: understanding the socio-cultural and interdisciplinary context of the development of various scientific fields (B12)
Professional education	Establishing conditions for: formation of a sense of personal responsibility for Russia's scientific and technological development, for the results of research and their consequences (B17)
Professional education	Establishing conditions for: formation of a scientific worldview, a culture of searching for non-standard scientific, technical/practical solutions, and a critical attitude toward pseudoscientific research (B19)
Professional education	Establishing conditions for: development of communication, teamwork and leadership skills (B20)

Professional education	Establishing conditions for: formation of creative engineering/professional thinking, skills of organizing collective project activities (В22)

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
	7 Semester						
1	Organization, structure and methodology of scientific research.	1-8	0/36/0	T-5 (25)	25	T-8	З-ОПК-11, У-ОПК-11, В-ОПК-11, З-ПК-3.6, У-ПК-3.6, В-ПК-3.6, З-ПК-3.7, У-ПК-3.7, В-ПК-3.7, З-УК-2, У-УК-2, В-УК-2
2	Research Work	9-15	0/36/0	Rep-15 (25)	25	Rep-15	З-ОПК-11, У-ОПК-11, В-ОПК-11, З-ПК-3.6, У-ПК-3.6, В-ПК-3.6, З-ПК-3.7, У-ПК-3.7, В-ПК-3.7, З-УК-2, У-УК-2, В-УК-2
	Totals for 7 Semester		0/72/0		50		
	Assessment events for 7 Semester				50	PFE	У-ОПК-11, З-ПК-3.6, У-ПК-3.6, В-ПК-3.6, З-ПК-3.7, У-ПК-3.7, В-ПК-3.7, З-УК-2,

							У-УК-2, В-УК-2

* – 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
Rep	Report
T	Testing
PFE	Pass/fail examination

SYLLABUS

Weeks	Topics / Content	Lect., hrs.	Pr./sem., hrs.	Lab., hrs.
	7 Semester	0	72	0
1-8	**Organization, structure and methodology of scientific research.**	0	36	0
1 - 2	**Organization, structure and methodology of scientific research.**	All		
		0	9	0
	Organization of scientific research. Study design and structure.	Online		
	Sample formation and types of observation. Randomized, cohort, case-control, correlational, and descriptive studies. Guidelines for working with laboratory animals. Clinical therapeutic trials. Local ethics committees	0	0	0
3 - 4	**Statistical analysis of scientific research results**	All		
	The concept of descriptive statistics. Representativeness of	0	9	0
	research results. Types of statistical analysis. Diagrams as a	Online		
	means of data presentation. Cluster and factor analysis. Exploratory analysis of primary data.	0	0	0
5 - 6	**Modeling and forecasting in scientific research.**	All		
	The predictive nature of modern personalized medicine. The	0	9	0
	concepts of predictor (factor) and response. Linear and logistic	Online		
	regression methods. Artificial neural networks.	0	0	0
7 - 8	**Presentation of scientific research results**	All		
	Types of presentation of scientific research results. Types and	0	9	0
	structure of scientific publications. Analysis of typical errors	Online		
	made by authors of scientific manuscripts and theses.	0	0	0
9-15	**Research Work**	0	36	0
9 - 11	**Modeling and forecasting in scientific research**	All		
	Conducting a literature review. Planning an experiment.	0	4	0
	Definition of the research goals and objectives.	Online		
		0	0	0
12 - 15	**Educational research work.**	All		
	Conducting an experiment and analyzing its results.	0	32	0
	Summarizing the results of the study. Presenting the research	Online		
	results in oral and written forms.	0	0	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
	7 Semester
1 - 3	**Incidence and prevalence. Definition and calculation methods.** Definition of the incidence and prevalence. Methods for calculating incidence and prevalence. Screening tests. Practical cases.
4 - 5	**Sensitivity and Specificity** Sensitivity and Specificity of a Study. Calculations. Difference between Sensitivity and Specificity in a Study.
6 - 7	**Basic Biostatistical Indicators** Statistical Distribution. Confidence Interval. General Statistical Tests. Median Analysis. Pearson Correlation Coefficient.
7 - 8	**Errors in conducting scientific research.** Errors tin design of the scientific research. Errors in participant allocation and recruitment. Errors in conducting research. Errors in interpreting results.
9 - 11	**Ethics committees.** Legal framework for working with laboratory animals. Guidelines for working with animals. Methods of manipulation and withdrawal from experiments.
12 - 13	**Clinical trials.** Clinical trials. Types of clinical trials. Clinical trials of medicines (Phase I-III studies). Post-registration studies of medicines (Phase IV studies) and medical devices. Observational and non-interventional studies.
14 - 15	**Scientific report: formatting guidelines and principles.** Research report formatting guidelines. Defining research objectives. Literature review principles. Citation guidelines
15 - 16	**Scientific Presentations.** Presentation of scientific data on selected topics.

6. EDUCATIONAL TECHNOLOGIES

Information and communication technologies (ICT).

Modular technology (lecture-seminar system) - lectures; practical and laboratory classes; independent student work; midterm assessment; examination.

Case study technology - situational cases.

Research-based teaching method - writing research papers.

Certain types of work can be taught using distance learning technologies.

Educational and methodological materials necessary for training are posted on the university's distance learning system, the Educational Portal (EP) of NRNU MEPhI.

Knowledge assessments are conducted through tests on the Educational Portal of NRNU MEPhI and OnlineTestPad.

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-11	З-ОПК-11	Т-8, Rep-15, Т-5, Отч-15
	У-ОПК-11	PFE, Т-8, Rep-15, Т-5, Отч-15
	В-ОПК-11	Т-8, Rep-15, Т-5, Отч-15
ПК-3.6	З-ПК-3.6	PFE, Т-8, Rep-15
	У-ПК-3.6	PFE, Т-8, Rep-15
	В-ПК-3.6	PFE, Т-8, Rep-15
ПК-3.7	З-ПК-3.7	PFE, Т-8, Rep-15
	У-ПК-3.7	PFE, Т-8, Rep-15
	В-ПК-3.7	PFE, Т-8, Rep-15
УК-2	З-УК-2	PFE, Т-8, Rep-15, Т-5, Отч-15
	У-УК-2	PFE, Т-8, Rep-15, Т-5, Отч-15
	В-УК-2	PFE, Т-8, Rep-15, Т-5, Отч-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 – «excellent»		A
85-89			B
75-84	4 – «good»	«pass»	C
70-74			D
65-69	3 – «satisfactory»		
60-64			E
below 60	2 – «fail»	«fail»	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 М 42 Математическая статистика в медицине в 2 т. Том 1 : учебное пособие для вузов, Медик В. А., Токмачев М. С., Москва: Юрайт, 2024

2. ЭИ Ш 67 Управление рисками проекта : учебник для вузов, Гребенкин А. В., Шкурко В. Е., Москва: Юрайт, 2024

FURTHER READING:

1. ЭИ З-55 Основы проектной деятельности : , Земсков Ю. П., Асмолова Е. В., Санкт-Петербург: Лань, 2022

2. 61 О-57 Практикум по медицинской информатике : Учеб. пособие для вузов, Демидова А.А., Омельченко В.П., Ростов-на-Дону: Феникс, 2001

3. ЭИ В 19 Система контроля версий. Основы командной разработки : учебное пособие для вузов, Васильева М. А., Филипченко К. М., Санкт-Петербург: Лань, 2022

SOFTWARE:

1. Microsoft Office 2016+ ()

2. Microsoft Word (K64-303)

3. Windows Media Player ()

LMS AND ONLINE RESOURCES

1. https://e.lanbook.com/ ()

2. www.book.ru ()

3. www.studentlibrary.ru ()

4. www.iprbooks.ru ()

https://online.mephi.ru/

http://library.mephi.ru/

9. LOGISTICAL SUPPORT

1. Аппарат для электрофизиологических исследований MP35 (Biopac Student Lab, полная комплектация для PC (64-306)

2. Compact MRT 09500-99 с набором образцов (64-306)

3. Персональный компьютер: Моноблок Lenovo V540-24IWL All-In-One 23,8" i3-8145U 8Gb 256GB_SSD_M.2 Intel (64-305)

4. Мышь, клавиатура (64-305)

5. Интерактивная доска SMART SBM 685 (64-305)

6. Проектор SMART P109 (64-305)

7. Электрокардиограф ЭК12Т-01-Р-Д/141 (64-301)

8. Спирограф СМП21-01РД (64-301)

9. Бинокулярные микроскопы Levenhuk MED 10B (64-305)

10. Лаборатория морфологии (64-205)

11. Лаборатория молекулярно-клеточных исследований (64-209)

12. Лаборатория in vivo иследований (64-209)

13. Аппарат холетеровского мониторирования ЭКГ (64-301)

14. Аппарат суточного мониторирования АД (СМАД) (64-301)

15. Электроэнцефалограф многоканальный "Нейровизор БММ-52" (64-301)

10. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR STUDENTS

Practice is an integral part of the learning process.
During the internship, the student is required to:
- Fully complete the assignments outlined in the internship program;
- comply with the internal work schedule at the enterprise, institution, or organization;

- study and strictly adhere to occupational health and safety regulations, sanitary norms

- be responsible for the work performed and its results;

Independent Work:

Each student should prepare individually for practical seminars reading the recommended literature. Independent work allows students to think in a calm environment, understand the information on the topic, and, if necessary, consult reference books. Careful reading and review of what has been read helps students fully grasp the topic and structure their knowledge.

In order for retention of meaningful information, it's advisable to study it in stages—by topics and in strict sequence, as subsequent topics typically build on previous ones. Therefore, much of the independent work involves preparing for seminars, analyzing cases, preparing for colloquiums, completing and defending individual homework assignments, and preparing for labs. To successfully complete these tasks, each student has access to the department's teaching aids.

Students should best plan the time for independent study required for this course throughout the semester, including regular repeated review of the material covered. Lecture notes should be regularly supplemented with information from the literature sources presented in the working program of the discipline. For each independent study topic listed in the working program, students should first read the recommended literature and, if necessary, compile a brief summary of the key concepts, terms, and information that must be memorized and are fundamental to this topic and subsequent sections of the course. Internet resources are recommended for expanding knowledge of the course.

When working independently, it is recommended to take notes on the material being studied (processed). Notes can be basic, containing only the main key points, but still sufficient to fully answer the question. Notes can be detailed. The amount of information in the notes is determined by the student.

When working with academic/scientific literature, students are encouraged to take notes as they read, using a simple or detailed outline, create abstracts, and prepare summaries of what they have read. Such notes may earn additional points for active participation.

Abstract:

Research literature and compile a bibliography, using 3 to 5 scientific papers, present the authors' opinions and student's own opinion on the chosen issue; outline the main aspects of the problem. Familiarize with the structure and format of an abstract.

Доклад-презентация:

Presentation Report:

The student must be able to prepare a report and PPT presentation on a given topic.

To prepare for the internship credit, the student must pass all midterm assessments and obtain permission to submit the internship report.

11. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR TEACHERS

The internship process includes: face-to-face work during practical classes, self-preparation for practical classes, presentation preparation, preparation for discussion of case studies, preparation for tests, and presentation of research results.

The main forms of organizing the educational process in this discipline are practical classes (using interactive learning technologies) and independent student work.

During practical classes, the department ensures that students develop skills in teamwork, interpersonal communication, decision-making, and leadership (through interactive classes, group discussions, role-playing games, training sessions, case analysis and simulations, and teaching practical training in the form of a course based on the results of scientific research conducted by the University, including consideration of regional characteristics of graduates' professional activities and the needs of employers).

Practical Classes:

Practical classes are conducted with the aim of acquiring practical skills in scientific research. Independent Work:

Independent work for students includes preparing for classes, writing essays, and preparing for ongoing assessments.

Working with academic literature is considered a type of academic work and is completed within the time allotted for its study (in the Independent Work Section). Each student has access to the university and department library collections. During practical training, students (under the supervision of the instructor) independently complete research projects on a given (selected) topic, document their findings, and present their results.

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