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

APPROVED НТС ИФИБ

Protocol No. 3.1

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ACADEMIC COURSE OUTLINE

ИММУНОЛОГИЯ / IMMUNOLOGY

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**
5	3	108	18	0	36		54	0	PFE
Total	3	108	18	0	36	14	54	0	

ABSTRACT

During the course of studying the discipline, medical students acquire knowledge about the structure and function of the human immune system, its age-related characteristics, types of immunity, factors determining the development of various types of immune response and the mechanisms of development of different types of immunopathological reactions, about the mechanisms of triggering autoimmune pathologies, effector mechanisms of antitumor immunity, immunobiotechnology, immunorehabilitation and the basic principles of immunotherapy and vaccination; the skills and abilities to analyze the mechanisms of development and manifestation of immunodeficiency states, allergic, autoimmune, immunoproliferative and other diseases of the immune system, recognize morphofunctional changes in the human immune system, compare morphological and clinical manifestations of diseases of the immune system

1. ACADEMIC COURSE GOALS AND OBJECTIVES

The purpose of this course is to develop students' modern understanding of the structure and function of the immune system, its different types, the characteristics of immune responses in health and disease, clinical, instrumental, and laboratory diagnostic methods, and the prevention of immunodeficiency and allergic diseases.

Course Objectives:

• Develop a systematic understanding of the structure and function of the human immune system, its age-related characteristics, the cellular and molecular mechanisms of immune system development and function, the main stages, types, and genetic control of the immune response, and immunodiagnostic methods.

• Develop knowledge of hypersensitivity, its classification according to Gell-Coombs, the etiology and pathogenesis of types I-IV hypersensitivity, and the principles of laboratory diagnostics.

• Develop skills in the application and evaluation of laboratory research results in immunodeficiency conditions, allergic diseases, and other immune-mediated diseases.

• Develop an understanding of immunodeficiency conditions, allergic, autoimmune, immunoproliferative, and other immune system diseases, develop skills and abilities to analyze the mechanisms of disease development and manifestation, recognize morphofunctional changes in the human immune system, and compare morphological and clinical manifestations of immune system diseases;

- Develop an understanding of the principles of immunoprophylaxis and the use of immunoprophylactic drugs;

- Develop knowledge of blood groups and methods for determining ABO and Rh blood group affiliation; transplant immunity, principles of donor and recipient selection, and transplant rejection reactions;

- Develop an understanding of tolerance and autoimmunity; and antitumor immunity.

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

This course is implemented as part of the compulsory component. Mastering this course requires knowledge, skills, and abilities developed through the study of such disciplines as Chemistry, Medical and Biological Physics, Biology, Histology, Embryology, Cytology, Anatomy, Biochemistry,

Normal Physiology, Medical Microbiology and Virology, and Radiobiology. Knowledge, skills, and abilities developed through the study of the course "Immunology" are necessary for mastering such disciplines as Topographic Anatomy, Pathological Anatomy, Pathological Physiology, Pharmacology, Clinical Pharmacology, and clinical disciplines.

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.	З-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. У-ОПК-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. В-ОПК-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.

4. PEDAGOGIC POTENTIAL OF THE COURSE

Pedagogic tracks/objectives	**Pedagogic goals (code)**
Intellectual education	Establishing conditions for: formation of culture of intellectual work (В11)
Professional education	Establishing conditions for: formation of motivation to improve the quality of medical care to the population

	and the desire to follow the rules and norms of interaction between the doctor, colleagues and the patient, contributing to the creation of the most favorable environment for the patient's recovery (B34)

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
	5 Semester						
1	General Immunology. Innate Immunity	1-6	6/0/12	T-6 (20)	20	T-6	З-ОПК-5, У-ОПК-5, В-ОПК-5
2	General Immunology. Acquired Immunity	7-11	6/0/10	T-11 (20)	20	T-11	З-ОПК-5, У-ОПК-5, В-ОПК-5
3	Clinical immunology. Immunodiagnostics. Immunotherapy	12-16	6/0/14	OQ-15 (10)	10	OQ-15	З-ОПК-5, У-ОПК-5, В-ОПК-5
	Totals for 5 Semester		18/0/36		50		
	Assessment events for 5 Semester				50	PFE	З-ОПК-5, У-ОПК-5, В-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
OQ	Oral quiz
T	Testing
PFE	Pass/fail examination

SYLLABUS

Weeks	Topics / Content	Lect., hrs.	Pr./sem., hrs.	Lab., hrs.
	5 Semester	18	0	36
1-6	**General Immunology. Innate Immunity**	6	0	12
1 - 2	**Introduction to Immunology**	All		

	Introduction to Immunology as a Medical Discipline. Modern Concepts of Immunity and Immunological Surveillance	2	0	2
		Online		
		0	0	0
3 - 4	**Structural and functional characteristics of the human immune system** Structure and functions of the human immune system, its age-related characteristics. Ontogenesis and phylogenesis of the immune system. Central and peripheral organs. Types of immunity	All		
		2	0	2
		Online		
		0	0	0
5 - 6	**Innate Immunity** Innate immunity. Immunopoiesis. Stem cells, mechanisms of their proliferation and differentiation. Concept of innate immunity. Receptors for recognizing "non-self." Cells of the innate immune system. Phagocytosis. History of discovery. Mechanisms of phagocytosis and the role of phagocytic reactions in immunity and intercellular cooperation. Adhesion molecules, homing, and cell migration. Natural killer (NK) cells. Humoral factors of innate immunity. The complement system. Activation pathways and role in immune defense.	All		
		2	0	8
		Online		
		0	0	0
7-11	**General Immunology. Acquired Immunity**	6	0	10
7 - 11	**Adaptive Immunity** Adaptive Immunity. Antigens and Antibodies. The Structure and Basic Properties of Antigens. Types of Antigen Molecules: Complete and Incomplete Antigens (Haptens). The Structure and Function of Immunoglobulins of Different Classes. Mechanisms for Switching Antibody Synthesis. The Human Major Histocompatibility Complex (HLA). The Gene Structure and Function of HLA Class I and II Molecules. Structure. Antigen-Presenting Cells. Antigen Processing and Presentation. The Concept of Apoptosis. T- and B-Lymphocytes. Subpopulations. Maturation and Differentiation. The Structure of T- and B-Cell Receptors. The Immune Response. Mechanisms of Cell Interaction During the Immune Response. Factors Determining the Development of Different Types of Immune Response. Effector Mechanisms of Immunity. Humoral Factors of Immune Responses. Classification and Properties of Cytokines. Cytokine-Producing Cells. The Diversity of Receptors and Mechanisms of Cytokine Reception.	All		
		6	0	10
		Online		
		0	0	0
12-16	**Clinical immunology. Immunodiagnostics. Immunotherapy**	6	0	14
12 - 15	**Immune Pathologies** Immune Pathologies. Diseases of the immune system and their underlying mechanisms. Classification of immunopathological reactions according to Gell and Coombs. Mechanisms underlying various types of immunopathological reactions. Allergy. Allergens. Types of hypersensitivity reactions. Regulation of immunoglobulin E synthesis and secretion. Mast cells and their role in the development of allergic reactions. Immediate hypersensitivity mediators. General principles of diagnosis and treatment of allergic diseases. Immunological tolerance. Transplant immunity. Autoimmune	All		
		4	0	12
		Online		
		0	0	0

	diseases. Mechanisms underlying autoimmune pathology. Primary and secondary immunodeficiencies. Classification. Principles of diagnosis and treatment of immunodeficiency conditions. Anti-infective immunity. Anti-tumor immunity. Immunological surveillance and tumor growth. Conceptual aspects. Effector mechanisms of anti-tumor immunity. Immunoproliferative diseases. Principles of tumor immunodiagnostics and immunotherapy.			
16	**Immunodiagnostics, Immunoprophylaxis, Immunotherapy** Immunodiagnostics, Immunoprophylaxis, Immunotherapy. Evaluation of the human immune system. Immunobiotechnology. Monoclonal antibodies. Hybridoma technology. Basic principles of immunotherapy and vaccination.	All		
		2	0	2
		Online		
		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

LABORATORY (LAB) SESSIONS TOPICS

Weeks	**Topics / Content**
	5 Semester
1	**Introduction to Immunology** Antigens and antibodies. Methods for detecting immunoglobulins. Production of monoclonal antibodies. Organization of an immunology laboratory. The human major histocompatibility complex (HLA). Gene structure and functions of HLA classes I and II. Antigen processing and presentation. HLA typing methods. T lymphocytes. Main subpopulations, markers and receptors, functions. Immunopoiesis. B-lymphocytes. Main subpopulations, markers and receptors, functions. Immunopoiesis.
7 - 11	**Adaptive immunity. The cytokine system** Cytokine testing methods. Antigen recognition Methods for determining killer cell activity. Methods for assessing the humoral component of immunity
12 - 16	**Immune Pathologies** Primary Immunodeficiencies: Immunopathogenesis, Diagnosis, and Clinical Manifestations. Secondary Immunodeficiencies, HIV Infection. Immunopathogenesis. Modern Diagnostic and Treatment Methods.

6. EDUCATIONAL TECHNOLOGIES

Information and communication technologies (ICT).

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

Case study technology - solving situational problems.

Research-based teaching method - writing research papers.

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	З-ОПК-5	PFE, T-6, T-11, OQ-15, T-6, УО-15
	У-ОПК-5	PFE, T-6, T-11, OQ-15, T-6, T-11
	В-ОПК-5	PFE, T-6, T-11, OQ-15, T-6, T-11

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»*	*«pass»*	A
85-89	4 – «*good*»		B
75-84			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 K42 Immunology : , Khaitov R.M., Москва: ГЭОТАР-Медиа, 2022

FURTHER READING:

1. ЭИ H99 Immunology of the Skin : Basic and Clinical Sciences in Skin Immune Responses, , Tokyo: Springer Japan, 2016

2. ЭИ M45 Medical Microbiology, Virology, Immunology : textbook : Vol. 2. : учебник, Boichenko M.N., Zverev V.V., Москва: ГЭОТАР-Медиа, 2020

3. ЭИ Z96 Medical Microbiology, Virology, Immunology : textbook. Vol. 1 : , Boichenko M.N., Zverev V.V., Москва: ГЭОТАР-Медиа, 2022

SOFTWARE:

1. Microsoft Office 2016+ ()

LMS AND ONLINE RESOURCES

1. The course of immunology (https://online.mephi.ru/course/view.php?id=957)

2. База данных elibrary.ru - научной электронной библиотеки. (http://elibrary.ru/defaultx.asp/)

3. Электронная библиотека медицинского вуза. (http://www.studmedlib.ru/)

4. Национальный центр биотехнологической информации (https://www.ncbi.nlm.nih.gov/)

https://online.mephi.ru/

http://library.mephi.ru/

9. LOGISTICAL SUPPORT

1. Бинокулярные микроскопы "Микромед 2" (64-501)

2. Персональный компьютер: Моноблок Lenovo V540-24IWL All-In-One 23,8" i3-8145U 8Gb 256GB_SSD_M.2 Intel (64-501)

3. Проектор SMART P109 (64-501)

4. Мебель лабораторная, стулья, шкафы для хранения (64-501)

5. Интерактивная доска SMART SBM 685 (64-501)

6. Мышь, клавиатура (64-501)

7. Лаборатория с оснащением, обеспечивающим проведение практической подготовки по микробиологии (64-503)

8. Камера Горяева (64-501)

9. Счетчик С-5М лейко-формулы крови,миелограммы,тромбоцитов, (64-501)

10. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR STUDENTS

Lecture:

Writing lecture notes: briefly, schematically, and sequentially capture the main points, conclusions, formulations, and generalizations; highlight important ideas, and highlight keywords and terms. Review terms and concepts using encyclopedias, dictionaries, and reference books, writing down definitions in your notebook. Identify questions, terms, and material that poses difficulties, mark them, and try to find the answer in the recommended literature. If you are unable to understand the material independently, formulate a question and ask the instructor during a consultation or practical lesson.

Independent Work:

Each student should prepare individually for the course topics by reading lecture notes and recommended literature. Independent work allows students to reflect in a calm environment, understand the information on the topic, and, if necessary, consult reference literature. Careful reading and review of what has been read helps students fully grasp the topic and organize their knowledge. To ensure lasting retention of the subject's content, it's advisable to study it in stages—topically and in strict sequence, as subsequent topics typically build on previous ones. Therefore, a large portion of independent work involves preparing for seminars, completing recommended problems, preparing for colloquiums, completing and defending individual homework assignments, and preparing for laboratory work. To successfully complete these tasks, each student has access to the teaching resources developed by the department.

It's best for students to plan the time for independent work required to study this course throughout the semester, while also ensuring regular review of the material covered. Material taken during lectures should be regularly supplemented with information from the literature presented in the course syllabus. For each independent study topic listed in the course syllabus, students should first read the recommended readings and, if necessary, create a brief summary of the key concepts, terms,

and information that must be memorized and are fundamental to this topic and to subsequent sections of the course. To expand their knowledge of the course, it is recommended to use online resources.

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

When working with educational/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.

Laboratory Activities:

Review of the syllabus, paying particular attention to the goals and objectives, structure, and content of the course. Taking notes on sources. Working with lecture notes, preparing answers to test questions, reviewing recommended readings, and working with the textbook. Listening to audio and video recordings on a given topic, solving computational and graphic problems, solving algorithmic problems, etc.

Test:

Familiarization with primary and secondary literature, including reference works and foreign sources, and a summary of key concepts, terms, and information required for memorization and fundamental to the topic. Writing annotations for the literature read, etc.

Abstract:

Researching literature and compiling a bibliography, using 3 to 5 scientific papers, presenting the authors' opinions and your own judgment on the selected issue; outlining the main aspects of the problem. Familiarize yourself with the structure and format of an abstract.

Preparing for an Exam/Credit:

When preparing for an exam (credit), it is necessary to refer to lecture notes, recommended readings, etc.

11. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR TEACHERS

Structure of the laboratory session for the course "Immunology":

1. Defining the topic and purpose of the laboratory session – 10 minutes;
2. Discussion of issues that caused difficulties during preparation for the laboratory session – 10 minutes;
3. Assessing theoretical knowledge through testing – 25 minutes;
4. Discussion of theoretical issues (Discussion Questions) – 45 minutes.

The course "Immunology" will be taught using distance learning technologies:

- Remote classes are conducted via Skype and Zoom;
- Educational and methodological materials required for the 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.

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