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Federal State Autonomous Educational Institution of Higher Education

PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA

NAMED AFTER PATRICE LUMUMBA

RUDN University

Institute of Medicine

educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

MECHANISMS OF DRUG ACTION

course title

Recommended by the Didactic Council for the Education Field of:

31.05.01 General Medicine

field of studies / speciality code and title

The course instruction is implemented within the professional education programme of higher education:

General Medicine

higher education programme profile/specialisation title

2026

1. COURSE GOAL(s)

The discipline "Mechanisms of Drug Action" is included in the program of specialty "General Medicine" in the direction 31.05.01 "General Medicine" and is studied in the 2th semester of the 2rd year. The discipline is implemented by the Department of General and Clinical Pharmacology. The discipline consists of 2 sections and 31 topics and is aimed at studying the key pharmacodynamic characteristics of various drug classes, including molecular targets and the sequence of events underlying the ultimate alteration of cell, organ, and body system functioning in a living organism. The goal of mastering this discipline is to develop systematic knowledge of drug pharmacodynamics.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the discipline "Mechanisms of Drug Action" is aimed at developing the following competencies (parts of competencies) in students:

Table 2.1. List of competences that students acquire through the course study

Code	Descriptor of generic competence	Competence level indicator
PC -3	Being able to prescribe treatment and monitor its efficacy and safety	PC-3.4. Being able to assess the efficacy and safety of the use of drugs, medical devices, medical nutrition and other treatment methods.

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course refers to the core/variable/elective* component of (FTD) block of the higher educational programme curriculum.

* - Underline whatever applicable.

Within the higher education programme students also master other (modules) and / or internships that contribute to the achievement of the expected learning outcomes as results of the course study.

Table 3.1. The list of the higher education programme components/disciplines that contribute to the achievement of the expected learning outcomes as the course study results

Competence Code	The competence	Previous Disciplines	Subsequent disciplines
PC-3	Being able to prescribe treatment and monitor its efficacy and safety	Introduction into nutriology	Practice in the Surgical Field: Surgical Assistant Practice in the Therapeutic Field: Physician's Assistant

		<p>General Practitioner: Outpatient Physician's Assistant</p> <p>Practice in the Obstetric and Gynecological Field: Obstetrician Assistant</p> <p>Practice in the Obstetric and Gynecological Field: Gynecologist Assistant</p> <p>General Practitioner: Pediatrician's Assistant</p> <p>Paediatrics</p> <p>Endoscopic Urology</p> <p>Dermatovenerology</p> <p>Faculty Surgery</p> <p>Hospital Therapy</p> <p>Endocrinology</p> <p>Polyclinic Therapy</p> <p>Hospital Surgery, Pediatric Surgery</p> <p>Obstetrics and Gynecology</p> <p>Outpatient Cardiology</p> <p>Oncology, Radiation Therapy</p> <p>Basics of Integrative Medicine</p> <p>Traumatology, Orthopedics</p> <p>Geriatrics and Palliative Medicine</p> <p>Neurology, Medical Genetics, Neurosurgery</p> <p>Faculty Therapy</p> <p>Urology</p> <p>Infectious Diseases</p> <p>Reproductive Health</p> <p>Professional Diseases</p> <p>Topical Issues of Neonatology</p> <p>Otorhinolaryngology</p> <p>Maxillofacial Surgery</p> <p>Clinical pharmacology</p> <p>Clinical trials</p> <p>Ophthalmology</p> <p>Psychiatry, Medical Psychology</p> <p>Allergology</p> <p>Phthisiology</p> <p>Telemedicine</p>
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			Basics of Child Nutrition Basics of Nutritional Therapy Pharmacology
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4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the discipline “Mechanisms of drug action” is 2 credits (72 academic hours)

Table 4.1. Types of academic activities during the periods of higher education programme mastering (full-time training)*

Type of academic activities	Total academic hours	Semesters/training modules			
		4			
<i>Contact academic hours</i>	68	68			
including:					
Lectures (LC)					
Lab work (LW)					
Seminar (workshops/tutorials) (S)	36	36			
<i>Self-studies</i>	36	36			
<i>Evaluation and assessment (exam/passing/failing grade)</i>	0	0			
Course workload	academic hours	72	72		
	credits	2	2		

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

No Name of Module	Name of Topic Content of Topic	Type of Academic Activities
Pharmacodynamics. Fundamental Principles and Key Concepts Mechanisms of Action and Effects of the Major Drug Classes	1.1 Receptor Mechanisms of Drug Action Receptor Classification; Characteristics and Quantitative Principles of Ligand-Receptor Binding; The Receptor as a Target for Drug Action.	S
	1.2 Biochemical Mechanism of Drug action Classification of Enzymes. The Nature of Drug-Enzyme Interaction. Major Groups of Target Enzymes in Pharmacology	S

	<p>1.3 Other Mechanisms of Drug Action Voltage-Gated Ion Channels, Transporter Proteins, Structural Proteins, and Nucleic Acids. The Nature of Their Interaction with Drugs. Novel Approaches to Targeting Intracellular Messenger Systems</p>	S
	<p>1.4 Key Quantitative Parameters of Drug-Target Interactions Dissociation Constant (Kd). Half-Maximal Effective Concentration (EC50). Maximal Effect (Emax). Inhibitory Concentration (Inhibition Index)</p>	S
	<p>1.5 Drug Effects: Types and Classifications Target Pharmacological Effects. Adverse Drug Reactions. Toxic Reactions.</p>	S
	<p>1.6 Classification of Adverse Drug Reactions World Health Organization (WHO) classification. Mechanism of Development and Population Frequency of Each of the Main Types of Adverse Drug Reactions</p>	S
	<p>1.7 Therapeutic Index. Therapeutic Drug Monitoring. The Concept of the Therapeutic Index: Principles of Calculation and Interpretation of Results. The Concept of Therapeutic Drug Monitoring: Principles of Implementation and Indications for Use.</p>	S
	<p>1.1 Mechanisms of Action and Effects of Antihypertensive Drugs Targets for the Major Classes of Antihypertensive Drugs: the Renin-Angiotensin-Aldosterone System, Receptors Localized in the Central Nervous System, Adrenoceptors, Calcium Channels, Targets in Vascular Smooth Muscle Cells, and Targets in the Kidneys. The Nature of Interaction with Receptor and Non-Receptor Targets. Principles Underlying the Development of the Targeted Therapeutic Effect and Adverse Drug Reactions.</p>	S
	<p>1.2 Mechanisms of Action and Effects of Antianginal Drugs Targets in Cardiomyocytes and Coronary Vessel Walls. The Nature of Interaction with Receptor and Non-Receptor Targets. Principles Underlying the Development of the Targeted Therapeutic Effect and Adverse Drug Reactions.</p>	S
	<p>1.3 Mechanisms of Action and Effects of Antiarrhythmic Drugs Targets in Cardiomyocytes and Cells of the Cardiac Conduction System. The Nature of Interaction with Receptor and Non-Receptor Targets. Principles Underlying the Development of the Targeted Therapeutic Effect and Adverse Drug Reactions</p>	S

<p>1.4 Mechanisms of Action of Cardiotonic Drugs Targets in Cardiomyocytes and Cells of the Cardiac Conduction System. The Nature of Interaction with Receptor and Non-Receptor Targets. Principles Underlying the Development of the Targeted Therapeutic Effect and Adverse Drug Reactions.</p>	S
<p>1.5 Mechanisms of Action and Effects of Lipid-Lowering Drugs Targets at the Stages of Cholesterol Synthesis: HMG-CoA Reductase (3-Hydroxy-3-Methylglutaryl-Coenzyme A Reductase); PCSK9 (Proprotein Convertase Subtilisin/Kexin Type 9); NPC1L1 Protein (Niemann-Pick C1-Like 1); Peroxisome Proliferator-Activated Receptor Alpha (PPAR-Alpha); Bile Acids in the Intestinal Lumen; Microsomal Triglyceride Transfer Protein (MTP/MTTP); Apolipoprotein B-100 (ApoB-100); Angiopoietin-Like Protein 3 (ANGPTL3). The Nature of Drug Interaction with These Targets. Targeted Therapeutic Effects and Adverse Drug Reactions.</p>	S
<p>1.6 Mechanisms of Action and Effects of Drugs Affecting the Respiratory System Sputum Components as Targets for Cough Medications. Targets for Bronchodilator Drugs. Targets for Anti-Inflammatory Drugs. Biologic Agents (Monoclonal Antibodies to Immunoglobulin E). Targeted Therapeutic Effects and Adverse Drug Reactions.</p>	S
<p>1.7 Mechanisms of Action and Effects of Drugs Used in the Pharmacotherapy of Gastric and Duodenal Ulcer Disease Targets: H⁺/K⁺-ATPase (Proton Pump), H₂-Histamine Receptors, M-Cholinoceptors. Principles of Gastric Mucosal Protection Against Hydrochloric Acid (HCl). Targeted Therapeutic Effects of These Drugs and Adverse Drug Reactions.</p>	S
<p>1.8 Mechanisms of Action and Effects of Drugs for the Pharmacotherapy of Obesity Peripheral Targets: Gastrointestinal Lipases, GLP-1 (Glucagon-Like Peptide-1), Glucose-Dependent Insulinotropic Polypeptide (GIP) and Their Receptors, the Glucagon Receptor, Melanocortin-4 Receptors (MC4R). Central Targets: Opioid Receptors (Mu-Type), the Noradrenaline and Dopamine Reuptake System, Serotonin Receptors (5-HT_{2C}). Targeted Pharmacological Effects and Adverse Drug Reactions.</p>	S

<p>1.9 Mechanisms of Action and Effects of Steroid Hormones</p> <p>Features of Steroid Hormone Biosynthesis. Genomic and Non-Genomic Mechanisms of Action. Effects on Organs and Systems During Short-Term and Long-Term Use. Targeted Therapeutic Effects and Adverse Drug Reactions</p>	S
<p>1.10 Mechanisms of Action and Effects of Insulins</p> <p>The Insulin Receptor: Principles of Function. Hypoglycemic Action of Insulins and Other Effects. Classification of Insulins; Prandial and Basal Insulins; Characteristics of Their Effects on the Human Body.</p>	S
<p>1.11 Mechanisms of Action and Effects of Drugs for the Treatment of Type 2 Diabetes Mellitus</p> <p>Targets for Drugs That Enhance Endogenous Insulin Secretion. Targets for Drugs That Increase Insulin Sensitivity. Targets for Peptide-Based Drugs. Targets for Drugs That Impair Carbohydrate Absorption from the Intestine. Targets for Drugs That Increase Urinary Glucose Excretion. Targeted Therapeutic Effects and Adverse Drug Reactions.</p>	S
<p>1.12 Mechanisms of Action and Effects of Drugs Used in the Treatment of Thyroid Disorders</p> <p>Principles of Thyroid Hormone Synthesis. Thyroid Hormone Preparations. Targets for Antithyroid Drugs. Targeted Therapeutic Effects and Adverse Drug Reactions</p>	S
<p>1.13 Mechanisms of Action and Effects of Non-Steroidal Anti-Inflammatory Drugs</p> <p>Isoforms of the Cyclooxygenase Enzyme as Targets for Non-Steroidal Anti-Inflammatory Drugs. Consequences of Arachidonic Acid Metabolism Disruption. Targeted Therapeutic Effects and Adverse Drug Reactions</p>	S
<p>1.14 Mechanisms of Action and Effects of Opioid and Non-Opioid Analgesics</p> <p>Opioid Receptors: Effects of Their Activation and Blockade. Consequences for the Organism.</p>	S
<p>1.15 Mechanisms of Action and Effects of Antidepressants</p> <p>Synaptic Transmission in the Central Nervous System as a Target for Drugs. Excitatory Neurotransmitters and Their Receptors. Principles of Enhancing the Effects of Excitatory Neurotransmitters in the Central Nervous System and Consequences for the Organism</p>	S

<p>1.16 Mechanisms of Action and Effects of Antipsychotics</p> <p>Principles of Suppressing the Effects of Excitatory Neurotransmitters in the Central Nervous System and Consequences for the Organism</p>	S
<p>1.17 Mechanisms of Action and Effects of Beta-Lactam Antibacterial Drugs</p> <p>Structure-Activity Relationship of Beta-Lactam Antibiotics and Their Effect on the Bacterial Cell Wall. Bacteria Traditionally Susceptible to Various Beta-Lactams. Classification of Beta-Lactams. Mechanisms of Bacterial Resistance to Beta-Lactam Antibiotics</p>	S
<p>1.18 Mechanisms of Action and Effects of Non-Beta-Lactam Antibacterial Drugs</p> <p>Targets and Nature of the Antibacterial Effect of Macrolides, Tetracyclines, Aminoglycosides, Fluoroquinolones, Sulfonamides, Oxazolidinones, and Lincosamides. Mechanisms of Toxic Effect Development for Drugs of Different Classes</p>	S
<p>1.19 Mechanisms of Action and Effects of Antiparasitic Drugs</p> <p>Targets for Anthelmintic Drugs, Antiprotozoal Drugs, and Insectoacaricides. Targeted Therapeutic Effects and Adverse Drug Reactions</p>	S
<p>1.20 Mechanisms of Action and Effects of Antimycotics</p> <p>Fungal Cell Structure as the Basis for Understanding Antifungal Drug Targets. Differences in the Mechanisms of Action of the Major Drug Classes (Polyenes, Azoles, Echinocandins, Allylamines, Pyrimidines, and Others). Targeted Therapeutic Effects and Adverse Drug Reactions</p>	S
<p>1.21 Mechanisms of Action and Effects of Antivirals</p> <p>Structural Features of Viruses as the Basis for Understanding the Mechanisms of Action of Antiviral Drugs. Targets for Antiherpetic, Anticytomegalovirus, Anti-Influenza Drugs, and Drugs for the Treatment of Other Respiratory Viral Infections; Antiretroviral Drugs; Drugs for the Treatment of Viral Hepatitis. Targeted Therapeutic Effects and Adverse Drug Reactions</p>	S
<p>1.22 Mechanisms of Action and Effects of Antineoplastic Drugs</p> <p>Major Targets for Cytostatic Drugs. Targets for Cell Cycle-Dependent and Cell Cycle-Independent Drugs. Principles of Action of Novel Targeted Anticancer Agents.</p>	S

	<p>1.23 Mechanisms of Action and Effects of Inhibitors of Intracellular Signaling Pathways Blockade of Proliferation Pathways: Targets — Growth Factors. Kinase Inhibition. Inhibition of Cell Survival and Metabolic Cascades. Blockade of the Mutant BRAF Cascade. Key Targeted Pharmacological Effects and Adverse Drug Reactions</p>	S
	<p>1.24 Mechanisms of Action and Effects of Genetically Engineered Biologic Drugs Principles of Monoclonal Antibody (mAb) Development. Monoclonal Antibodies Targeting Interleukins and Their Receptors, Interferons, Tumor Necrosis Factor-Alpha, and Immunoglobulins (IgE). Diversity of Effects Depending on the Target. Adverse Drug Reactions</p>	S

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENT

Table 6.1. Classroom equipment and technology support requirements

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
Seminar	<p>Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, stable wireless Internet connection.</p> <p>Software: Microsoft Windows, MS Office /Office 365, MS Teams, Chrome (latest stable release), Skype</p> <p>Classrooms 349, 350, 352</p>	<p>Classroom for lectures and lab works, group and individual consultations, current control, and intermediate certification.</p> <p>A set of specialized furniture; technical devices: Optoma HD36 multimedia projector, Lenovo IdealPad330-5ikb laptop, Internet access.</p> <p>Wall projection screen, floorboard information marker magnetic, interactive complex for testing students.</p>
Self-studies	<p>Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable multimedia projector, laptop, projection screen, stable wireless Internet connection.</p> <p>Software: Microsoft Windows, MS Office /Office 365, MS Teams, Chrome (latest stable release), Skype</p> <p>Classroom 349</p>	<p>Classroom for lectures and lab works, group and individual consultations, current control, and intermediate certification.</p> <p>A set of specialized furniture; technical devices: Optoma HD36 multimedia projector, HP250G7 laptop, Internet access.</p> <p>Wall projection screen, floorboard information marker magnetic, interactive complex for testing students.</p>
Learning-and Research Lab	<p>Classroom, equipped with a set of specialized furniture; whiteboard; a set of devices includes portable</p>	<p>Wall projection screen, magnetic floor information marker board, Optoma HD36 multimedia projector, Lenovo 15.6 laptop,</p>

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
	multimedia projector, laptop, projection screen, stable wireless Internet connection. Software: Microsoft Windows, MS Office /Office 365, MS Teams, Chrome (latest stable release), Skype Lab No 1 on the base of the city clinical hospital No 24	centrifuge 5804, analytical scale AF225DPCT, Vortekx shaker, CryoCubeF101h freezer

7. RECOMMENDED SOURCES FOR COURSE STUDIES.

Main readings:

1. Katzung's Basic and Clinical Pharmacology / edited by Todd W. Vanderah. - 16th edition. - McGraw Hill, 2024. - 1347 p. : il. - Книга на английском языке. - ISBN 978-265-98057-3 : 9676.04.

Additional readings:

1. Tutorial Guide to Pharmacodynamics [Текст] = Пособие по фармакологии : Учебное пособие / S.K. Zyryanov, O.I. Butranova. - Книга на английском языке. - М. : PFUR, 2019. - 56 с. : ил.

2. Basic Principles of Drug Discovery and Development 1st Edition. Benjamin Blass. Paperback. Imprint: Academic Press. Published Date: 27th April 2015. Page Count: 580 ISBN: 9780124115088 eBook ISBN: 9780124115255

Internet (based) sources

1. Electronic libraries with access for RUDN students:

- Electronic library network of RUDN – ELN RUDN
<http://lib.rudn.ru/MegaPro/Web>
- ELN «University Library online» <http://www.biblioclub.ru>
- ELN Urait <http://www.biblio-online.ru>
- ELN «Student Advisor» www.studentlibrary.ru
- ELN «Lan» <http://e.lanbook.com/>

2. Databases and search engines:

- electronic fund of legal and regulatory and technical documentation
<http://docs.cntd.ru/>
- search system Yandex <https://www.yandex.ru/>
- search system Google <https://www.google.ru/>
- abstract database SCOPUS <http://www.elsevierscience.ru/products/scopus/>

Learning toolkits for self-studies during the development of the discipline*:

1. A course of lectures on the discipline "Pharmacology".
2. Guidelines for self-study on the discipline "Pharmacology"
3. Online educational course on the Stepik platform: "Pharmacology of Antibacterial Agents" Free access: <https://stepik.org/course/123136/promo>

* - all educational and methodological materials for independent work of students are placed in accordance with the current procedure on the page of the discipline on RUDN LMS TUIS!

8. EVALUATION TOOLKIT AND GRADE SYSTEM FOR ASSESSMENT

Evaluation Toolkit (ET) and a point-rating system (PRS)* for assessment the level of competence formation (part of competencies) based on the results of mastering the discipline "Mechanisms of drug action" are presented in the Appendix to this Work Program of the discipline.

* - *ET and PRS are formed on the basis of the requirements of the relevant local regulatory act of the RUDN*

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