Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
RUDN University

Institute of Medicine

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

COURSE SYLLABUS

Mathematics

course title

Recommended by the Didactic Council for the Education Field of:

31.05.03 Dentistry

field of studies / speciality code and title

The course instruction is implemented within the professional education programme ofhigher education:

Dentistry

higher education programme profile/specialisation title

2022-2023

1. COURSE GOAL(s)

The goal of the course «**Mathematics**» is to equip students with the knowledge of the basic mathematic knowledge necessary for subsequent natural science disciplines, as well as to form their natural science worldview.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the course (module) «**Mathematics**» is aimed at the development of the following competences /competences in part: **GPC-8, PC-1, PC-6.**

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

Competence code	**Competence descriptor**	**Competence formation indicators** (within this course)
PC-1	Being able to implement critical analysis of problem situations based on systems approach, develop an action strategy.	PC-1.1. Analyzing the problem situation as a system identifying its components and links between them.
		PC-1.2. Defining gaps in the information required to deal with a problem situation and designing processes to address them.
		PC-1.3. Assessing in a critical way the reliability of information sources; working with contradictory information from different sources.
		PC-1.4. Developing and giving meaningful reasons for and against a strategy for solving a problem situation in terms of a systematic and interdisciplinary approaches.
PC-6	Being able to identify and implement the priorities of their own activities and the ways of improving them based on self-assessment and lifelong learning.	PC 6.1. Assessing their own resources and their (personal, contextual, time) limits; using them in an optimal way to successfully perform the assigned task
GPC-8	Being able to use main physical and chemical, mathematical and scientific notions and methods when dealing with professional tasks.	GPC-8.1. Applying basic fundamental physical and chemical knowledge to deal with professional tasks.
		GPC-8.2. Using applied natural science knowledge to deal with professional tasks.
		GPC-8.3. Applying fundamental mathematical knowledge to deal with professional tasks.

3.COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course refers to the core/variable/elective* component of (B1) 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	Competence descriptor	Previous courses/modules*	Subsequent courses/modules*
PC-1	Being able to implement critical analysis of problem situations based on systems approach, develop an action strategy.	-	Bioethics, introduction into specialty, philosophy, history of medicine, jurisprudence, economics, psychology, pedagogy, organization of general patient care, public health and healthcare, internal medicine, general surgery, life safety, catastrophe medicine, forensic medicine.
PC-6	Being able to identify and implement the priorities of their own activities and the ways of improving them based on self-assessment and lifelong learning.	-	Bioethics, jurisprudence, economics, psychology, pedagogy, medical informatics.
GPC-8	Being able to use main physical and chemical, mathematical and scientific notions and methods when dealing with professional tasks.	-	Physics, chemistry, biological chemistry, biology, normal physiology, microbiology, immunology, pharmacology, epidemiology, radiation diagnostics, materials science.

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the course 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			
			1			
Contact academic hours		**34**	**34**			
Including:						
Lectures (LC)		**17**	**17**			
Lab work (LW)						
Seminars (workshops/tutorials) (S)		17	17			
Self-studies		*38*	*38*			
Evaluation and assessment (exam/passing/failing grade)		*0*	*0*			
Course workload	academic	**72**	**72**			

Type of academic activities		Total academic hours	Semesters/training modules			
			1			
	hours_					
	credits	**2**	**2**			

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Course module title	Course module contents (topics)	Academic activities types
Module 1 Introduction.	Mathematics as a method for studying biological systems. Connection and communication between the scientific disciplines. Examples of setting and solving biological problems using mathematical methods. Physicochemical processes, their formalization. Multiphysics tasks. Quantitative and qualitative models, reduction, the idea of a qualitative analysis of a mathematical model. The need to use the	LC, S
	1. Repetition of the basic information from the high school math course. Numerical sets and subsets – Number line, modulus of a number – Operations with fractions – Scientific notation of a number – Literal algebraic expressions – Percent, mass fraction – Proportion – Logarithm.	LC, S
Module 2 Linear algebra.	Cartesian coordinate system. Solution of a system of two linear equations (SLE) by analytical and graphical methods. Number axis – Cartesian coordinate system – Equality – Equation – Graphical and analytical solution of equations – Solution of a linear equation with 1 unknown – Solution of a linear equation with 2 unknowns – Solution of a system of 2 linear equations with 2 unknowns	LC, S
	Vectors and matrices. Solution of SLE by the Gauss–Jordan method. Scalar and vector – Dot product of vectors – Orthogonality – Vector length – Angle between vectors – The method of adding up of equations – Matrix notation of SLE, Gauss–Jordan method with integer coefficients for independent SLE.	LC, S
	Linear dependence of equations. General and	LC, S

Course module title	Course module contents (topics)	Academic activities types
	particular solutions of SLE. Linear dependence of vectors, of equations (algebraic and geometric interpretations). General and particular solutions of a consistent dependent SLE. Inconsistent systems.	
	Multiplication of vectors and matrices. Transformation of vector by left multiplication by a matrix, algebraic and geometric senses (on a plane). Matrix multiplication.	LC, S
	Determinant and eigenvalues of a matrix. Determinant of a 2x2 matrix. Cramer's rule. Homogeneous systems. Eigenvalues and eigenvectors of a 2x2 matrix, characteristic equation of a matrix.	LC, S
Module 3 Differential calculus.	Functions and graphs. Numbers, parameters, variables – Cartesian coordinate system – Function, methods of definition, function domain Function graph, its advantages – Functions and their graphs in physiology – Elementary functions and their graphs – Graph transformations – Function properties – Sketching a graph by its features (without a table) – Graphs of functions with parameters – Asymptotes – Limit of a sequence – Limit of a function (limit of a continuous function at a point and at infinity; limit at a discontinuity point) – Limit of a rational function at infinity – Theorems about limits – Analyzing the graph of a function using limits – Plan for analyzing the functional dependence.	LC, S
Module 3 Differential calculus	Functions and graphs. Numbers, parameters, variables – Cartesian coordinate system – Function, methods of definition, function domain Function graph, its advantages – Functions and their graphs in physiology – Elementary functions and their graphs –	LC, S

Course module title	Course module contents (topics)	Academic activities types
	Graph transformations – Function properties – Sketching a graph by its features (without a table) – Graphs of functions with parameters – Asymptotes – Limit of a sequence – Limit of a function (limit of a continuous function at a point and at infinity; limit at a discontinuity point) – Limit of a rational function at infinity – Theorems about limits – Analyzing the graph of a function using limits – Plan for analyzing the functional dependence.	
	2. Fundamentals of Differential Calculus. Analysis of graphs using derivatives. Velocity of the mechanical movement, rate of change of the physiological variables – Derivative – Tangent and secant lines – Slope of the tangent line – Linearization of the function, differential – Calculation of the simplest derivatives – Table of derivatives – Rules of differentiation – Analysis of graphs of functions using the 1^{st} and the 2^{nd} derivatives.	LC, S
	Fundamentals of Differential Calculus. Analysis of graphs using derivatives. Velocity of the mechanical movement, rate of change of the physiological variables – Derivative – Tangent and secant lines – Slope of the tangent line – Linearization of the function, differential – Calculation of the simplest derivatives – Table of derivatives – Rules of differentiation – Analysis of graphs of functions using the 1^{st} and the 2^{nd} derivatives	LC, S
	2. Foundations of Integral Calculus. Separable ordinary differential equations (ODEs). ODE of one variable – Reason for using ODEs – Examples from physics, chemistry, biology – Autonomous and non–autonomous ODEs – General and particular solutions of ODE – The Cauchy problem – Graphical representation of the solution –	LC, S

Course module title	Course module contents (topics)	Academic activities types
	Antiderivative and indefinite integral – Geometrical meaning of antiderivative – Table of indefinite integrals – Integration rules – Separable ODEs – Definite integral, the Newton–Leibniz formula – Integration of ODE of one variable accounting the initial condition – Application of ODEs for the analysis of the kinetics of chemical and biological processes – Fundamentals of chemical kinetics	

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

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)
Seminars	laptop - 1 pc., projector - 1 pc., screen - 1 pc., copier - 1 pc., printer - 1 pc., scanner - 1 pc.	laptop - 1 pc., projector - 1 pc., screen - 1 pc., copier - 1 pc., printer - 1 pc., scanner - 1 pc.
Lecture	laptop - 1 pc., projector - 1 pc., screen - 1 pc., copier - 1 pc., printer - 1 pc., scanner - 1 pc.	laptop - 1 pc., projector - 1 pc., screen - 1 pc., copier - 1 pc., printer - 1 pc., scanner - 1 pc.

7. RESOURCES RECOMMENDED FOR COURSE STUDY

a) Software:

On-line graph plotting: https://www.geogebra.org/

b) Databases, reference and knowledge bases on mathematics:

1. https: //www.khanacademy.org/
2. https://mathworld.wolfram.com/topics/
3. Video tutorials using the Gauss-Jordan method: https://www.youtube.com/watch?v=0fTSBIBD7Cs https://www.youtube.com/watch?v=eYSASx8_nyg

10. Literature.

1. G. Strang, E. Herman et al. Calculus, vol. 1. 2016. (OpenStax,
Rice University)
2. S. Lang. Introduction to Linear Algebra. Second Edition. Springer, 1986. (Yale University)
3. S. Lipschutz. Theory and Problems of Linear Algebra. 1991. Additional:
4. A. Panfilov. Qualitative analysis of differential equations, 2010.

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/

*Training toolkit for self- studies to master the course *:*

1. The set of lectures on the course ”Mathematics”
2. The laboratory workshop (if any).on the course ”Mathematics”
3. The guidelines for writing a course paper / project (if any) on the course ”Mathematics”.
4. ……

* The training toolkit for self- studies to master the course is placed on the course page in the university telecommunication training and information system under the set procedure.

8. ASSESSMENT TOOLKIT AND GRADING SYSTEM* FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL UPON COURSE COMPLETION

The assessment toolkit and the grading system* to evaluate the competences formation level (GPC-8, PC-1, PC-6) upon the course study completion are specified in the Appendix to the course syllabus.

* The assessment toolkit and the grading system are formed on the basis of the requirements of the relevant local normative act of RUDN University (regulations / order).

DEVELOPERS:

Lecturer at the Mathematical Institute named after S.M. Nikolskii — A. Tokarev

position, department	signature	name and surname
Director of the Mathematical Institute named after S.M. Nikolskii		A. Skubachevsky
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HEAD OF EDUCATIONAL DEPARTMENT:

of Mathematical Institute		A. Skubachevsky
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HEAD
OF HIGHER EDUCATION PROGRAMME:

First Deputy Director of MI for Academic Affairs		Iv.V.Radysh
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