

Документ подписан простой электронной подписью
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**Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
RUDN University**

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

COURSE SYLLABUS

Mathematical biology and bioinformatics

course title

Recommended by the Didactic Council for the Education Field of:

01.03.02 "Applied mathematics and computer science"

field of studies / speciality code and title

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

Applied Mathematics and Programming

higher education programme profile/specialisation title

1. COURSE GOAL(s)

The discipline “Mathematical biology and bioinformatics” is aimed at familiarizing students with modern approaches to the study of biological systems using mathematical and computational methods, as well as at forming a natural science worldview among students.

The purpose of the discipline is to obtain basic knowledge about the laws of nature governing the operation of chemical, biochemical and biological systems, about the methods of constructing mathematical models of these systems and about the methods of analyzing the constructed models.

2. REQUIREMENTS FOR LEARNING OUTCOMES

The development of the discipline " Mathematical biology and bioinformatics " is aimed at the formation of the following competencies (parts of competencies) in students:

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

Competence code	Competence descriptor	Competence formation indicators (within this course)
GPC-4	Able to understand the principles of modern information technologies and use them to solve the tasks of professional activity	GPC-4.1. Presents the results of the work in the form of a scientific publication (abstracts, article, review) in Russian and English
		GPC-4.2. Presents the results of the work in Russian and English orally
PC-1	Capable of determining the general forms and patterns of a particular subject area	PC-1.1. Plans separate stages of research in the presence of a general research plan
		PC-1.2. Prepares elements of documentation, draft plans, and programs of individual stages of research
		PC-1.3. Selects research methods for solving research tasks
		PC-1.4. Conducts an initial search for information on a given topic
		PC-1.5. Able to study mathematical structure using computational methods
		PC-1.6. Able to publicly present well-known scientific research
		PC-1.7. Able to represent the own scientific achievements

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The discipline “Mathematical biology and bioinformatics” refers to the variable component of the mandatory part of block 1 of the curriculum.

Within the framework of the educational program, students also master other disciplines and/or practices that contribute to achieving the planned results of mastering the discipline " Mathematical biology and bioinformatics".

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*
GPC-4	Able to understand the principles of modern information technologies and use them to solve the tasks of professional activity	Functional analysis	Elements of computer algebra and mathematical computing packages Random processes and queuing theory Time series and panel data analysis Exponential queuing networks Models of multiservice networks with priorities
PC-1	Capable of determining the general forms and patterns of a particular subject area	Discrete mathematics and mathematical logic Functional analysis Computer science and programming technologies	Numerical methods Elements of computer algebra and mathematical computing packages Random processes and queuing theory Econometrics Fundamentals of financial mathematics and theory of optimal securities portfolio Optimization methods Analysis of time series and panel data Nonlinear models of mathematical physics Exponential queuing networks Managed systems with aftereffect Models of multiservice networks with priorities Machine learning in telecommunications Pre-graduate practice Research work Scientific seminar on differential and functional differential equations

* To be filled in according to the competence matrix of the higher education programme.

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			
			5	6	7	8
<i>Contact academic hours</i>		34	34			
including:						
Lectures (LC)		17	17			
Lab work (LW)		0	0			
Seminars (workshops/tutorials) (S)		17	17			
<i>Self-studies</i>		38	38			
<i>Evaluation and assessment (exam/passing/failing grade)</i>						
Course workload	academic hours	72	72			
	credits	2	2			

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
Section 1. General information of the subject area	Topic 1. Mathematics as a method of studying biological systems.	LC
	Topic 2. Phenomenological chemical kinetics.	LC
	Topic 3. Analysis of the kinetics of complex reactions.	LC
	Topic 4. Enzymes. Inhibition.	LC
Section 2. Application of mathematical research methods	Topic 5. Qualitative analysis of differential equations. Linear systems on a plane	LC, S
	Topic 6. Qualitative analysis of nonlinear systems on the plane.	LC, S
	Topic 7. Mechanisms of the hemostasis system.	LC
	Topic 8. Cooperative processes. Trigger systems in biology.	LC, S

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)
Lecture	A lecture hall for lecture-type classes, equipped with a set of specialised furniture; board (screen) and technical means of multimedia presentations.	
Seminar	A classroom for conducting seminars, group and individual consultations, current and mid-term assessment, for personal student's work; equipped with a set of specialised furniture and with the marker or chalk board.	Personal computers for each student with pre-installed python, numpy, matplotlib, scipy
Self-studies	the same as for Seminar	

* The premises for students' self-studies are subject to **MANDATORY** mention

7. RESOURCES RECOMMENDED FOR COURSE STUDY

Main readings:

1. D. Murray. Mathematical biology. vol. I & vol. II. Springer, 2002.

Additional readings:

- 1) Riznichenko G.Y. Lectures on mathematical models in biology. Publishing house "RHD", 2011
- 2) O.E. Solovyov. Mathematical modeling of living systems. Ural University Press, 2013.
- 3) Alexander Panfilov (Alexander Panfilov). Qualitative analysis of differential equations, 2010. <https://arxiv.org/abs/1803.05291>
- 4) A.B. Rubin. Biophysics: textbook. M.: KNORUS, 2006.

Internet sources

1. Electronic libraries (EL) of RUDN University and other institutions, to which university students have access on the basis of concluded agreements:
 - RUDN Electronic Library System (RUDN ELS) <http://lib.rudn.ru/MegaPro/Web>
 - EL "University Library Online" <http://www.biblioclub.ru>
 - EL "Yurayt" <http://www.biblio-online.ru>
 - EL "Student Consultant" www.studentlibrary.ru
 - EL "Lan" <http://e.lanbook.com/>
 - EL "Trinity Bridge"
2. Databases and search engines:
 - PubMed <https://pubmed.ncbi.nlm.nih.gov/> / – a database of medical and biological publications created by the US National Center for Biotechnological Information.
 - Google Academy (Google Scholar) <https://scholar.google.ru/> / – search engine for full texts of scientific publications of all formats and disciplines.
 - electronic foundation of legal and normative-technical documentation <http://docs.cntd.ru/>
 - Yandex search engine [https:// www .yandex.ru/](https://www.yandex.ru/)

- Google search engine <https://www.google.ru/>
- Scopus abstract database <http://www.elsevierscience.ru/products/scopus/>

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

1. The set of lectures and other materials in the TUIS electronical course

* 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 (competences in part) 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:

Associate Professor, S.M.

Nikol'skii Mathematical

Institute

position, department

A.S. Mozokhina

signature

name and surname

HEAD OF EDUCATIONAL DEPARTMENT:

Director of MI RUDN

name of department

A.B. Muravnik

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name and surname

HEAD OF HIGHER EDUCATION PROGRAMME:

Scientific Director of MI RUDN

position, department

A. L. Skubachevskii

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name and surname