

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

*Faculty of Physics, Mathematics and Natural Sciences*

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

**COURSE SYLLABUS**

**Additional Chapters of Mathematical Modeling**

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course title

**Recommended by the Didactic Council for the Education Field of:**

**01.04.01 Mathematics**

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field of studies / speciality code and title

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

«Functional methods in differential equations and interdisciplinary research»

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higher education programme profile/specialisation title

## 1. COURSE GOAL(s)

The course is aimed to be a bridge between the study of mathematics and the applications of mathematics to various fields. The course affords the students the opportunity to see how the pieces of an applied problem fit together. The students investigate meaningful and practical problems chosen from common experiences encompassing many academic disciplines, including the mathematical sciences, physics, economics, ecology, biology, medicine, and sociology.

## 2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the discipline "Additional Chapters of Mathematical Modeling" is aimed at developing the following competencies (parts of competencies):

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

Code	Competence	Competence achievement indicators (within this discipline)
GPC-3	Able to use knowledge in the field of mathematics when returning to teaching	GPC-3.1. Presents the results of the work in the form of a scientific publication (abstract, article, review) in Russian and English
		GPC-3.2. Presents the results of his work orally in Russian and English
PC-9	Able to teach mathematical disciplines and informatics in general educational organizations, professional educational organizations and educational institutions of higher education	PC-9.1. Formation of pedagogical skills and abilities
		PC-9.2. Ability to work and interact with a team
PC-40.011.01	Able to carry out work on the processing and analysis of scientific and technical information and research results	PC-40.011.01.1. Ability to process scientific and technical information
		PC-40.011.01.2 Ability to analyze the results of scientific research

## 3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The discipline " Additional Chapters of Mathematical Modeling " refers to the part formed by the participants in the educational relations of block B1 of the EP HE.

As part of the EP HE, students also master other disciplines and / or practices that contribute to the achievement of the planned results of mastering the discipline "Additional Chapters of Mathematical Modeling".

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

Code	Competence	Previous disciplines/modules, practices	Subsequent disciplines/modules, practices*
GPC-3	Able to use knowledge in the field of mathematics when returning to teaching	-	State Examination
PC-9	Able to teach mathematical disciplines and informatics in general educational organizations, professional educational organizations and educational institutions of higher education	-	Function spaces, Interdisciplinary term paper, Pedagogical training, State Examination
PC-40.011.01	Able to carry out work on the processing and analysis of scientific and technical information and research results	-	Modern problems of mathematics, State Examination

#### 4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total labor intensity of the discipline "Additional Chapters of Mathematical Modeling" is 4 credits.

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

Type of study work	TOTAL, a.h.	Semester			
		1	2	3	4
<i>Contact work, academic hours</i>	36	36			
Lectures (LC)	18	18			
Lab work (LW)					
Seminars (workshops/tutorials) (S)	18	18			
<i>Self-studies</i>	72	72			
<i>Evaluation and assessment (exam/ passing/failing grade)</i>	36	36			

Type of study work		TOTAL, a.h.	Semester			
			1	2	3	4
Course workload	a.h.	144	144			
	credits	4	4			

## 5. COURSE CONTENTS

*Table 5.1. Course contents and academic activities types*

Course Module Title	Brief Description of the Module Content	Type of study work
Section 1. Methods for construction of mathematical models	Topic 1.1. Mathematical models and their properties (correctness, cost-effectiveness, flexibility). The main stages of constructing a model. Dimensional analysis. Model fitting. Selection of the most appropriate model. Construction of empirical models. Optimization of discrete models. Optimization of continuous models.	Lecture, seminar
Section 2. Examples of mathematical models	Topic 2.1. Modeling with difference equations (spread of a contagious disease, decay of Digoxin in the bloodstream, prescription for Digoxin) and with a systems of difference equations (a car rental company). Modeling with differential equations and systems. Simulation modeling. Probabilistic modeling with discrete systems. Model construction based on decision-making theory. Modeling using graph theory.	Lecture, seminar

## 6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

*Table 6.1. Classroom equipment and technology support requirements*

Classroom type	Classroom equipment	Specialized educational/laboratory equipment, software and materials for mastering the discipline
Lecture	An auditorium for lecture-type classes, equipped with a set of specialized furniture; board (screen) and technical means of multimedia presentations.	-
Seminar	An auditorium for conducting seminar-type classes, group and individual consultations,	-

Classroom type	Classroom equipment	Specialized educational/laboratory equipment, software and materials for mastering the discipline
	current control and intermediate certification, equipped with a set of specialized furniture and technical means for multimedia presentations.	
For independent work of students	An auditorium for conducting seminar-type classes, group and individual consultations, current control and intermediate certification, equipped with a set of specialized furniture and technical means for multimedia presentations.	-

## 7. RESOURCES RECOMMENDED FOR COURSE STUDY

### *Main readings:*

1. Samarskii A.A., Mikhailov A.P. "Principles of Mathematical Modeling. Ideas, Methods, Examples". Translated from the 1997 Russian original. Numerical insights. 3. London: Taylor & Francis. x, 349 p. (2002).

### *Additional readings:*

1. Giordano F.R., Fox W.P., Horton S.B. "A First Course in Mathematical Modeling", 5<sup>th</sup> Edition, Brooks/Cole, 2014.

### *Internet sources*

1. RUDN ELS and third-party ELS, to which university students have access on the basis of concluded agreements:

- RUDN Electronic Library System - RUDN EBS <http://lib.rudn.ru/MegaPro/Web>
- ELS "University Library Online" <http://www.biblioclub.ru>
- EBS Yurayt <http://www.biblio-online.ru>
- ELS "Student Consultant" [www.studentlibrary.ru](http://www.studentlibrary.ru)
- EBS "Lan" <http://e.lanbook.com/>
- EBS "Trinity Bridge"

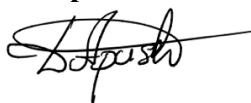
### **2. Databases and search engines:**

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

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

Evaluation materials and a point-rating system\* for evaluating the level of formation of competencies (parts of competencies) based on the results of mastering the discipline "Additional Chapters of Mathematical Modeling" are presented in the Appendix to this Work Program of the discipline

**Developer:**



**D.E. Apushkinskaya**

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signature

name and surname

**HEAD  
OF HIGHER EDUCATION PROGRAMME:**



**V.I. Burenkov**

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signature

name and surname

**HEAD  
OF EDUCATIONAL DEPARTMENT**



**A.B. Muravnik**

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name and surname