Federal State Autonomous Educational Institution for Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE LUMUMBA
(RUDN University)

Academy of Engineering
(Name of the Department-Developer of the Higher Education Programme)

WORKING PROGRAM OF EDUCATIONAL COURSE

MATHEMATICAL AND SOFTWARE SUPPORT OF COMPUTER SYSTEMS, COMPLEXES AND COMPUTER NETWORKS
(Name of the Course)

Recommended by the Methodological Council for the Education Field:

2.3.5. Mathematical Support and Software for Computer Systems, Complexes and Computer Networks
(the code and the name of the training direction/specialty)

The course is part of the Higher Education Programme:

Mathematical Support and Software for Computer Systems, Complexes and Computer Networks
(Name of the Higher Education Programme, major/area of study)

2023

1. COURSE GOALS

The aim of the discipline "Mathematical and Software Support of Computer Systems, Complexes and Computer Networks" is to form a system of scientific knowledge and professional competencies in the field of mathematical and software for computer systems, as well as to update the knowledge of key concepts from previous disciplines, especially important for mathematical modelling. The students are introduced to the main modern tasks of mathematical modelling arising in various fields and learn to choose the most appropriate method for solving the tasks set for him/her.

2. REQUIREMENTS FOR THE OUTCOMES OF THE COURSE

As a result of mastering the discipline "Mathematical and Software Support of Computer Systems, Complexes and Computer Networks" graduate student should:
Know: Fundamentals of mathematical modelling methodology, elements of probabilistic modelling, elements of operational modelling, basic classes of numerical methods, their features, theoretical approaches to the creation of software complexes, principles of software engineering, the latest trends in software engineering
Skill: Effectively use theoretical components of science in practice: concepts, judgements, inferences, laws; present a panorama of software engineering methods, use modern tools to create software packages, abstract away the irrelevant in mathematical modelling, plan an optimal numerical experiment; select numerical methods suitable for solving a particular problem.
To possess: concepts of measure and integral of Lebesgue; methodology of planning, statement and processing of results of numerical experiment; mathematical modelling of scientific and engineering design problems, concepts of convex analysis; concepts of mathematical statistics; basic terminology of decision theory; basic terminology of operations research theory; basic numerical methods; methodology of statement of computing experiments; one of the common systems of mathematical modelling.

3. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The course "Mathematical and Software Support of Computer Systems, Complexes and Computer Networks" has a total of "3" credit units.

Table 3.1. Types of study by period of study in a higher education programme for full-time study.

Type(s) of academic activities		**TOTAL,** ac.h	**Semester(s)**
			3
Contact academic hours		*60*	*60*
Lectures (**L**)		30	30
Lab work (**LW**)			
Seminars (**S**)		30	30
Self-study, ac.h.		*48*	*48*
Evaluation and assessment, ac.h.			
Course workload	**ac.h**	**108**	**108**
	cred.	3	**3**

4. COURSE CONTENTS

Table 4.1. Content of the course by type of study

Наименование раздела дисциплины	Содержание раздела (темы)	Вид учебной работы
Section 1: Introduction	The systems approach and mathematical modelling as a scientific methodology for problem solving. Conceptual design of mathematical models. Designing a model to assess the reliability of an information-computer system.	**L, S**
Section 2: Mathematical Modelling in Engineering	The modern state of the problem of modeling of systems. Mathematical modelling as a basic method of research. Mathematical modeling as a method of cognition of the real world. Studying mathematical modelling with the use of computer facilities. Using mathematical modelling in various fields of human activity. Main stages of mathematical modelling.	**L, S**
Section 3: Mathematical Models in Engineering Disciplines	Concept of mathematical model. Structure of mathematical models. Fundamental principles of mathematical models. Classification of mathematical models. Classification of mathematical models, features, hierarchy.	**L, S**
Section 4: Research Methods for Mathematical Models	Analytical models. Simulation models. Empirical-statistical models. Artificial Intelligence. Stages of constructing a mathematical model.	**L, S**
Section 5: Mathematical models in research	Models of dynamic systems. Singular points. Bifurcations. Dynamic chaos. Ergodicity and mixing. The concept of self-organization. Dissipative structures. Regimes with aggravation. Computer technologies. Numerical methods. Interpolation and approximation of functional relationships. Numerical differentiation and integration. Information technologies. Operations research and artificial intelligence tasks. Pattern recognition.	**L, S**

5. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 5.1. Classroom equipment and technology support requirements

Classroom for Academic Activity Type	Classroom equipment	Specialised training/laboratory equipment, software and materials for the course (if needed)
Lecture room	Room for lecture-type classes, equipped with a set of specialised furniture; a blackboard (screen) and technical means of multimedia presentations.	A postgraduate student's individual workplace should be equipped with a personal device with internet access. A mobile phone is not a device technically capable of providing access to all information resources and services for mastering the modules. Computer classrooms should be equipped with multimedia
Seminar room	Room for seminar-type classes, group and individual consultations, current control and intermediate attestation, equipped with a set of specialised furniture and technical means of multimedia presentations.	
Computer class	Computer room for classes, group and individual consultations, current control and interim certification, equipped with personal computers (5 pcs.), blackboard (screen) and technical means of	

Classroom for Academic Activity Type	Classroom equipment	Specialised training/laboratory equipment, software and materials for the course (if needed)
	multimedia presentations.	and computer equipment with access to the Internet.
Self-study room	Room for students' self-study (can be used for seminars and consultations), equipped with a set of specialised furniture and computers.	

7. RECOMMENDED SOURCES FOR COURSE STUDIES

Primary literature:

1. Mathematical modelling: Ideas. Methods. Examples. - 2nd ed. - Moscow - Fizmatlit, 2001. 320 c. ISBN 5-9221-0120-X

Additional literature:

1. Bobenko A. I., Suris Y. B. Discrete Differential Geometry. The integrable structure - M. ; Izhevsk : NIC "Regular and Chaotic Dynamics" : Izhevsk Institute for Computer Research, 2010. - 448 c.

2. Samarskii A. A., Vabishchevich P. Numerical methods of solving inverse problems of mathematical physics: tutorial. - M. : Publishing house LKI, 2014. - 480 c.

3. Naatz V. I., Naatz I. E. Mathematical models and numerical methods in the tasks of ecological monitoring of the atmosphere : Monograph - Moscow : FIZMATLIT, 2010. - 328 c.

4. A. V. Rumyantsev. A Finite Element Method in Problems of Heat Conduction: Textbook - Kaliningrad: Publishing house of KSU, 1995. - 170 c.:

5. Sveshnikov A.G. et al. Linear and non-linear Sobolev type equations - M. : Fizmatlit, 2007. - 736 c.

6. Mathematical and Computer Simulation of the Distributed Mechanical Structures: Monograph. / V.A. Krysko, S.P. Pavlov, M.V. Zhigalov, O.A. Saltykova, A.V. Krysko Saratov: Saratov State Technical University, 2018. 432 c. ISBN 978-5-7433-3244-1

7. Wavelet analysis in mathematical modelling of distributed mechanical structures. Textbook. / Afonin O.A., Kirichenko A.V., Yakovleva T.V., Saltykova O.A., Yakovleva T.V., Krysko A.V. Saratov: CUBIC, 2018. 144 c. ISBN 978-5-91818-589-6

8. Methods of mathematical modelling and solution of applied problems. / Tutorial. Yakovleva T.V., Saltykova O.A., Kirichenko A.V., Pavlov S.P. Saratov: CUBIC, 2018. 68 c. ISBN 978-5-91818-607-7

Information and telecommunication network resources on the Internet:

1. Digital Library System (DLS) of RUDN University and of other third-party organizations to which university students have access on the basis of contracts:
   - RUDN DLS: http://lib.rudn.ru/MegaPro/Web
   - DLS University library online (in Russian: «Университетская библиотека онлайн») http://www.biblioclub.ru
   - DLS “Yurite” (in russian: Юрайт) http://www.biblio-online.ru
   - DLS “Student Advisor” (in Russian: «Консультант студента») www.studentlibrary.ru
   - DLS “Troitsky Bridge” (in Russian: «Троицкий мост»)
2. Database and search engines
   - Electronic collection of legal, regulatory and technical documentation http://docs.cntd.ru/
   - Yandex search engine: https://www.yandex.ru/
   - Google search engine: https://www.google.ru/
   - reference database SCOPUS http://www.elsevierscience.ru/products/scopus/

Teaching materials for students' self-study while mastering the course/module:*

1. Course lectures «Mathematical and Software Support of Computer Systems, Complexes and Computer

Networks».

* - All teaching materials for students' self-study are published according to the current procedure on the **TUIS** course page!

8. MID-TERM ASSESSMENT AND EVALUATION TOOLKIT

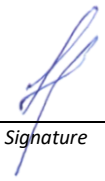
Assessment materials and scoring and rating system* for assessing the level of competence (part of competences) for the course "Mathematical and Software Support of Computer Systems, Complexes and Computer Networks" are presented in the Appendix to this Working Programme of Educational Course.

* - Assessment materials and scoring system are formed based on the requirements of the RUDN local normative act.

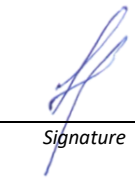
DEVELOPER:

Associate Professor		Olga A. Saltykova
Position, Department	*Signature*	*Name, Patronymic Name, Surname*

HEAD OF THE DEPARTMENT:

Professor		Yuri N. Razoumny
Position, Department	*Signature*	*Name, Patronymic Name, Surname*

HEAD OF THE HIGHER EDUCATION PROGRAMME:

Professor		Yuri N. Razoumny
Position, Department	*Signature*	*Name, Patronymic Name, Surname*