Federal State Autonomous Educational Institution of Higher Education "Peoples' Friendship University of Russia"

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(faculty / institute / academy)

Recommended by the ICSS

AGENDA OF THE DISCIPLINE

The title of discipline _ Mathematical modeling, numerical methods and program complexes

Recommended for the direction of training/specialty

09.06.01 "Informatics and computer technology" (postgraduate study)

(the code and name of the direction of training / specialty are indicated)

Direction of the program (profile)

Mathematical modeling, numerical methods and complexes of programs

(name of the educational program in accordance with the direction (profile)

1. Aims and objectives of the discipline Formation of in-depth theoretical knowledge of graduate students in the field corresponding to the scientific specialty. The objectives of the discipline are:

To update the knowledge of key concepts from previous disciplines, especially important for mathematical modeling. To acquaint students with the main modern problems of mathematical modeling arising in to teach students to choose the most suitable method for solving the tasks assigned to them. To acquaint students with the capabilities of modern packages of computational mathematics.

2. Place of discipline in the structure EPHE:

Discipline Mathematical modeling, numerical methods and program complexes belongs to the *variable part of the curriculum*.

Table 1 shows the previous and subsequent disciplines aimed at the formation of discipline competencies in accordance with the competence matrix of EPHE.

Table No. 1

Preceding and subsequent disciplines aimed at the formation of competencies, the

ability to develop new research methods and their application in independent research activities in the field of professional activity (GPC -3), the

ability to objectively evaluate the results of research and development carried out by other specialists and in others scientific institutions (GPC -5)

possession of methods for conducting patent research, licensing and copyright protection in the creation of innovative products in the field of professional activity (GPC -7) the

ability for independent (including leading) research activities requiring broad fundamental training in modern areas of industry science, deep specialized training in the chosen direction, possession of the skills of modern research methods (PC-3)

possession of fundamental knowledge in the main sections of mathematical modeling, numerical method s and complexes of programs (PC-4)

3. Requirements for the results of mastering the discipline:

The process of studying the discipline is aimed at the formation of the following competencies:

As a result of studying the discipline, the student must:

Know: Fundamentals of the methodology of mathematical modeling, elements of probabilistic modeling, elements of operational modeling, main classes numerical methods, their features, theoretical approaches to the creation of software complexes, principles of software engineering, the latest trends in software engineering

Be able to: Effectively use in practice the theoretical components of science: concepts, judgments, inferences, laws; to present a panorama of software engineering methods, use modern means of creating software complexes, abstract from the irrelevant in mathematical modeling, plan the optimal conduct of a numerical experiment; choose numerical methods suitable for solving a particular problem.

Possess: the concepts of Lebesgue measure and integral; methodology for planning, setting and processing the results of a numerical experiment; mathematical modeling of scientific problems and problems of engineering design, concepts of convex analysis; concepts of mathematical statistics; basic terminology of decision theory; basic terminology of the theory of operations research; basic numerical methods; methodology for setting up computational experiments; one of the most common mathematical modeling systems**.**

4. The scope of the discipline and types of educational work

The total labor intensity of the discipline is ___4_____ credit units.

Type of educational work	Total hours	Semesters
		4
Classroom lessons (total)	40	40
Including:	-	
Lectures	20	20

Practical lessons (PL)		20	20
Seminars (S)			
Laboratory work (LW)			
Independent study (total)		104	104
Total labor intensity	hours	144	144
	c.u..	4	4

5. Content of the discipline

5.1. Contents of discipline sections

№p/p	Name of discipline section	Contents of section (topics)
1.	Introduction	System approach and mathematical modeling as a scientific methodology for solving problems. Conceptual design of mathematical models. Designing a model for assessing the reliability of an information and computing system.
2.	Mathematical modeling in technology The	current state of the problem of modeling systems. Mathematical modeling as the main research method. Mathematical modeling as a method of knowing the real world. Study of mathematical modeling using computer technology. The use of mathematical modeling in various fields of human activity. The main stages of mathematical modeling.
3	Mathematical models in engineering disciplines	The concept of a mathematical model. The structure of mathematical models. Fundamental principles of building mathematical models. Classification of mathematical models. Classification of mathematical models, features, hierarchy.
4	Methods of research of mathematical models	Analytical models. Simulation models. Empirical-statistical models. Artificial Intelligence. Stages of building a mathematical model.
5	Mathematical models in scientific research	Models of dynamic systems. Special points. Bifurcations. Dynamic chaos. Ergodic and agitated. The concept of self-organization. Dissipative structures. Exacerbation modes. Computer techologies. Numerical methods. Interpolation and approximation of functional dependencies. Numerical differentiation and integration. Information Technology. Operations Research and Artificial Intelligence Challenges. Pattern recognition.

(The content is indicated in didactic units. At the discretion of the developers, the material may not be presented in the form of a table)

5.2. Sections of disciplines and types of classes

№ p / p	Name of the discipline section	Lectures	Practice	Laboratory	Seminars	SRS	Total hour.
1.	Introduction	4	4			20	28
2.	Mathematical modeling in engineering	4	4			20	28
3	Mathematical models in engineering disciplines	4	4			20	28
4	Methods of research of mathematical models	4	4			22	30
5	Mathematical models in scientific research	4	4			22	30

6. Laboratory practice *not provided*

7. Practical lessons (seminars) *(if any)*

№ p / p	No. of discipline section	Topic of practical lessons (seminars)	Laboratory capacity (hours)
1.	Introduction	System approach and mathematical modeling as a scientific methodology for solving problems. Conceptual design of mathematical models. Designing a model for assessing the reliability of an information and computing system.	4
2.	Mathematical modeling in technology The	current state of the problem of systems modeling. Mathematical modeling as the main research method. Mathematical modeling as a method of knowing the real world. Study of mathematical modeling using computer technology. The use of mathematical modeling in various fields of human activity. The main stages of mathematical modeling.	4
3	Mathematical models in engineering disciplines	The concept of a mathematical model. The structure of mathematical models. Fundamental principles of building mathematical models. Classification of mathematical models. Classification of mathematical models, features, hierarchy.	4
4	Methods of research of mathematical models	Analytical models. Simulation models. Empirical-statistical models. Artificial Intelligence. Stages of building a mathematical model.	4
5	Mathematical models in scientific research	Models of dynamic systems. Special points. Bifurcations. Dynamic chaos. Ergodic and agitated. The concept of self-organization. Dissipative structures. Exacerbation modes. Computer technologies. Numerical methods. Interpolation and approximation of functional dependencies. Numerical differentiation and integration. Information Technology. Operations Research and Artificial Intelligence Challenges. Pattern recognition.	4

8. Material and technical support of the discipline:
(describes the material and technical base necessary for the implementation of the educational process in the discipline (module)).

Auditorium with a list of material and technical supportClassroom	**Location**
for laboratory work ("Laboratory of automated control systems"), room. No. 416 Equipment and furniture: - personal computers based on the system unit BT / Core2-Duo3000 / 4x1024Mb / 1000GbR / V512Mb / S / DVD + -RW + monitor, keyboard, mouse (13 pcs.); - educational and research stand of the "Kontar" software and hardware complex (12 pcs.); - interactive whiteboard Polyvision TSL 610; - Toshiba TLP-XC3000 projector; - Cisco Catalyst 2960 24 switch; - power filter 13 pcs.);	Moscow, st. Ordzhonikidze, 3

- Internet access: LAN and Wi-Fi, - tables, chairs, - mobile marker board.	

9. Information support of the discipline

a) Standard software for personal computers, MATLAB

b) information and reference and search systems Yandex, Google.

10. Educational and methodological support of the discipline:

(the availability of printed and electronic educational and information resources is indicated)

a) basic literature _____

1. Mathematical modeling: Ideas. Methods. Examples. - 2nd ed., Rev. - M. - Fizmatlit, 2001.320 p. ISBN 5-9221-0120-X

b) additional literature _____

1. Mathematical and computer modeling of distributed mechanical structures: monograph. / Krysko V.A., Pavlov S.P., Zhigalov M.V., Saltykova O.A., Krysko A.V. Saratov: Sarat. state tech. un-t, 2018.432 p. ISBN 978-5-7433-3244-1
2. Wavelet analysis in mathematical modeling of distributed mechanical structures. Tutorial. / Afonin O.A., Kirichenko A.V., Yakovleva T.V., Saltykova O.A., Yakovleva T.V., Krysko A.V. Saratov: KUBIK, 2018.144 p. ISBN 978-5-91818-589-6
3. Methods of mathematical modeling and solution of applied problems. / Tutorial. Yakovleva T.V., Saltykova O.A., Kirichenko A.V., Pavlov S.P. Saratov: KUBIK, 2018.68 p. ISBN 978-5-91818-607-7

11. Methodical instructions for students on mastering the discipline (module)

In practical classes in the discipline, control activities are carried out in order to identify the acquired knowledge, abilities, skills and competencies. As part of independent work, graduate students study the educational and methodological support of the discipline, prepare homework, work on questions and assignments for self-preparation, search and review scientific publications and electronic sources of information. Independent work should be systematic and supervised by the teacher, taken into account by the teacher for the certification.

To improve the quality level of mastering the discipline, a graduate student should prepare for a lecture, since it is the leading form of organizing student education and implements functions that contribute to: the

- formation of the basic concepts of the discipline,
- stimulating interest in the discipline, topics of its study,
- systematization and structuring of the entire body of knowledge in the discipline,
- orientation in the scientific literature, revealing the problems of the discipline.

Preparation for the lecture is as follows:

- studying the material of the previous lecture,
- analyzing the topic of the upcoming lecture (according to the thematic plan, according to the lecturer's information),
- familiarizing with the training material using the textbook and teaching aids,
- analyzing the place of the topic being studied in one's professional training,
- preparing questions that are possible to ask the lecturer at the lecture.

Preparation for practical exercises:

- familiarization with the plan of a practical lesson: first with the main questions, then with questions for discussion, assessment of the scope of the assignment;
- studying the lecture notes on the topic of the practical lesson, highlighting the material necessary to study the questions posed;
- familiarization with the recommended basic and additional literature on the topic, new publications in periodicals;
- highlighting the basic concepts of the studied topic, the possession of which contributes to the effective development of the discipline;
- preparation of abstracts or mini-abstracts that can be used in public speaking in class.

The work program of the discipline in terms of goals, the list of knowledge, skills, terms and educational issues can be used by you as a guide in the organization of training.

Preparing for the test. It is necessary to prepare for the test purposefully, regularly, systematically and from the first days of training in this discipline. At the very beginning of the study of the discipline, the graduate student gets acquainted with the program for the discipline, the list of knowledge and skills that the graduate student must possess, control activities, a textbook, textbooks for the discipline being studied, electronic resources, and a list of questions for credit.

The systematic implementation of educational work in lectures, practical classes and classes will allow you to successfully master the discipline and create a good base for passing the test.

Postgraduate students are required to attend classes, complete assignments of the discipline supervisor, familiarize themselves with the recommended literature and prepare an essay for a round table (the choice of an essay topic is carried out in agreement with the discipline supervisor and scientific supervisor). Postgraduate students carry out projects, creative tasks for independent work, taking into account the profile of the disciplines that they will implement in the process of industrial practice. The results of completing tasks for independent work are assessed on the basis of a point-rating assessment and are reflected in the educational route of the graduate student. When certifying a graduate student, the quality of work in the classroom is assessed (the ability to conduct a scientific discussion, the ability to clearly and succinctly formulate one's thoughts), the level of preparation for independent research activities of a specialist in the field of pedagogy of higher education, the history of pedagogy and education, the quality of assignments (presentations, reports , analytical notes, etc.).

12. Fund assessment tools for interim assessment of students on discipline (module)

Materials for assessing the level of mastering the educational material of the discipline "Mathematical modeling, numerical methods and program complexes " (evaluation materials), which include a list of competencies indicating the stages of their formation, a description of indicators and criteria for evaluating competencies at various stages of their formation, a description of assessment scales, standard control tasks or other materials necessary for evaluating knowledge, skills, skills and (or) experience of activity that characterize the stages of competence formation in the process of mastering an educational program, methodological materials that determine the procedures for evaluating knowledge, skills, skills and (or) experience of activity that characterize the stages of competence formation are fully developed and are available to students on the discipline page in the TUIS RUDN.

The program is compiled in accordance with the requirements of OS VO RUDN

Developers:

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