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

_____
(faculty/institute/academy)

Recommended by the ICSS

AGENDA OF THE DISCIPLINE

The title of discipline _ Computational methods of intelligent systems

Recommended for the direction of training/specialty

09.06.01 «Computer Science and Computer Engineering" (postgraduate course)

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

Direction of the program (profile)

System Analysis, Control and Information Systems

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

1. Aims and objectives of the discipline Formation of advanced theoretical knowledge in the field corresponding to the scientific specialty among graduate students. 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 that arise in various fields. Teach students to choose the most appropriate method for solving the tasks assigned to them. To familiarize students with the capabilities of modern computational mathematics packages.

2. The place of the discipline in the EPHE:

The discipline Mathematical modeling, numerical methods and software packages belongs to the *variable* part of block 1 of the curriculum.

3. Requirements for the results of mastering the discipline:

The process of studying the discipline is aimed at the formation of the following competencies:
knowledge of the methodology of theoretical and experimental research in the field of professional activity – GPC -1
the ability to design and carry out complex research, including interdisciplinary, based on a holistic systematic scientific worldview using knowledge in the field of history and philosophy of science – UC-2
the ability to independent (including managerial) research activities that require extensive fundamental training in modern areas of branch science, deep specialized training in the chosen direction, possession of skills of modern research methods – PC-3

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

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

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

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

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

The total labor intensity of the discipline is _____3_____ credit units.

Type of educational work	Total hours	Semesters
		3
Classroom lessons (total)	40	40
Including:		
Lectures	20	20
Practical lessons (PL)	20	20
Seminars (S)	-	-
Laboratory work (LW)	-	-
Independent study (total)	68	68
Total labor intensity hours	108	108
c.u..	3	3

5. Content of the discipline

5.1. The content of the discipline sections

№ p/p	The name of the discipline section	Section content (topics)
1.	Representation of data in a computer and the logical foundations of building computers.	Global and local computer networks. Web technologies.
2.	Fundamentals of teaching computer and information technology.	The architecture of computers and operating systems. Information processing technologies.
3	Multi-tasking logic. JSM method.	Three-valued semantics of modal predicate logic. Four-digit logic. Plausible reasoning. JSM method as an automatic learning system.
4	Artificial neural networks in control	The structure of neural networks. Representation of logical functions using artificial neural networks. Neural network architectures.
5	Genetic programming	Infix, prefix and postfix symbolic notation of a mathematical expression. Decision tree. Genetic algorithm operations for symbolic notation of mathematical expressions.
6	Grammatical Evolution and Analytical Programming	Backus-Naur formal grammar , records codes in grammatical evolution, codons. Conditions for correct entry. Crossing operation in grammatical evolution Record codes in analytical programming.
7	Network operator	Representation of a mathematical expression in the form of a directed graph. Network operator matrix. Method of variation of the network operator.
8	PROLOG programming language	Syntax of the PROLOG language . Lists, operations, structures. Brute force control. Built-in predicates. Knowledge representation and construction of an expert system in the PROLOG language .
9	Universal shells for expert systems	The structure of the gensym G 2 software package . Object-oriented design technology for expert systems. Class hierarchy in the G 2 software package / Model rules and procedures. Data organization workspaces. Creation of an expert system based on the G 2 complex . Development environment. A structured natural language used in the G2 framework .

(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. busy	Lab. busy	Semin	SRS	hour.
1.	Representation of data in a computer and the logical foundations of building computers.	2	2	-	-	8	12
2.	Fundamentals of teaching computer and information technology.	2	2	-	-	8	12

3	Multi-tasking logic. JSM method.	2	2	-	-	8	12
4	Artificial neural networks in control	2	2	-	-	6	10
5	Genetic programming	2	2	-	-	6	10
6	Grammatical evolution and analytical programming	3	3	-	-	8	14
7	Network operator	2	2	-	-	8	12
8	Language programming PROLOG	2	2	-	-	8	September
12	Universal expert system shell	3	3	-	-	14	August

6. Laboratory practical *not provided*

7. workshops (seminars) *(if any)*

№ p / n	№ section discipline	Topic workshops (seminars)	Trudeau - capacity (hours)
1.	Representation of data in a computer and the logical foundations of building computers.	Global and local computer networks. Web technologies.	2
2.	Fundamentals of teaching computer and information technology.	The architecture of computers and operating systems. Information processing technologies.	2
3	Multi-tasking logic. JSM method.	Three-valued semantics of modal predicate logic. Four-valued logic. Plausible reasoning. JSM method as an automatic learning system.	2
4	Artificial neural networks in control	The structure of neural networks. Representation of logical functions using artificial neural networks. Neural network architectures.	2
5	Genetic programming	Infix, prefix and postfix symbolic notation of a mathematical expression. Decision tree. Genetic algorithm operations for symbolic notation of mathematical expressions.	2
6	Grammatical evolution and analytical programming	Formal Backus-Naur grammar, records codes in grammatical evolution, codons. Conditions for correct entry. Crossing operation in grammatical evolution Record codes in analytical programming.	3
7	Network operator	Representation of a mathematical expression in the form of a directed graph. Network operator matrix. Method of variation of the network operator.	2
8	Programming language PROLOG	Syntax of the PROLOG language. Lists, operations, structures. Brute force control. Built-in predicates. Knowledge representation and construction of an expert system in the PROLOG language.	2
9	Universal shells of expert systems	The structure of the gensym G2 software package. Object-oriented design technology for expert systems. Class hierarchy in the G2 software package / Model rules and procedures. Data organization workspaces. Creation of an expert system based on the G2 complex. Development	3

		environment. A structured natural language used in the G2 framework.	

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.); - Internet access: LAN and Wi-Fi, - tables, chairs, - mobile marker board.	Moscow, st. Ordzhonikidze, 3

9. Information support of the discipline
a) Standard software for personal computers, PROLOG
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) main literature
1. Gladkov, L. A. Genetic algorithms: textbook / L. A. Gladkov, V. V. Kureichik, V. M. Kureichik; ed. V. M. Kureichik. - Moscow: Fizmatlit, 2010 .-- 317 p. - Access mode: by subscription. - URL:https://biblioclub.ru/index.php?page=book&id=68417(date of access: 24.05.2021). - ISBN 978-5-9221-0510-1. - Text: electronic.
2. S. Haykin. Neural Networks and Learning Machines. 3rd Edition. Pearson,
S. 2018.3A. Shumsky. Machine intelligence. Essays on the theory of machine learning and artificial intelligence. M., RIOR, 2019. DOI: 10.29039 / 02011-1

b) additional literature _____
4. Fundamentals of programming in the Prolog language: a course of lectures: textbook. manual for university students studying in the specialties in the region. inform. technologies / P. A. Shrainer. - M.: Internet - Un-t Inform. Technologies, 2005 .-- 176 p. - (Series "Fundamentals of Information Technologies" / Internet-University of Information Technologies). - ISBN 5-9556-0034-5.
5. Andrew Tanenbaum Computer Architecture, 6th edition (2013) / Structured Computer Organization (2012)
6. J. Jarratano, Gary Riley Expert systems: design principles and programming

11. Methodological 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 learning 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 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 topic being studied, 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 measures, 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 head of the discipline, get acquainted with the recommended literature and prepare an essay for a round table (the choice of the topic of the essay is carried out in agreement with the head of the discipline and the 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)

points BRS	**Traditional assessment in the Russian Federation**	**for the transfer Points estimates**	**Estimates**	**Estimates of the ECTS**
95-100	5	95-100	5 +	A
86-94		86-94		5

69-85	4	69-85	4	C
61-68	3	61-68	3+	D
51-60		51-60	3	E
31-50	2	31-50	2+	FX
0-30		0-30	2	F
	Passed		Passed	Passed

Notes to table count:

Description grades ECTS

A	***"Excellent" the*** theoretical content of the course is fully mastered, without gaps, the necessary practical skills to work with the material learned are formed, all the study assignments provided for by the curriculum have been completed, the quality of their implementation is assessed by the number of points close to the maximum**.**
In	***"Very Good" the*** theoretical content of the course is mastered completely, without gaps, the necessary practical skills for working with the mastered material are basically formed, all the educational tasks provided for by the curriculum have been completed, the quality of most of them is assessed by the number of points close to the maximum.
With	***"Good", the*** theoretical content of the course is fully mastered, without gaps, some practical skills of working with the mastered material are not sufficiently formed, all the study tasks provided for by the training program have been completed, the quality of performance of none of them was not assessed by the minimum number of points, some types of tasks were completed with errors**.**
D	***"Satisfactory"*** theoretical content of the course is partially mastered, but the gaps are not significant, the necessary practical skills for working with the acquired material are basically formed, most of the educational tasks provided for in the training program have been completed, some of the completed tasks may contain errors.
E	***"Mediocre"*** theoretical content of the course is partially mastered, some practical skills have not been formed, many of the educational tasks provided for by the training program have not been completed, or the quality of performance of some of them is assessed by the number of points close to the minimum.

Materials for assessing the level of mastering the educational material of the discipline " Computational methods of intelligent systems " (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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