Ministry of Science and Higher Education of the Russian Federation
Federal State Autonomous Educational Institution of Higher Education
Perm National Research Polytechnic University

APPROVED BY
Pro-rector for Academic Affairs
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ACADEMIC COURSE WORKING PROGRAM

Academic course: Computer-based Mathematics
(Name)

Form of education: Full-time studies
(full-time / part-time / correspondence)

Level of higher education: Bachelor's program
(Bachelor's program / Specialist program / Master's program)

Workload in hours (in credits): 108(3)
(Hours (CU))

Training program (degree): 15.03.06 Mechatronics and Robotics
(Code and denomination of degree)

Direction: Mechatronics and Robotics
(Title of curriculum)

Perm 2021

1 General Provisions

1.1 Goals and Objectives of the Course

The goal of the course is to study discrete structures applied during developing mathematical models and algorithms; to study algorithms applied during solving socio-economic, information technology and computational search and optimization objectives in discrete space.

1.2 Prescribed Objects of the Course

Theory of sets, logical algebra, graphs, automaton

1.3 Starting Conditions

Unstipulated

2 Planned Results of the Course Training

Competence	Indicator's Index	Planned Results of the Course Training (to know, to be able, to master)	Indicator of Attaining Competence which the planned results of training are correlated with	Means of Assessment
PC-2.6	**IA-1** $_{PC-2.6}$	**To know** methods of determining functional indicators of flexible production systems.	**Knows** methods of determining functional indicators of flexible production systems.	Grading test
PC-2.6	**IA-2**$_{PC-2.6}$	**To be able to** calculate performance indicators of flexible production systems using methods of computer mathematics.	**Is able to** calculate performance indicators for flexible production systems.	Laboratory work presentation
PC-2.6	**IA-3**$_{PC-2.6}$	**To master the skills** of definition of functional indicators of flexible production systems.	**Has mastered the skills** of definition of functional indicators of flexible production systems.	Grading test

3 Full time and forms of academic work

Form of academic work	Hours in all	Distribution in hours according to semester
		Number of semester
		3
1 Holding classes (including results monitoring) in the form: 1.1 Contact classwork, including:	72	72
- lectures (L)	24	24
- laboratory work (LW)	22	22
- practice, seminars and/or other seminar-type work (PW)	22	22
- control of self-work (CSW)	4	4
- test paper		
1.2 Students' self-work (SSW)	36	36
2 Interim/midterm assessment		
Exam		
Grading test	9	9
Test		
Course Project (CP)		
Course Work (CW)		
Workload in hours	**108**	**108**

4 Course contents

Course units with brief contents	Full time of classroom activity in hours according to the forms			Full time of extracurricular work in hours according to the forms
	L	LW	PW	SSW
3rd semester				
Theory of sets	6	4	8	10
Sets definition. Sets Representation. Membership and containment relations. Operations on sets. Algebra of sets laws. Graphs. Graphs properties. Correspondence. Correspondence properties. Relations. Relations properties. Morphism. Equivalence relations, equivalence classes, ordering relationship. Partially order sets, arrays, cardinality of sets, cardinality comparison.				
Logical algebra	6	4	4	10
Expression definition, logical operations. Laws of logical algebra, Boolean functions. Formulas, equivalent formulas, substitution and replacement. Representation forms of expression.				

Complete functions system.				
Graph theory	6	10	6	10
Graph theory fundamentals. Algorithms for navigating in graphs. Trees. Graph traversals. Planar graphs. Euler theorem. Graph coloring.				
Automatons	6	4	4	6
Deterministic finite automatons. Representation. Minimization. Regular expressions. Regular language recognition.				
Total with regard to 3rd semester	**24**	**22**	**22**	**36**
Total with regard to the course	**24**	**22**	**22**	**36**

Topics of exemplary practical work

№	Topic of practical (seminars) work
1	Sets. Operations on sets.
2	Algebra of sets laws.
3	Correspondence. Relations.
4	Cardinality of sets.
5	Logical operations on expression. Laws of logical algebra.
6	Boolean functions. Formula, matched formula, substitution and replacement.
7	Dijkstra's method.
8	Shimbel's method.
9	Graph coloring.
10	Representation of finite automatons.
11	Regular expressions.

Topics of exemplary laboratory work

№	Topic of laboratory work
1	Sets calculator.
2	Logical expressions calculator.
3	Graphs navigation.
4	Finding the minimum-state of spanning tree.
5	Graph traversal.
6	Game development based on deterministic automaton.

5. Organizational and Pedagogical Conditions

5.1 Educational Technologies Used for Competences Formation

Holding lectures in the discipline is based on the active method of training in the process of which students are not passive but active participants of the lesson answering questions of the teacher. Teacher's questions are aimed at activating the process of learning material as well as at the development of logical thinking. The questions stimulating associative thinking and connecting new material with the previous one are identified by the teacher in advance.

Practical lessons are hold by realization of the method based on active training: problem areas are determined, groups are formed. The following aims are pursued in the process of practical education: use of definite disciplines knowledge and creative methods in solving problems and decision-making; students' skill-building of teamwork, interpersonal communication and development of leadership skills; consolidation of the basic theoretical knowledge.

Laboratory classes are based on an interactive learning method in which students communicate not only with the teacher but also with each other. At the same time, students ' activity in the learning process dominates. The teacher's place in interactive classes is reduced to orienting students ' activities to achievement of the goals of studies.

Interactive lectures, group discussions, role-playing games, training sessions, and analysis of situations and simulation models are used in academic studies.

5.2 Students' Manual for the Course Study

Learning the course, it is advisable for students to implement the following recommendations:

1. Learning of the discipline should be done systematically.
2. After learning one of the course units with the help of the text-book or lecture notes it is recommended to reproduce the basic terms, definitions, notions of the unit from memory.
3. Special attention should be paid to the reports on practical studies and individual complex tasks for self-work.
4. The topics list for individual study is given by the teacher at the lectures. The teacher also provides students with literary sources (first of all, new ones in the periodical scientific literature) for a more detailed understanding of the issues presented at the lectures.

6. List of Teaching Materials and Information Supply for Students' Self work in the Discipline

6.1 Paper-based courseware

№	Bibliographic entry (author, title, mode of publication, place, publishing house, year of publication, number of pages)	Number of copies in the library
	1 Basic literature	
1	Schwarz K. Mathematical foundation of computing : preliminary course notes / K. Schwarz. Fall, 2015	
2	Ronald L. G. Concrete mathematics : a foundation for computer science / Ronald L. Graham, Donald E. Knuth, Oren Patashnik. Boston: Addison-Wesley publishing company, 1990.	
	2 Additional literature	
	2.1 Educational and scientific literature	
1	Stein C. Discrete mathematics for computer scientists / C. Stein, R. L. Drysdale, K. Bogart. – Boston : Addison-Wesley, 2011	

2	Gallier J. H. DiscreteMathematics,SomeNotes / J. H.Gallier., Department of Computer and Information Science University of Pennsylvania : Philadelphia, 2009	
2.2 Periodical literature		
2.3 Standardized and Technical literature		
3 Students' manual in mastering discipline		
4 Teaching and learning materials for students' self-work		

6.2 Electronic Courseware

Kind of literature	Name of training tool	Reference to information resource	Accessibility of EBN (Internet / local net; authorized / free access)
Additional literature	Levin O. Discrete mathematics, an open introduction	http://discrete.openmathbooks.org/pdfs/dmoi-tablet.pdf	local net; free access
Additional literature	Lehman E., Leighton T. Mathematics for Computer Science	https://www.cs.princeton.edu/courses/archive/fall06/cos341/handouts/mathcs.pdf	local net; free access
Additional literature	Bogart K. Discrete Math for Computer Science Students	https://www.kth.se/social/files/557ec6b0f27654784e263d66/fullbook.pdf	local net; free access

6.3 License and Free Distributed Software used in the Course Educational Process

Type of Software	Software branding
Operating systems	Windows 10 (Azure DevTools for Teaching)
Office applications	Microsoft Office Professional 2007. license 42661567
General purpose application software	MATLAB 7,9 + Simulink 7.4 Academic, PNRPU 2009

6.4 Modern Professional Databases and Inquiry Systems Used in the Course Educational Process

Branding	Reference to information resource
Elsevier "Freedom Collection" Database	https://www.elsevier.com/
Scopus Database	https://www.scopus.com/
Electronic Scientific Library Database	http://elibrary.ru/
Scientific Library of Perm National Polytechnic Research University	http://lib.pstu.ru/

Lan' Electronic library system	https://e.lanbook.com/
IPR books Electronic library system	http://www.iprbookshop.ru/
Information resources of Consultant+ web	http://www.consultant.ru/

7 Logistics of the Course Educational Process

Type of classes	Name of the necessary basic equipment	Number of units
Laboratory work	Laptop computer	30
Lecture	Multimedia projector or TV	1
Practice work	Laptop computer	30

8 Fund of the Course Evaluating Tools

Described in a separate document