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: Workshop on modeling robotic technological process
(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): 180 (5)
(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 the basic concepts of the modeling theory, the models and modeling classification; to study the basics of experimental planning and regression models constructing for the mechanical engineering technological processes research.

1.2 Prescribed Objects of the Course

- Models, modeling, model affecting factors;
- Planning and conducting an experiment;
- Regression models.

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-2.5	**IA-1$_{PC-2.5}$**	**To know** the operating principles, technical characteristics and calculation methods of the flexible production systems main elements characteristics.	**Knows** principle of operation, technical characteristics and methods of calculating basic characteristics of flexible production system components.	Individual task
PC-2.5	**AI-2$_{PC-2.5}$**	**To be able to** develop technical projects using design automation tools and advanced competitive product development; technical documentation preparation and legalization.	**Is able to** develop technical projects using design automation and competitive product development best practices; draw up technical documentation.	Laboratory work presentation
PC-2.5	**AI-3$_{PC-2.5}$**	**To master the skills** of flexible production system elements schematic diagrams development; preparation of the explanatory note to the technical project on flexible production systems.	**Has mastered the skills** of developing functional diagrams of flexible production systems components; explanatory note of flexible production systems' engineering design.	Report

3 Full time and forms of academic work

Form of academic work	Hours in all	Distribution in hours according to semesters
		Number of semester
		5
1 Holding classes (including results monitoring) in the form: 1.1 Contact classwork, including:	72	72
- lectures (L)	12	12
- laboratory work (LW)	36	36
- practice, seminars and/or other seminar-type work (PW)	20	20
- control of self-work (CSW)	4	4
- test paper		
1.2 Students' self-work (SSW)	72	72
2 Interim/midterm assessment		
Exam	36	36
Grading test		
Test		
Course Project (CP)		
Course Work (CW)		
Workload in hours	**180**	**180**

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
5th semester				
Models, modeling, model affecting factors	4	12	6	24
Basic concepts and definitions Goals and principles of modeling Axioms of modeling theory Models and modeling types Mathematical model structure Mathematical models classification Analytical model construction algorithm				
Planning and conducting an experiment	4	12	8	24
Planning an experiment Factor levels selection Factorial experiment Conducting an experiment				
Regression models	4	12	6	24

Regression models Regression models adequacy Types of regression models with a single input variable Regression models with multiple input variables				
Total with regard to 5th semester	**12**	**36**	**20**	**72**
Total with regard to the course	**12**	**36**	**20**	**72**

Topics of exemplary practical work

№	Topic of practical (seminars) work
1	Factorial experiment
2	Multivariate (multiple) Linear Regression
3	Assessment for the adequacy and accuracy of a multivariate linear model

Topics of exemplary laboratory work

№	Topic of laboratory work
1	Analytical model building
2	Empirical model building
3	Planning and conducting an experiment

5 Organizational and Pedagogical Conditions

5.1 Educational Technologies Used for Competences Formation

Holding the course lectures is based on an active method of education, wherein students are not passive listeners, but active participants answering teacher's questions while the class. The teacher's goal is to activate the processes of learning the material by asking questions, along with the development of logical thinking. The teacher outlines a list of questions in advance that stimulate associative thinking and networking based on the material previously mastered.
Practical classes are held based on the learning-by-action method: problem fields are identified and groups are formed. Seminars pursue the following goals: applying creative problem-solving methods and knowledge from individual courses to solve problems and make decisions; perfecting teamwork, interpersonal communication, and leadership skills; and reinforcing 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 achieve 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, laboratory works 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	Samarskii A.A., Mikhailov A.P. Principles of Mathematical Modeling. Ideas, Methods, Examples / New York: CRC Press, 2001, 360 p.	Free access
2	Velten K. Mathematical Modeling and Simulation: Introduction for Scientists and Engineers / Weinheim: WILEY-VCH, 2009	Free access
2 Additional literature		
2.1 Educational and scientific literature		
1	Mityushev V. Mathematical and Computer Modelling of Dynamical Systems / Mityushev V., Nawalaniec W., Rylko N. Introduction to Mathematical Modeling and Computer Simulations / New York: CRC Press, 2018	Free access
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	Journal, Mathematical and Computer Modeling of Dynamical Systems. Methods, Tools and Applications in Engineering and Related Sciences / United Kingdom, Taylor & Francis, 1998	https://www.tandfonline.com/toc/nmcm20/current	free access

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

Type of Software	Software branding
Operating systems	Debian (GNU GPL)
General purpose application software	Scilab (license GNU GPL v2)
Development, testing and debugging environments	NetBeans (SUN PUBLIC LICENSE)

6.4 Modern Professional Databases and Inquiry Systems Used in the Course

Branding	Reference to information resource
Web of Science Database	http://www.webofscience.com/
Electronic library system Database (eLIBRARY.RU)	https://elibrary.ru/
Scientific Library of Perm National Research Polytechnic 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 the Network Consultant Plus	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	Personal computer	30
Lectures	Multimedia projector	1
Practical work	Personal computer	1

8 Fund of the Course Evaluating Tools

Described in a separate document