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: Microcontroller Technology
(Name)

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

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

Total labour intensiveness: 216 (6)
(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 form professional competencies in studying the principles of design, architecture, structural and algorithmic solutions of modern microcontroller platforms, learning the techniques and tools for developing and debugging hardware and software of microcontroller-based devices and systems of various functional purposes.
The objectives of the course are:

- **to study** the principles of design, architecture, structural and algorithmic solutions of modern microcontroller-based devices and systems;
- **to form** the ability to develop and model standard and specialized modules of microcontroller-based systems of various functional purpose;
- **to master the skills** of working with modern software development tools, debugging on software emulators and prototypes.

1.2 Prescribed Objects of the Course

- Architecture and organization of modern general-purpose microcontrollers;
- Standard structure and organization of the microcontrollers I/O subsystem;
- Principles of event handling and timer servicing;
- Modern tools for designing and debugging software microcontroller-based devices and systems.

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, 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** operating principles, technical characteristics and calculation methods of basic characteristics of flexible production systems components.	**Knows** principle of operation, technical characteristics and methods of calculating basic characteristics of flexible production system components.	Laboratory work presentation
PC-2.5	**IA-2**$_{PC-2.5}$	**To be able to** develop technical projects using design automation tools and competitive product development best practices; draw up technical documentation.	**Is able to** develop technical projects using design automation and competitive product development best practices; draw up technical documentation.	Course project
PC-2.5	**IA-3**$_{PC-2.5}$	**To master the skills** of developing functional diagrams of flexible production systems components; explanatory note of flexible production	**Has mastered the skills** of developing functional diagrams of flexible production systems components; explanatory note of flexible production	Internship report

		systems' engineering design.	systems' engineering design.	

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)	22	22
- laboratory work (LW)	20	20
- practice, seminars and/or other seminar-type work (PW)	24	24
- control of self-work (CSW)	6	6
- test		
1.2 Students' self-work (SSW)	144	144
2 Intermediate attestation		
Exam		
Grading test	9	9
Test (Credit)		
Course Project (CP)	36	36
Course Work (CW)		
Workload in hours	**216**	**216**

4 Course contents

Name of the units with the course outline	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				
Study of microcontroller technology for control systems	8	8	12	72
Introduction. Basic concepts and definitions. Microcontroller architecture. Microcontroller memory. Program memory, data memory, and RAM. Development and debugging of microcontroller system software.				
Development of microcontroller technology for control systems	14	12	12	72
Microcontroller I/O ports. Discrete input ports. Discrete output ports. Analog output ports, DAC, PWM, signal filtering. Analog input ports, ADC, reference voltage. Timers. Counters. Interrupts. Communication interfaces, RS232, I2C, SPI. Conclusion.				
Total with regard to 5th semester	**22**	**20**	**24**	**144**
Total with regard to the course	**22**	**20**	**24**	**144**

Topics of exemplary practical works

№	Topic of practical works
1	Work with microcontroller I/O ports.
2	Sensor signal and data processing.
3	Indicator data display.
4	Management of executors with controllers.
5	The exchange of data through communication devices.

Topics of exemplary laboratory works

№	Topic of laboratory works
1	Principles of receiving and processing data from sensors through discrete and analog interfaces.
2	Principles of control effects on the execution units through discrete and analog interfaces.
3	Development of robotic control systems.

Topics of exemplary course project/work

№	Topic of course project/work
1	Development of microcontroller control system.

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 formulated by the teacher in advance.

Practical lessons are held 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 under-standing 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	Barrett S.F. Microcontrollers Fundamentals for Engineers and Scientists / Steven F. Barrett and Daniel J. Pack. Morgan & Claypool. 2006, 115p.	
2	Amos B. Hands-On RTOS with Microcontrollers. Packt Publishing, 2020.	
2 Additional literature		
2.1 Educational and scientific literature		
1	Ledin J. Modern Computer Architecture and Organization. Packt Publishing. Illustrated edition, 2020.	
2.2 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	Introduction to Microcontrollers	https://ti.tuwien.ac.at/ecs/teaching/courses/mclu/theory-material/Microcontroller.pdf	internet, 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)
Operating systems	MS Windows XP (Azure Dev Tools for Teaching)
Office applications	LibreOffice 6.2.4. OpenSource, free
General purpose application software	Microsoft Office Visio Professional 2016 (Azure Dev Tools for Teaching)
Development, test, and debug environment	Microsoft Visual Studio (Azure Dev Tools for Teaching)

Development, test, and debug environment	MS Visual studio 2019 community (Free)

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

Branding	Reference to information resource
Scientific electronic library 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 ConsultantPlus	http://www.consultant.ru/

7 Logistics of the Course Educational Process

Type of classes	Name of the necessary basic equipment	Number of units
Course project	Personal computer	13
Laboratory class	Personal computer	13
Lecture	Board, projector, screen	1
Practical class	Board, projector, screen	1

8 Fund of the Course Evaluating Tools

Described in a separate document