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
_____ N.V. Lobov
11 2021

ACADEMIC COURSE WORKING PROGRAM

Academic course: Algorithmic Programming Languages
(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: 144 (4)
(Hours (CU))

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

Direction: Mechatronics and robotics (general profile, SMOS)
(Title of curriculum)

Perm 2021

1 General Provisions

1.1 Goals and Objectives of the Course

The goal of the course is to develop a set of knowledge, skills and abilities on theoretical and applied fundamentals of programming in algorithmic language using modern programming systems and standard libraries.
The objectives of the study discipline are:
Studying of:

- algorithms properties, ways of estimating their complexity and peculiarities of algorithmic languages and programming systems;
- high-level programming language;
- visual environment or programming system designed for programming in high-level language.

Acquiring skills:

- to apply in practice modern technologies of algorithms and programs developing, programming languages, testing methods, debugging and solving of tasks on computer;
- to program basic algorithms in a high-level language using the built-in
- tools and standard libraries;
- to evaluate the complexity of the algorithm.

Acquiring abilities of:

- working with modern technical and software means of interaction between the user and the computer;
- development of testing and debugging of programs in a high level algorithmic programming language.

1.2 Prescribed Objects of the Course

- algorithm, properties of algorithms, methods of algorithms developing, methods of algorithms representing, evaluation of the complexity of algorithms;
- program, methods and means of programming, programming language, elements of programming language, programming system, programming stages, debugging and programs testing, the basic computational (numerical) and non-numerical algorithms, standard libraries.

1.3 Starting Conditions

Unstipulated

2 Planned Results of the Course Training

Competence	Indicator 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-2.4	**AI-1 PC-2.4**	Knows high-level programming languages and modern software environments for developing algorithms to control flexible production systems.	Knows high-level programming languages and modern software environments to control flexible production systems.	Grading test
PC-2.4	**AI-2 PC-2.4**	Is able to develop algorithms and implement them in the form of high level programming languages programmes for flexible production systems control.	Is able to develop high-level programming languages programs and control programmes for flexible production systems.	Defense of laboratory work
PC-2.4	**AI-3 PC-2.4**	Possesses the skills in selecting optimal algorithms for managing flexible production systems, skills in the selection of software environments for developing and software development and debugging software for control systems of flexible manufacturing systems.	Possesses the skills in selecting optimal combination of software environments for flexible production systems control and software debugging for flexible production systems control system.	Grading test

3 Full time and forms of academic work

Form of academic work	Hours in all	Distribution in hours according to semesters
		Number of semester
		3
1 Holding classes (including results monitoring) in the form: 1.1 Contact classwork, including:	76	76
- lectures (L)	32	32
- laboratory work (LW)	40	40
- practice, seminars and/or other seminar-type work (PW)		
- control of self-work (CSW)	4	4
- test		
1.2 Students' self-work (SSW)	68	68
2 Intermediate attestation		
Exam		
Grading test	9	9
Test (Credit)		
Course Project (CP)		
Course Work (CW)		
Workload in hours	**144**	**144**

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
3rd semester				
Introduction	2	0	0	0
Objectives and aims of the course. Basic concepts, terms and definitions. Historical reference.				

Concept of algorithm.	2	2	0	4
Concept of algorithm, its properties, means of description and recording methods. ESPD, GOST 19.701(90). Stages of preparation and solving problems using computers.				
Measurement of the algorithm complexity	2	2	0	4
Software products design methodology. Methods of program design.				
Classification of programming languages	4	2	0	6
Classification of programming languages. Compilers and interpreters. The concept of a high-level language. Syntax and semantics. Basic elements of a programming system.				
Basic elements of a programming language	4	4	0	6
Elements of a programming language: Alphabet, lexemes, names, expressions, operations, operators, built-in data types. Programme structure. Basic data input/output.				
Working with arrays and strings	2	6	0	8
One- and multidimensional arrays. Strings. Basics of operating arrays and strings, search, array element deletion, strings. Simple sorting of array elements, binary search.				
Sub Programmes (functions)	4	8	0	8
Definition of a function in a language. Standard and user-defined functions. Formal and actual parameters, their variety. Transfer of parameters by value, by reference. Transfer of arrays, structures as function's parameters.				
Streaming input/output. File handling.	2	4	0	6
File declaration and initialisation. Handling files in sequential sequential and random access. Features of streaming input/output.				
User classes	4	6	0	8
Classes and objects. Encapsulation, constructors. Inheritance. Polymorphism. Abstract classes. Class patterns.				
OpenGL graphics library	4	6	0	8
Contents and purpose of OpenGL, Glaux, Glut,				

GLU libraries. Configuring and enabling the window interface. Configuring image parameters: background colour, output colour, colour model, enabling Z-buffer. Image primitives: pixels, lines, polygons. Description of primitives and its implementation.				
Conclusion	2	0	0	10
Summing up the course. Preparation and discussion of creative projects.				
Total with regard to 3rd semester	**32**	**40**	**0**	**68**
Total with regard to the course	**32**	**40**	**0**	**68**

Topics of exemplary laboratory works

№	**Topic of laboratory works**
1	Conversion of symbolic information into a numeric type
2	Checking an array for ascending or descending
3	Adding a given element to an array under a certain condition
4	Dynamic arrays
5	Functions and arrays
6	Array sorting methods (insertion, exchange, selection)
7	Recursive functions
8	Array sorting methods (quick sorting, counting sorting)
9	Classes and objects. Encapsulation, constructors.
10	Inheritance. Polymorphism. Abstract classes.

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.

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	Fundamentals of object-oriented programming in C++ algorithmic language. Perm: publisher of PSTU, 2019. (Technologies of object-oriented programmes developing in C++ language: tutorial textbook: in 2 p. P.2)	15
2	Structured programming basics in C++ algorithmic language. Perm: Publishing house of PSTU, 2019. (Technologies of object-oriented programmes in C++ language : tutorial textbook. : in 2 p.; P. 1).	15
3	Pavlovskaya T.A. C/C++. Programming in high-level language for masters and bachelors: textbook for universities / T.A. Pavlovskaya [and oth.]. Saint-Petersburg: Piter, 2020	50
2 Additional literature		
2.1 Educational and scientific literature		
1	Okulov S.M. Programming in algorithms. Moscow: BINOM. Lab of knowledge, 2002	50
2.2. Standardized and Technical literature		

2.3. Regulatory and technical publications		
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	Matyushin A.O. Microcontroller programming: strategy and tactics. Moscow: DMK Press, 2017. 356 p. ISBN 978-5-97060-098-6. Text: electronic // Lan : Electronic library system.	https://e.lanbook.com/book/93261	local network; free access
Main literature	Programming in C/C++ high-level language [Electronic source]: outline of lectures	http://www.iprbookshop.ru/48037.html	local network; free access
Main literature	Friedman A.L. C++ programming language [Electronic source]	http://www.iprbookshop.ru/73738.html	local network; 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	Windows 10 (Azure Dev Tools for Teaching subp.)
Office applications	LibreOffice 6.2.4. OpenSource, free of charge.
Project, research, development, design, modeling and implementation management systems	Protege

Development, testing and debugging environments	Microsoft Visual Studio (Azure Dev Tools for Teaching subp.)
Development, testing and debugging environments	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
Elsevier "Freedom Collection" database	https://www.elsevier.com/
Scopus database	https://www.scopus.com/
Scientific electronic library database (eLIBRARY.RU)	https://elibrary.ru/
Scientific Library of the Perm State Technical University	http://lib.pstu.ru/
“Lan” Electronic Library System	https://e.lanbook.com/
IPRbooks Electronic Library System	http://www.iprbookshop.ru/
Information sources of the ConsultantPlus Network	http://www.consultant.ru/
Information and reference system of normative and technical documentation "Techexpert: norms, rules, standards and legislation of Russia"	https://техэксперт.сайт/

7 Logistics of the Course Educational Process

Type of classes	Name of the necessary basic equipment	Number of units
Laboratory class	Personal Computer	20
Lecture	Projector	1

8 Fund of the Course Evaluating Tools

Described in a separate document