Federal State Autonomous Educational Institution of Higher Education
"Peoples' Friendship University of Russia named after Patrice Lumumba"

Academy of Engineering

(name of the main educational unit (MEU) that developed the educational program of higher education)

WORKING PROGRAM OF THE DISCIPLINE

DESIGN AND ANALYSIS OF ALGORITHMS

(name of discipline/module)

Recommended for the field of study/specialty:

27.04.04 CONTROL IN TECHNICAL SYSTEMS

(code and name of the training area/specialty)

The discipline is mastered within the framework of the implementation of the main professional educational program of higher education (EP HE):

AIML and Space Sciences / Artificial Intelligence, Machine Learning and Space Sciences

(name (profile/specialization) of the educational institution of higher education)

2025

1. THE GOAL OF MASTERING THE DISCIPLINE

The discipline "Design and Analysis of Algorithms" is included in the master's program "Artificial Intelligence, Machine Learning and Space Sciences" in the direction 27.04.04 "Control in Technical Systems" and is studied in the 1st semester of the 1st year. The discipline is implemented by the Department of the Partner University. The discipline consists of 7 sections and 8 topics and is aimed at studying algorithmization for the development of the ability and readiness to effectively build and analyze algorithms in future professional activities.

The purpose of mastering the discipline is to study the basic methods of constructing and analyzing algorithms for solving applied and research problems; to gain experience in the practical application of knowledge for solving applied and research problems.

2. REQUIREMENTS TO THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline "Design and Analysis of Algorithms" is aimed at developing the following competencies (parts of competencies) in students:

Table 2.1. List of competencies developed in students while mastering the discipline (results of mastering the discipline)

Cipher	Competence	Indicators of Competence Achievement (within the framework of this discipline)
UC-6	Able to define and implement priorities of own activities and ways of its improvement based on self-assessment	UC-6.1 Controls the amount of time spent on specific activities; UC-6.2 Develops tools and methods for time management when completing specific tasks, projects, and goals; UC-6.3 Analyzes his resources and their limits (personal, situational, temporary, etc.) for the successful completion of the assigned task; UC-6.4 Distributes tasks into long-, medium- and short-term ones with justification of their relevance and analysis of resources for their implementation;
GPC-2	Able to formulate control problems in technical systems and justify methods for solving them	GPC-2.1 Knows the basic methods of solving control problems in technical systems; GPC-2.2 Able to justify methods for solving control problems in technical systems; GPC-2.3 Proficient in methods of setting control tasks in technical systems;
GPC-3	Capable of independently solving control problems in technical systems based on the latest achievements of science and technology	GPC-3.1 Knows the basic approaches to solving control problems in technical systems; GPC-3.2 Able to apply basic approaches based on the latest achievements of science and technology to solving control problems in technical systems; GPC-3.3 Has mastered methods for solving control problems in technical systems based on the latest achievements of science and technology;
GPC-8	Able to select methods and develop control systems for complex technical objects and technological processes	GPC-8.1 Knows the basic methods used to develop control systems for complex technical objects and technological processes; GPC-8.2 Can develop control systems for complex technical objects and technological processes; GPC-8.3 Has skills in selecting methods and developing control systems for complex technical objects and technological processes;

3. PLACE OF THE DISCIPLINE IN THE STRUCTURE OF THE EDUCATIONAL EDUCATIONAL EDUCATION

Discipline " Design and Analysis of Algorithms" refers to the mandatory part of block 1 "Disciplines (modules)" of the educational program of higher education.

As part of the higher education program, students also master other disciplines and/or practices that contribute to the achievement of the planned results of mastering the discipline "Design and Analysis of Algorithms".

Table 3.1. List of components of the educational program of higher education that contribute to the achievement of the planned results of mastering the discipline

Cipher	Name of competence	Previous courses/modules, practices*	Subsequent disciplines/modules, practices*
UC-6	Able to define and implement priorities of own activities and ways of its improvement based on self-assessment		Undergraduate practice / Pre-graduation practice;
GPC-2	Able to formulate control problems in technical systems and justify methods for solving them		Undergraduate practice / Pre-graduation practice;
GPC-3	Capable of independently solving control problems in technical systems based on the latest achievements of science and technology		Advanced Methods of Space Flight Mechanics; Undergraduate practice / Pre-graduation practice; Research work / Research work (acquiring primary skills in research work);
GPC-8	Able to select methods and develop control systems for complex technical objects and technological processes		Undergraduate practice / Pre-graduation practice; Blockchain Technology;

* - filled in in accordance with the competency matrix and the SUP EP HE
** - elective disciplines/practices

4. SCOPE OF THE DISCIPLINE AND TYPES OF STUDY WORK

The total workload of the discipline " Design and Analysis of Algorithms " is "3" credit units.

Table 4.1. Types of educational work by periods of mastering the educational program of higher education for full-time education.

Type of academic work	TOTAL,ac.h.		Semester(s) 1
Contact work, academic hours	*34*		*34*
Lectures (LC)	17		17
Laboratory work (LW)	0		0
Practical/seminar classes (SC)	17		17
Independent work of students, academic hours	*74*		*74*
Control (exam/test with assessment), academic hours	*0*		*0*
General complexity of the discipline	**ac.h.**	*108*	*108*
	credit.ed.	*3*	*3*

5. CONTENT OF THE DISCIPLINE

Table 5.1. Contents of the discipline (module) by types of academic work

Section number	Name of the discipline section		Section Contents (Topics)	Type of academic work*
Section 1	Introduction.	1.1	Subject of the discipline: analysis of the quality of algorithms and development of methods for constructing efficient algorithms	LC, SC
Section 2		2.1	Complexity measures. Time and capacity complexity	LC, SC
Section 3		3.1	Computing models	LC, SC
Section 4		4.1	Mathematical foundations of algorithm analysis.	LC, SC
Section 5		5.1	Data structures for representing some mathematical objects.	LC, SC
Section 6		6.1	Tree data structure for the UNION FIND problem	LC, SC
Section 7		7.1	Sorting data. Internal sorting (of arrays)	LC, SC
		7.2	External sorting (of sequences)	LC, SC

* - filled in only for FULL-TIME education: LC – lectures; LW – laboratory work; SC – practical/seminar classes.

6. LOGISTIC AND TECHNICAL SUPPORT OF DISCIPLINE

Table 6.1. Material and technical support of the discipline

Audience type	Equipping the auditorium	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
Lecture	An auditorium for conducting lecture-type classes, equipped with a set of specialized furniture; a board (screen) and technical means for multimedia presentations.	
Seminar	An auditorium for conducting seminar-type classes, group and individual consultations, ongoing monitoring and midterm assessment, equipped with a set of specialized furniture and technical means for multimedia presentations.	
For independent work	A classroom for independent work of students (can be used for conducting seminars and consultations), equipped with a set of specialized furniture and computers with access to the Electronic Information System.	

* - the audience for independent work of students MUST be indicated!

7. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE

Main literature:

1. Kozen DC The design and analysis of algorithms. – Springer Science & Business Media, 2012.

2. Alsuwaiyel MH Algorithms: design techniques and analysis. – World Scientific, 2021. – T. 15.

Further reading:

1. Du DZ, Ko KI, Hu X. Design and analysis of approximation algorithms. – Springer Science & Business Media, 2011. – T. 62.

2. Santoro N. Design and analysis of distributed algorithms. – John Wiley & Sons, 2006.

Resources of the information and telecommunications network "Internet":

1. RUDN University EBS and third-party EBSs to which university students have access on the basis of concluded agreements

- Electronic library system of RUDN - ELS RUDN https://mega.rudn.ru/MegaPro/Web

- Electronic library system "University library online"http://www.biblioclub.ru

- EBS Yuraithttp://www.biblio-online.ru

- Electronic Library System "Student Consultant" www.studentlibrary.ru

- EBS "Znanium"https://znanium.ru/

2. Databases and search engines

- Sage https://journals.sagepub.com/

- Springer Nature Link https://link.springer.com/

- Wiley Journal Database https://onlinelibrary.wiley.com/

- Scientometric database Lens.org https://www.lens.org

Educational and methodological materials for independent work of students in mastering a discipline/module*:

1. Lecture course on the subject "Creation and analysis of algorithms".

* - all educational and methodological materials for independent work of students are posted in accordance with the current procedure on the discipline page in TUIS!

DEVELOPER:

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