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**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

ARTIFICIAL INTELLIGENCE

(name of discipline/module)

Recommended for the field of study/specialty:

27.04.04 CONTROL IN TECHNICAL SYSTEMS

(code and name of the field of study/specialty)

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

Artificial Intelligence, Machine Learning, and Space Science

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

1. THE GOAL OF MASTERING THE DISCIPLINE

The course "Artificial Intelligence" is part of the Master's program "Artificial Intelligence, Machine Learning, and Space Sciences" in the 27.04.04 "Control in Technical Systems" program and is studied in the second semester of the first year. The course is offered by the department of the partner university. It consists of eight sections and 19 topics and focuses on the study of modern information technologies and software tools for solving professional problems, acquiring the skills to select and use modern information technologies, and using modern general and specialized application software packages to solve professional problems.

The purpose of mastering the discipline is to develop in students a set of knowledge, skills and abilities in the use of modern information technologies and software in solving professional problems.

2. REQUIREMENTS FOR THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline "Artificial Intelligence" 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 Competency Achievement (within this discipline)
PC-4	Capable of participating in scientific research and development of design solutions in the field of ballistics, dynamics and flight control of spacecraft	PC-4.1 Familiar with the basic methods and approaches used to solve problems in the field of artificial intelligence and robotic systems; PC-4.2 Proficient in methods for solving professional problems in the field of artificial intelligence and robotic systems; PC-4.3 Able to apply mathematical methods and modern information technologies when conducting scientific research;

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

Discipline "Artificial Intelligence" 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 "Artificial Intelligence".

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, practical training*	Subsequent disciplines/modules, practices*
PC-4	Capable of participating in scientific research and development of design solutions in the field of ballistics, dynamics and flight control of spacecraft		Dynamics and Control of Space Systems; <i>Artificial Neural Networks (Reinforcement Learning)**</i> ; Undergraduate practice / Pre-graduation practice; Research Work;

* - filled in accordance with the competency matrix and the SUP EP HE

** - elective courses/practices

4. SCOPE OF THE DISCIPLINE AND TYPES OF EDUCATIONAL WORK

The total workload of the “Artificial Intelligence” discipline is 5 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,academic hours		Semester(s)
			2
<i>Contact work, academic hours</i>	34		34
Lectures (LC)	17		17
Laboratory work (LW)	17		17
Practical/seminar classes (SC)	0		0
<i>Independent work of students, academic hours</i>	110		110
<i>Control (exam/test with assessment), academic hours</i>	36		36
Total complexity of the discipline	academic hours	180	180
	credit	5	5

5. CONTENT OF THE DISCIPLINE

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

Section number	Name of the discipline section	Topic Title		Topic Contents	Type of academic work*
Section 1	Introduction to Artificial Intelligence	1.1	An introduction to artificial intelligence systems. The concept of artificial intelligence. The history of the development of artificial neural networks, machine learning, and the place of these disciplines in science.	The concept of artificial intelligence as a scientific field. The history of the development of artificial neural networks and machine learning. The stages of AI's development: from the first logical systems to modern deep neural networks. The place of these disciplines in the system of modern scientific knowledge, their connection with computer science, mathematics, psychology, and neuroscience.	LC, LW
		1.2	The functional structure of an artificial intelligence system. Directions for the development of artificial intelligence. Modern AI applications and key current trends in psychology.	The architecture of a typical AI system: subsystems for perception, knowledge processing, decision-making, and interaction with the external environment. Areas of artificial intelligence development: symbolic approaches, neural network approaches, evolutionary modeling, and hybrid systems. Modern AI applications and key current areas in psychology: emotion recognition, behavior analysis, mental health diagnostics, and psychological counseling systems.	LC, LW
		1.3	Data and knowledge. Knowledge representation in intelligent systems.	The difference between the concepts of "data" (raw facts) and "knowledge" (structured information with interpretation rules). Knowledge representation in intelligent systems. Knowledge representation models: production rules, semantic networks, frames, logical formalisms. Selecting a model depending on the subject area and the problem being solved.	LC, LW
Section 2	General concept of information technology	2.1	The concept of information technology. Definition of key concepts. Information technology in professional activities.	Definitions of key concepts: information, technology, and information technology. The life cycle of information technology. Information technology in the professional work of a psychologist: data collection, processing test results, documentation, and remote counseling.	LC, LW
		2.2	Classification model of activity: the nature of transformations in social relations, the form of expression of the result, the scale of implementation of the activity, the features of procedural forms of activity	The nature of transformations in social relations. The form of expression of the results of activity. The scale of activity (individual, group, organizational, interorganizational). Features of procedural forms of activity: project-based, operational, research, and management activities. Application of classification for the selection of appropriate information technologies.	LC, LW
Section 3	Information technology and	3.1	Ensuring access to information. Concepts	Methods and means of accessing information: local access, remote	LC, LW

Section number	Name of the discipline section	Topic Title		Topic Contents	Type of academic work*
	information systems		defining information technology strategy.	access via networks, cloud services. Concepts defining the informatization strategy: the concept of the "information society," e-government, digital economy, and open data. The role of psychological factors in informatization.	
		3.2	List of key information technologies and systems. Tasks for developing an information support system.	A list and brief description of the main information technologies: office technologies, multimedia technologies, geoinformation technologies, big data processing technologies, and artificial intelligence technologies. The challenges of developing an information support system for professional activities.	LC, LW
Section 4	Machine learning terminology	4.1	Key AI terms. Common problem definitions: regression, classification, clustering, visualization. Learning from precedents and training sets. Quality metrics. Data types. Terminology: object, target variable, feature, quality metric, model, training method. Analysis of specific problem definitions, features, and quality metrics for these tasks.	Basic machine learning problem statements: regression (predicting a continuous variable), classification (assigning an object to one of the categories), clustering (division into groups without supervision), visualization (dimensionality reduction for graphical representation). Learning from precedents and a training set. Quality metrics: precision, recall, F-score, mean square error, coefficient of determination. Data types: numeric, categorical, text, time series, images. Terminology: object (example from the sample), target variable (what is being predicted), feature (object characteristic).	LC, LW
		4.2	Machine learning as a tool for automated pattern discovery. An overview of the main types of models and their training principles (using simple examples).	An overview of the main types of models and their training principles using simple examples. Supervised learning: requires a labeled sample. Unsupervised learning: requires the discovery of hidden structures. Reinforcement learning: requires learning through interaction with the environment and feedback in the form of a reward or penalty.	LC, LW
		4.3	Linear models and text analysis, examples of analyzing bank reviews and job postings. Decision trees, decision forests, and internet search engines. Search engine operating principles.	The principles of linear models (logistic regression, linear regression) for text data analysis. Examples of bank review analysis (text sentiment: positive, negative, neutral) and job posting analysis (highlighting key requirements, competencies, and automated candidate selection). Decision trees, decision forests, and internet search engines. Search results ranking principles: PageRank, relevance, and link structure considerations. Search engine principles: indexing, keyword search, and behavioral factors considerations.	LC, LW
Section 5	Information processes	5.1	The concept of information processes. A generalized structure of the information circulation process in an information system.	Definition of an information process as a set of actions for collecting, transmitting, processing, storing, and delivering information. Generalized structure of the information circulation process in an information system: information sources, transmission channels,	LC, LW

Section number	Name of the discipline section	Topic Title		Topic Contents	Type of academic work*
				receivers, converters, and storage devices.	
		5.2	Information processes of information circulation: creation, collection, transmission, processing,	A detailed examination of the main processes: creation (generation of new information), collection (combining information from different sources), transmission (delivery from source to recipient via communication channels), and processing (transformation of information for problem-solving purposes). The psychological aspects of human perception of information within these processes are explored.	LC, LW
Section 6	Information security	6.1	The concept of information protection and information security. Fundamentals of protecting information from threats.	Definition of information security as the prevention of leakage, theft, distortion, forgery, and destruction of information. Fundamentals of information security against threats: natural threats, man-made threats, and intentional threats (hacker attacks, malware, social engineering).	LC, LW
		6.2	Protecting the interests of individuals, society, and the state from threats of exposure to substandard information and violations of information dissemination procedures. Protecting information, information resources, and information systems from threats of unauthorized and illegal influence by third parties.	Protection against threats of poor-quality (false, manipulative, disinformation) information. Protection against violations of information dissemination procedures (unauthorized access, breach of confidentiality). Protection of information resources and information systems from threats of destruction and incapacitation (technical failures, cyberattacks, physical impact).	LC, LW
		6.3	Protecting rights and freedoms in the information sphere in the context of computerization. Restricted information and its protection.	Protecting human and civil rights and freedoms in the context of information technology: the right to privacy, the right to access information, and the right to protect personal data. Restricted information and its protection: state secrets, commercial secrets, professional secrets (including psychological and medical), and personal data. Measures and mechanisms for protecting restricted information.	LC, LW
Section 7	Data visualization	7.1	Culture of presenting data and conclusions in graphical form.	Principles of effective communication using graphic tools. Selecting a visualization type based on the purpose (comparison, composition, distribution, relationship, change over time). Conclusions in graphic form: how to avoid distortions and misinterpretations. Fundamentals of graphic literacy: scale, color, captions, legends, annotations.	LC, LW
		7.2	Data visualization approaches and ideas, demonstration of visualization examples	Key approaches: minimalism, data focus, and eliminating visual noise. Effective visualization ideas: using pre-attentive attributes, contextual information, and hierarchical organization. Examples of	LC, LW

Section number	Name of the discipline section	Topic Title		Topic Contents	Type of academic work*
				successful and unsuccessful data visualizations from psychological research, marketing, sociology, and other fields are showcased.	
Section 8	Problems and technologies of expert systems.	8.1	The concept of an expert system (ES). General characteristics of ES. Types of ES and types of tasks solved. Structure and modes of use of ES.	An expert system is defined as an intelligent program that reproduces the reasoning of a human expert in a narrow subject area. General characteristics of expert systems: focus on solving weakly structured problems, using knowledge and inference rules. Types of expert systems: diagnostic, consulting, training, predictive, and design. Types of problems solved. Expert system structure: knowledge base, inference engine, explanation subsystem, user interface, knowledge acquisition subsystem. Modes of use: knowledge input mode (knowledge engineering) and consulting mode (user).	LC, LW
		8.2	Classification of ES tools and knowledge organization in ES. Knowledge engineering. Main tasks of a knowledge engineer. Intelligent information ES.	Tools: expert system shells, logical programming languages (Prolog, etc.), libraries, and frameworks. Knowledge organization in an expert system. Knowledge engineering as a discipline for extracting, structuring, and formalizing expert knowledge. The main tasks of a knowledge engineer include interviewing experts, analyzing the subject area, selecting a knowledge representation model, and verifying the knowledge base. Intelligent information systems based on expert technologies. Examples of expert system application in psychology (diagnostics, recommender systems, psychological counseling).	LC, LW

* - to be completed 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 for the discipline

Audience type	Equipment of the auditorium	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
Lecture	A lecture hall equipped with specialized furniture, a whiteboard (screen), and multimedia presentation equipment.	
Computer class	A computer room for conducting classes, group and individual consultations, ongoing monitoring and midterm assessment, equipped with personal computers (in the amount of ____ units), a board (screen) and technical means for multimedia presentations.	
For independent work	A classroom for independent student work (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to the Electronic Information System.	

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

7. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE

Main literature:

1. Hunt EB Artificial intelligence. – Academic Press, 2014.
2. Ertel W. Introduction to artificial intelligence. – Springer Nature, 2024.

Further reading:

1. McCarthy J. et al. What is artificial intelligence. – 2007.
2. Jackson PC Introduction to artificial intelligence. – Courier Dover Publications, 2019.

Resources of the information and telecommunications network "Internet":

1. RUDN University Electronic Library System and third-party electronic library systems to which university students have access based on concluded agreements
 - RUDN University Electronic Library System – RUDN University Electronic Library System <https://mega.rudn.ru/MegaPro/Web>
 - Electronic Library System "University Library Online" <http://www.biblioclub.ru>
 - EBS "Urayt" <http://www.biblio-online.ru>
 - Electronic Library System "Student Consultant" www.studentlibrary.ru
 - EBS "Knowledge" <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 "Artificial Intelligence".

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

DEVELOPER:

Associate Professor

Position, DEPARTMENT

Signature

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