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 (PMU) - the developer of the EP HE)

INTERNSHIP PROGRAM

Research work

(name of the internship)

Educational practice

(type of practice: educational, industrial)

Recommended by the ICSC for the field of study/specialty:

27.04.04 "Control in Technical Systems"

(code and name of the direction of training/specialty)

Practical training of students is carried out as part of the implementation of the main professional educational program of higher education (EP HE):

Data Science and Space Engineering

(name (profile/specialization) of the EP HE)

2024

1. PURPOSE OF THE INTERNSHIP

The purpose of research work is to master the skills of independent research work on the collection, processing of scientific and technical materials based on the results of research on the topic of the master's thesis and their submission for publication in the form of scientific and technical articles, reviews, abstracts, reports, reports and lectures. These materials should be used to form the topic of the student's master's thesis.

The main objectives of the research work are:

- Organization and planning educational activity;
- collection, processing, analysis and systematization of world-class scientific and technical information, including in foreign languages;
- selection of methods and means for solving problems on the topic of research;
- gaining experience in using standard professional software products focused on solving design, technological and scientific problems;
- development of plans and programs of innovation activities in the unit;
- gaining experience of active interaction with colleagues in the scientific field of activity;
- preparation of scientific and technical reports, reviews, publications, scientific reports, applications for inventions, the text of a master's thesis and other materials based on the results of the research performed.

2. REQUIREMENTS FOR THE RESULTS OF TRAINING BASED ON THE RESULTS OF THE INTERNSHIP

Conducting research work is aimed at the formation of the following competencies (parts of competencies) in students:

Table 2.1. List of competencies formed in students during the internship (learning outcomes based on the results of the internship)

Cipher	Competence	Indicators of Competency Achievement (within the framework of this discipline)
GC-1	Ability to carry out a critical analysis of problem situations based on a systematic approach, to develop an action strategy	GC-1.1. Analyzes the task, highlighting its basic components;
		GC-1.2. Determines and ranks the information required to solve the problem;
		GC-1.3. Searches for information to solve the problem by various types of requests;
		GC-1.4 Offers options for solving the problem, analyzes the possible consequences of their use;
		GC-1.5 analyzes the ways of solving problems of a worldview, moral and personal nature on the basis of the use of basic philosophical ideas and categories in their historical development and socio-cultural context.
GC-2	Able to manage a project at all stages of its life cycle	GC-2.1 Formulates a problem, the solution of which is directly related to the achievement of the project goal;
		GC-2.2 Defines the links between the tasks set and the expected results of their solution;
		GC-2.3 Within the framework of the tasks set, it determines the available resources and constraints, the current legal norms;

Cipher	Competence	Indicators of Competency Achievement (within the framework of this discipline)
		GC-2.4 Analyzes the schedule for the implementation of the project as a whole and chooses the best way to solve the tasks, based on the current legal norms and available resources and restrictions;
		GC-2.5 Monitors the progress of the project, adjusts the schedule in accordance with the results of control.
GC-7	Ability to search for the necessary sources of information and data, perceive, analyze, remember and transmit information using digital means, as well as with the help of algorithms when working with data obtained from various sources in order to effectively use the information received to solve problems; evaluate information, its reliability, build logical conclusions based on incoming information and data	GC-7.1. Knows the main digital technologies, methods of search, processing, analysis, storage and presentation of information used in the modern conditions of the digital economy;
		GC-7.2. Is able to apply modern digital technologies to solve the problems of professional activity in the digital economy;
		GC-7.3. Possesses modern digital technologies, methods of search, processing, analysis, storage and presentation of information (in the field of management in technical systems) in the digital economy and modern corporate information culture.
GPC-5	Ability to conduct patent research, determine the forms and methods of legal protection and protection of rights to the results of intellectual activity, dispose of rights to them to solve problems in the development of science, engineering and technology	GPC-5.1. Knows the methods and approaches to patent research, forms and methods of legal protection and protection of rights to the results of intellectual activity;
		GPC-5.2. Is able to dispose of the rights to the results of intellectual activity to solve problems in the field of development of science, engineering and technology;
		GPC-5.3. Knows the methods and approaches to patent research, knows the methods of legal protection and protection of rights to the results of intellectual activity.
GPC-6	Ability to collect and analyze scientific and technical information, generalize domestic and foreign experience in the field of automation and control	GPC-6.1. Knows the basic methods of collecting and conducting analysis of scientific and technical information;
		GPC-6.2. Is able to analyze and summarize domestic and foreign experience in the field of automation and control facilities;
		GPC-6.3. Possesses methods of collecting and analyzing scientific and technical information, and can also generalize domestic and foreign experience in the professional field.
GPC-7	Is able to make an informed choice, develop and implement in practice circuitry, system engineering and hardware and software solutions for automation and control systems	GPC-7.1 Is able to develop and implement circuitry and system engineering solutions for automation and control systems;
		GPC-7.2 Is able to develop hardware and software solutions for automation and control systems;
		GPC-7.3 Owns approaches for the informed selection and implementation in practice of circuitry, system engineering and hardware and software solutions for automation and control systems.
GPC-10	Able to manage the development of	GPC-10.1 Familiar with the main approaches to the development of methodological and regulatory documents,

Cipher	Competence	Indicators of Competency Achievement (within the framework of this discipline)
	methodological and regulatory documents, technical documentation in the field of automation of technological processes and production, including the life cycle of products and their quality	technical documentation in the field of automation of technological processes and production;
		GPC-10.2 Owns approaches to guide the development of technical documentation and regulatory documents in the field of automation of technological processes and production, including the life cycle of products and their quality.
PC-1	Ability to formulate goals, objectives of scientific research in the field of application of geographic information systems in the development of territories, choose methods and means for solving professional problems	PC-1.1. Knows the methods and means of solving the problems of scientific research in the field of the use of geographic information systems in the development of territories;
		PC-1.2. Is able to formulate the goal and objectives of scientific research in the professional field;
		PC-1.3. Possesses techniques for formulating the goals and objectives of scientific research, knows how to choose methods and means for solving problems of professional activity.
PC-2	Ability to apply modern theoretical and experimental methods for the development of mathematical models of the objects and processes under study related to professional activities in the field of training	PC-2.1. Knows modern theoretical and experimental methods used to develop mathematical models of studied objects and processes of professional activity;
		PC-2.2. Is able to determine the effectiveness of the methods used to develop mathematical models of the objects and processes under study;
		PC-2.3. Owns modern theoretical and experimental methods for the development of mathematical models of objects in the field of application of geographic information systems in the development of territories.
PC-3	Ability to carry out design and technological work and research using geographic information systems and technologies in the development of territories	PC-3.1. Knows the fundamental principles of remote sensing, basic mathematical methods and information technologies in the field of application of Earth remote sensing systems. Knows the theory and methodology of creating thematic information products and providing services based on the use of remote sensing data and geographic information systems in the development of territories; knows the basic approaches to design and technological work;
		PC-3.2. Is able to formulate recommendations for the improvement of devices and systems, prepare the results of scientific research for publication and form documents for filing an application for an invention;
		PC-3.3. Possesses methods of analyzing the results obtained using geographic information systems and technologies in the development of territories; is able to carry out design and technological work for the development of territories using geographic information systems and remote sensing systems.
PP-4	Able to participate in scientific research and development of design solutions in the field of ballistics, dynamics and spacecraft flight control	PC-4.1 Familiar with the main methods and approaches used to solve problems in the field of artificial intelligence and robotic systems;
		PC-4.2 Owns methods for solving professional problems in the field of artificial intelligence and robotic systems;

Cipher	Competence	Indicators of Competency Achievement (within the framework of this discipline)
		PC-4.3 Is able to apply mathematical methods and modern information technologies in scientific research.

3. PLACE OF PRACTICE IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM OF HIGHER EDUCATION

The research work belongs to the variable component of the mandatory part of Block 2 Curriculum Practice.

Within the framework of the EP HE, students also master disciplines and/or other practices that contribute to the achievement of the planned learning outcomes based on the results of research work.

Table 3.1. List of components of the EP HE that contribute to the achievement of the planned learning outcomes based on the results of the internship

Cipher	Competency Name	Previous Disciplines/Modules, Practices*	Subsequent disciplines/modules, practices*
GC-1	Ability to carry out a critical analysis of problem situations based on a systematic approach, to develop an action strategy	History and Methodology of Science Artificial Neural Networks (Deep Learning) Artificial neural networks (deep learning)	Undergraduate Training State Final Certification
GC-2	Able to manage a project at all stages of its life cycle	History and Methodology of Science	Undergraduate Training State Final Certification
GC-7	Ability to search for the necessary sources of information and data, perceive, analyze, remember and transmit information using digital means, as well as with the help of algorithms when working with data obtained from various sources in order to effectively use the information received to solve problems; evaluate information, its reliability, build logical conclusions based on incoming information and data	History and Methodology of Science Information Technology in Mathematical Modelling Artificial Neural Networks (Deep Learning) Artificial neural networks (deep learning)	Undergraduate Training State Final Certification
GPC-5	Ability to conduct patent research, determine the forms and methods of legal protection and protection of rights to the results of intellectual activity, dispose of rights to them to solve problems in the development of science, engineering and technology	Machine Learning and Big Data Mining Dynamics and Control of Space Systems	Undergraduate Training State Final Certification
GPC-6	Ability to collect and analyze scientific and technical information,	Advanced Methods of Earth Remote	Undergraduate Training State Final Certification

Cipher	Competency Name	Previous Disciplines/Modules, Practices*	Subsequent disciplines/modules, practices*
	generalize domestic and foreign experience in the field of automation and control	Sensing / Современные методы дистанционного зондирования Земли	
GPC-7	Is able to make an informed choice, develop and implement in practice circuitry, system engineering and hardware and software solutions for automation and control systems	Advanced Methods of Space Flight Mechanics Dynamics and Control of Space Systems	Undergraduate Training State Final Certification
GPC-10	Able to manage the development of methodological and regulatory documents, technical documentation in the field of automation of technological processes and production, including the life cycle of products and their quality	Advanced Methods of Space Flight Mechanics	Undergraduate Training State Final Certification
PC-1	Ability to formulate goals, objectives of scientific research in the field of application of geographic information systems in the development of territories, choose methods and means for solving professional problems	Advanced Methods of Space Flight Mechanics Artificial Neural Networks (Deep Learning) Artificial neural networks (deep learning) Artificial Neural Networks (Reinforcement Learning)	Undergraduate Training State Final Certification
PC-2	Ability to apply modern theoretical and experimental methods for the development of mathematical models of the objects and processes under study related to professional activities in the field of training	History and Methodology of Science Information Technology in Mathematical Modelling Virtual Reality and Computer Vision Advanced Methods of Space Flight Mechanics Geoinformation Systems and Applications Dynamics and Control of Space Systems	Undergraduate Training State Final Certification

Cipher	Competency Name	Previous Disciplines/Modules, Practices*	Subsequent disciplines/modules, practices*
		Artificial Neural Networks (Deep Learning) Artificial neural networks (deep learning) Artificial neural networks (reinforcement learning)	
PC-3	Ability to carry out design and technological work and research using geographic information systems and technologies in the development of territories	Virtual Reality and Computer Vision Advanced Methods of Earth Remote Sensing / Современные методы дистанционного зондирования Земли	Undergraduate Training State Final Certification
PP-4	Able to participate in scientific research and development of design solutions in the field of ballistics, dynamics and spacecraft flight control	History and Methodology of Science Advanced Methods of Earth Remote Sensing / Современные методы дистанционного зондирования Земли Dynamics and Control of Space Systems Artificial Neural Networks (Reinforcement Learning)	Undergraduate Training State Final Certification

* - to be completed in accordance with the competency matrix and the SUP of the EP HE

4. SCOPE OF PRACTICE

The total labor intensity of the research work is 18 credits (648 academic hours).

5. CONTENT OF THE INTERNSHIP

*Table 5.1. Internship content**

Name of the practice section	Content of the section (topics, types of practical activities)	Labor intensity, ac.p.
Section 1. Organizational and preparatory	Receiving an individual assignment for practice from the supervisor	2
	Safety briefing in the workplace (in the laboratory and/or in production)	2

Name of the practice section	Content of the section (topics, types of practical activities)	Labor intensity, ac.p.
Section 2. Principal	Collection of analytical data in accordance with the individual task. Description of application processes and software.	200
	Analysis and processing of the data obtained	200
	Research and publication work	200
	Current control of the internship by the supervisor	20
	Keeping an internship diary	4
Preparation of an internship report		10
Preparation for defense and defense of the internship report		10
	ALTOGETHER:	648

* - the content of the internship by sections and types of practical training is FULLY reflected in the student's internship report.

6. MATERIAL AND TECHNICAL SUPPORT FOR THE INTERNSHIP

Scientific and educational laboratories of the Department of Mechanics and Control Processes, premises of partner enterprises in which students undergo internship, equipped with a local network with Internet access, a projector and an interactive whiteboard.

7. METHOD OF PRACTICE

Research work can be carried out both in the structural divisions of RUDN University or in organizations in Moscow (stationary), and at bases located outside Moscow (offsite).

Internship on the basis of an external organization (outside RUDN University) is carried out on the basis of an appropriate agreement, which specifies the terms, place and conditions of the internship in the base organization.

The terms of the internship correspond to the period specified in the calendar curriculum of the EP HE. The timing of the internship can be adjusted in agreement with the Department of Educational Policy and the Department of Organizing Internships and Promoting the Employment of Graduates at RUDN University.

8. EDUCATIONAL, METHODOLOGICAL AND INFORMATION SUPPORT OF PRACTICE

Reference citations:

– Classical and modern methods of the theory of automatic control. Textbook in 5 volumes; 2nd ed., revised and supplemented / Ed. by K.A. Pupkov, N.D. Egupov. – Moscow: BMSTU Publishing House, 2004.

– Pupkov K.A. Modeling and testing of automatic control systems. Uch. allowance. Moscow, RUDN Publ., 2014. – 98 p.

– Egupov N.D., Kolesnikov L.V., Pupkov K.A., Trofimov A.I. / ed. Matveev V.A. Algoritmicheskaya teoriya sistem upravleniya, osnovannaya na spektral'nykh metodakh [Algorithmic theory of control systems based on spectral methods]. Monograph in 2 vols. – Moscow: BMSTU Publishing House, 2014. – 464 p. Volume 1 and – 464 p. Volume 2.

Further reading:

Russian journals: Automation and Telemechanics; Sensors and Systems; Proceedings of Higher Educational Institutions; Instrument Engineering; News of Higher Educational Institutions. Applied Nonlinear Dynamics; Proceedings of Higher Educational Institutions. Problems of Energy; Proceedings of the Russian Academy of Sciences. Theory and Control Systems; Information-Measuring and Control Systems; Information Technologies; Mathematical Modeling; Mechatronics. Automation. Control; Nonlinear World; Review of Applied and Industrial

Mathematics; Devices and systems: "Control, Control, Diagnostics"; Applied Mathematics and Mechanics; Forecasting problems; Problems of Theory and Practice of Management; Management problems; Management Systems and Information Technology; Digital signal processing; Open systems; Neurocomputers: development, application**.**

Foreign magazines: CAD/CAM/CAE Observer; Artificial Intelligence; IEEE Transaction on Automation Control; Control; IEEE Mechanical.

Resources of the information and telecommunication network "Internet":

1) Electronic Library System (EBS) of RUDN University and third-party EBS, to which university students have access on the basis of concluded contracts:

- EBS RUDN http://lib.rudn.ru/MegaPro/Web http://lib.rudn.ru/MegaPro/Web
- EBS "University Library Online" http://www.biblioclub.ru
- EBS Yurayt http://www.biblio-online.ru
- EBS "Student Consultant" www.studentlibrary.ru
- EBS "Lan" http://e.lanbook.com/
- EBS "Troitsky Bridge"

2) Databases and search engines:

- electronic collection of legal and regulatory and technical documentation http://docs.cntd.ru/
- Yandex https://www.yandex.ru/ search engine https://www.yandex.ru/
- Google Search Engine https://www.google.ru/
- SCOPUS Abstract Database http://www.elsevierscience.ru/products/scopus/

Educational and methodological materials for internship, filling out a diary and drawing up an internship report:*

1) Rules of safe working conditions and fire safety during research work (initial briefing).

2) General structure and principle of operation of technological production equipment used by students during internship; technological maps and regulations, etc. (if necessary).

3) Methodical instructions for students to fill out a diary and draw up an internship report.

* - all educational and methodological materials for internship are posted in accordance with the current procedure on the internship page in TUIS

9. ASSESSMENT MATERIALS AND A POINT-RATING SYSTEM FOR ASSESSING THE LEVEL OF COMPETENCE FORMATION BASED ON THE RESULTS OF THE INTERNSHIP

Assessment materials and a point-rating system* for assessing the level of competence formation (part of competencies) based on the results of research work are presented in the Appendix to this Internship Program (module).

* - OM and BRS are formed on the basis of the requirements of the relevant local regulatory act of RUDN University (provision/procedure).

DEVELOPERS:

Associate Professor of the Department of Mechanics and Control Processes		Saltykova O.A.
Position, BUP	Signature	Surname I.O.

HEAD OF THE BUP:

Head of the Department of Mechanics and Control Processes		Razumny Yu.N.
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