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

Academy of Engineering

(name of the main educational unit (MEU) – developer of the educational program of higher education)

INTERNSHIP PROGRAM

Research work / Research work (acquiring basic skills in research work)

(name of practice)

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 training area/specialty)

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

**AIML and Space Science / Artificial Intelligence, Machine Learning and Space
Science**

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

1. PURPOSE OF THE INTERNSHIP

The objective of Research work (acquiring primary skills of research work) is to master the skills of independent research work on collecting, processing scientific and technical materials based on the results of research on the topic of the master's thesis and submitting them for publication in the form of scientific and technical articles, reviews, abstracts, reports, papers and lectures. These materials should be used to form the topic of the student's master's thesis.

The main tasks of Research work / Scientific research work (obtaining primary skills of scientific research work) are:

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

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

Conducting Research work / Scientific research work (obtaining primary skills of scientific research work) is aimed at developing the following competencies (parts of competencies) in students:

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

Cipher	Competence	Indicators of Competence Achievement (within the framework of this discipline)
UC-1	Ability to carry out critical analysis of problem situations based on a systems approach, develop an action strategy	UC-1.1. Analyzes the task, identifying its basic components;
		UC-1.2. Defines and ranks the information required to solve the assigned task;
		UC-1.3. Conducts a search for information to solve the assigned task using various types of requests;
		UC-1.4 Suggests options for solving the problem, analyzes the possible consequences of their use;
		UC-1.5 Analyzes ways of solving problems of ideological, moral and personal nature based on the use of basic philosophical ideas and categories in their historical development and socio-cultural context.
UC-2	Able to manage a project at all stages of its life cycle	UC-2.1 Formulates a problem, the solution of which is directly related to achieving the project goal;
		UC-2.2 Defines the connections between the tasks set and the expected results of their solution;

Cipher	Competence	Indicators of Competence Achievement (within the framework of this discipline)
		<p>UC-2.3 Within the framework of the set tasks, determines the available resources and limitations, current legal norms;</p> <p>UC-2.4 Analyzes the project implementation schedule as a whole and selects the optimal way to solve the tasks set, based on current legal regulations and available resources and limitations;</p> <p>UC-2.5 Monitors the progress of the project, adjusts the schedule in accordance with the monitoring results.</p>
UC-7	The ability to search for the necessary sources of information and data, perceive, analyze, remember and transmit information using digital means, as well as using 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	<p>UC-7.1. Knows the basic digital technologies, methods of searching, processing, analyzing, storing and presenting information used in the modern conditions of the digital economy;</p> <p>UC-7.2. Able to apply modern digital technologies to solve problems of professional activity in the conditions of the digital economy;</p> <p>UC-7.3. Has a command of modern digital technologies, methods of searching, processing, analyzing, storing and presenting information (in the field of management in technical systems) in the context of the digital economy and modern corporate information culture.</p>
GPC-3	Ability to independently solve control problems in technical systems based on the latest achievements of science and technology	<p>GPC-3.1. Knows the basic approaches to solving control problems in technical systems;</p> <p>GPC-3.2. Able to apply basic approaches based on the latest achievements of science and technology to solving control problems in technical systems;</p> <p>GPC-3.3. Has mastered methods for solving control problems in technical systems based on the latest achievements in science and technology</p>
GPC-5	Ability to conduct patent research, determine forms and methods of legal protection and defense of rights to the results of intellectual activity, manage rights to them to solve problems in the development of science, technology and engineering	<p>GPC-5.1. Knows the methods and approaches to conducting patent research, forms and methods of legal protection and defense of rights to the results of intellectual activity;</p> <p>GPC-5.2. Able to manage rights to the results of intellectual activity to solve problems in the field of development of science, engineering and technology;</p> <p>GPC-5.3. Has knowledge of methods and approaches to conducting patent research, knows methods of legal protection and defense of rights to the results of intellectual activity.</p>
GPC-6	Ability to collect and analyze scientific and technical information, summarize domestic and foreign experience in the field of automation and control equipment	<p>GPC-6.1. Knows the basic methods of collecting and analyzing scientific and technical information;</p> <p>GPC-6.2. Able to analyze and generalize domestic and foreign experience in the field of automation and control equipment;</p> <p>GPC-6.3. Has knowledge of methods for collecting and analyzing scientific and technical information, and can also generalize domestic and foreign experience in the professional field.</p>

Cipher	Competence	Indicators of Competence Achievement (within the framework of this discipline)
GPC-7	Capable of making informed choices, developing and implementing in practice circuit, system engineering and hardware-software solutions for automation and control systems	GPC-7.1 Able to develop and implement in practice circuit and system engineering solutions for automation and control systems;
		GPC-7.2 Can develop hardware and software solutions for automation and control systems;
		GPC-7.3 Possesses approaches for making a well-founded choice and implementing in practice circuit, system engineering and hardware-software solutions for automation and control systems.
GPC-10	Capable of managing the development of methodological and regulatory documents, technical documentation in the field of automation of technological processes and production, including on the life cycle of products and their quality	GPC-10.1 Familiar with the main approaches to the development of methodological and regulatory documents, technical documentation in the field of automation of technological processes and production;
		GPC-10.2 Has knowledge of approaches to managing 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 and objectives of scientific research in the field of application of geographic information systems in territorial development, to select methods and means for solving professional problems	PC-1.1. Knows the methods and means of solving scientific research problems in the field of application of geographic information systems in territorial development;
		PC-1.2. Able to formulate the goal and objectives of scientific research in the professional field;
		PC-1.3. Has mastered the techniques for formulating the goals and objectives of scientific research, and knows how to select methods and means for solving problems of professional activity.
PC-2	Ability to apply modern theoretical and experimental methods for developing mathematical models of 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 the objects under study and processes of professional activity;
		PC-2.2. Able to determine the effectiveness of the methods used to develop mathematical models of the objects and processes under study;
		PC-2.3. Has mastered modern theoretical and experimental methods for developing mathematical models of objects in the field of application of geographic information systems in territorial development.
PC-3	Ability to carry out design and technological work and research using geographic information systems and technologies in territorial development	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 territorial development; knows the basic approaches to carrying out design and technological work;
		PC-3.2. Able to formulate recommendations for improving devices and systems, prepare scientific research results for publication and generate documents for filing an application for an invention;
		PC-3.3. Has knowledge of methods for analyzing results obtained using geographic information systems and

Cipher	Competence	Indicators of Competence Achievement (within the framework of this discipline)
		technologies in territorial development; is able to carry out design and technological work for territorial development using geographic information systems and remote sensing systems.
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 Has knowledge of 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 PRACTICE IN THE STRUCTURE OF THE EDUCATIONAL INSTITUTION

Research work / Research work (acquiring primary skills in research work) is an optional component of the compulsory part of Block 2 Practice of the curriculum.

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

Table 3.1. List of components of the educational program of higher education that contribute to the achievement of planned learning outcomes following the completion of the internship

Cipher	Name of competence	Previous courses/modules, practices*	Subsequent disciplines/modules, practices*
UC-1	Ability to carry out critical analysis of problem situations based on a systems approach, develop an action strategy	History and Methodology of Science / History and methodology of science	Undergraduate Training / Pre-graduation Internship State final certification
UC-2	Ability to manage a project at all stages of its life cycle	History and Methodology of Science / History and methodology of science	Undergraduate Training / Pre-graduation Internship State final certification
UC-7	The ability to search for the necessary sources of information and data, perceive, analyze, remember and transmit information using digital means, as well as using 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 / History and methodology of science	Research work / Research work Undergraduate Training / Pre-graduation Internship State final certification

Cipher	Name of competence	Previous courses/modules, practices*	Subsequent disciplines/modules, practices*
GPC-3	Ability to independently solve control problems in technical systems based on the latest achievements of science and technology	Design and Analysis of Algorithms / Design and Analysis of Algorithms Applied Statistics Advanced Methods of Space Flight Mechanics / Modern Methods of Space Flight Mechanics	Undergraduate Training / Pre-graduation Internship State final certification
GPC-5	Ability to conduct patent research, determine forms and methods of legal protection and defense of rights to the results of intellectual activity, manage rights to them to solve problems in the development of science, technology and engineering	Relational Database Management System / Relational Database Management System	Research work / Research work Undergraduate Training / Pre-graduation Internship State final certification
GPC-6	Ability to collect and analyze scientific and technical information, summarize domestic and foreign experience in the field of automation and control equipment	Relational Database Management System / Relational Database Management System; Inferential Statistics / Inductive Statistics; Python for Data Science / Python for Data Science; Technology Threats and Cybersecurity Systems / Technology Threats and Cybersecurity Systems	Research work / Research work Undergraduate Training / Pre-graduation Internship State final certification
GPC-7	Capable of making informed choices, developing and implementing in practice circuit, system engineering and hardware-software solutions for automation and control systems	Operations Research and Optimization Techniques / Operations Research and Optimization Techniques	Undergraduate Training / Pre-graduation Internship State final certification
GPC-10	Capable of managing the development of methodological and regulatory documents, technical documentation in the field of automation of technological processes and production, including on the life cycle of products and their quality	Advanced Methods of Space Flight Mechanics / Modern methods of space flight mechanics; Technology Threats and Cybersecurity Systems / Technology Threats and Cybersecurity Systems	Research work / Research work Undergraduate Training / Pre-graduation Internship State final certification
PC-1	Ability to formulate goals and objectives of scientific research in the	Introduction to Natural Language	Undergraduate Training / Pre-graduation Internship

Cipher	Name of competence	Previous courses/modules, practices*	Subsequent disciplines/modules, practices*
	field of application of geographic information systems in territorial development, to select methods and means for solving professional problems	Processing / introduction to natural language processing; Artificial Neural Networks (Deep Learning) Artificial Neural Networks (Deep Learning) Artificial Neural Networks (Reinforcement Learning)	State final certification
PC-2	Ability to apply modern theoretical and experimental methods for developing mathematical models of objects and processes under study related to professional activities in the field of training	Mathematics for Spatial Sciences / Spatial Mathematics; Operations Research and Optimization Techniques / Methods of operations research and optimization; Advanced Methods of Space Flight Mechanics / Modern methods of space flight mechanics; Dynamics and Control of Space Systems / Dynamics and Control of Space Systems; Artificial Neural Networks (Deep Learning) Artificial Neural Networks (Deep Learning) Artificial Neural Networks (Reinforcement Learning)	Research work / Research work Undergraduate Training / Pre-graduation Internship State final certification
PC-3	Ability to carry out design and technological work and research using geographic information systems and technologies in territorial development	Introduction to Geospatial Technology / Introduction to Geospatial Technology; Advance Python Programming for Spatial Analytics /	Undergraduate Training / Pre-graduation Internship State final certification

Cipher	Name of competence	Previous courses/modules, practices*	Subsequent disciplines/modules, practices*
		Advanced Python Programming for Spatial Analytics	
PC-4	Capable of participating in scientific research and development of design solutions in the field of ballistics, dynamics and flight control of spacecraft	Artificial Intelligence / Artificial Intelligence; Dynamics and Control of Space Systems / Dynamics and Control of Space Systems; Artificial Neural Networks (Reinforcement Learning)	Research work / Research work Undergraduate Training / Pre-graduation Internship State final certification

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

4. SCOPE OF THE INTERNSHIP

The total workload of Research work / Scientific research work (obtaining primary skills in scientific research work) is 3 credit units (108 academic hours).

5. CONTENT OF THE INTERNSHIP

*Table 5.1. Contents of practice**

Name of the practice section	Section content (topics, types of practical activities)	Labor intensity, ac.h.
Section 1. Organizational and preparatory	Receiving an individual assignment for practice from the supervisor	2
	Safety training at the workplace (in the laboratory and/or in production)	2
Section 2. Main	Collection of analytical data in accordance with individual assignment. Description of application processes and software.	50
	Analysis and processing of the received data	10
	Research and publication work	10
	Ongoing monitoring of the internship by the supervisor	10
	Keeping a diary of your internship	4
Preparation of the internship report		10
Preparation for defense and defense of the internship report		10
TOTAL:		108

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

6. MATERIALLY-TECHNICAL SUPPORT FOR CONDUCTING THE INTERNSHIP

The scientific and educational laboratories of the Department of Mechanics and Control Processes, the premises of partner enterprises where students undergo practical training, are equipped with a local network with Internet access, a projector and an interactive whiteboard.

7. METHOD OF CONDUCTING THE INTERNSHIP

Research work / Research work (obtaining primary skills in research work) can be carried out both in RUDN structural divisions or in Moscow organizations (stationary), and at bases located outside of Moscow (visiting).

Conducting an internship at an external organization (outside RUDN) is carried out on the basis of a relevant agreement, which specifies the terms, place and conditions for conducting the internship at the base organization.

The internship dates correspond to the period specified in the academic calendar of the EP VO. The internship dates may be adjusted upon agreement with the Educational Policy Department and the Department for the Organization of Internships and Assistance to Graduates' Employment at RUDN.

8. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT FOR PRACTICE

Main literature:

– Classical and modern methods of automatic control theory. Textbook in 5 volumes; 2nd edition, revised and enlarged / Ed. by K.A. Pupkov, N.D. Egupov. – Moscow: Publishing House of Bauman Moscow State Technical University, 2004.

– Pupkov K.A. Modeling and testing of automatic control systems. Tutorial. – M.: RUDN, 2014. – 98s.

– Egupov N.D., Kolesnikov L.V., Pupkov K.A., Trofimov A.I. / edited by Matveev V.A. Algorithmic theory of control systems based on spectral methods. Monograph in 2 volumes. – Moscow: Publishing house of Bauman Moscow State Technical University, 2014. – 464 pages. Volume 1 and – 464 pages. Volume 2.

Further reading:

Domestic journals: Automation and Remote Control; Sensors and Systems; News of Higher Educational Institutions. Instrument Making; News of Higher Educational Institutions. Applied Nonlinear Dynamics; News of Higher Educational Institutions. Power Engineering Problems; News of the Russian Academy of Sciences. Control Theory and Systems; Information Measuring and Control Systems; Information Technology; Mathematical Modeling; Mechatronics. Automation. Control; Nonlinear World; Review of Applied and Industrial Mathematics; Devices and Systems: "Control, Monitoring, Diagnostics"; Applied Mathematics and Mechanics; Forecasting Problems; Problems of Control Theory and Practice; Control Problems; Control Systems and Information Technology; Digital Signal Processing; Open Systems; Neurocomputers: Development, Application.

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

Resources of the information and telecommunications network "Internet":

1) Electronic library system (ELS) of RUDN and third-party ELS, to which the university students have access on the basis of concluded agreements:

- EBS RUDN <http://lib.rudn.ru/MegaPro/Web>
- Electronic library system "University Library Online" <http://www.biblioclub.ru>
- EBS "Yurait" <http://www.biblio-online.ru>
- Electronic Library System "Student Consultant" www.studentlibrary.ru
- EBS "Lan" <http://e.lanbook.com/>
- EBS "Troitsky Bridge"

2) Databases and search engines:

- electronic fund of legal and normative-technical documentation <http://docs.cntd.ru/>

- Yandex search engine <https://www.yandex.ru/>
- Google search engine <https://www.google.ru/>
- SCOPUS abstract database <http://www.elsevierscience.ru/products/scopus/>

Educational-methodological materials for completing the internship, filling out the diary and preparing the internship report:*

- 1) Rules for safe working conditions and fire safety during Research work / Research work (obtaining primary skills in research work) (primary instruction).
 - 2) General structure and operating principle of technological production equipment used by students during their internship; process maps and regulations, etc. (if necessary).
 - 3) Methodological instructions for students to fill out a diary and prepare a practice report.
- * - all educational and methodological materials for completing the internship are posted in accordance with the current procedure on the internship page in TUIS

9. EVALUATION MATERIALS AND SCORE-RATING SYSTEM FOR ASSESSING THE LEVEL OF COMPETENCE DEVELOPMENT BASED ON THE RESULTS OF PRACTICE

Assessment materials and a scoring and rating system* for assessing the level of development of competencies (part of competencies) based on the results of passing Research work / Research work (acquiring primary skills in 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 (regulations/procedures).

DEVELOPERS:

**Associate Professor of the Department
of Mechanics and Control Processes**

Position, Department

Signature

Saltykova O.A.

Surname I.O.

HEAD OF THE DEPARTMENT:

**Head of the Department of Mechanics
and Control Processes**

Name of the Department

Signature

Razumny Yu.N.

Surname I.O.

HEAD OF THE EP HE:

**Head of the Department of Mechanics
and Control Processes**

Position, Department

Signature

Razumny Yu.N.

Surname I.O.