(name of the main educational unit (PMU) - the developer of the EP HE)

INTERNSHIP PROGRAM

Technological Practice

(name of the internship)

Internship

(type of practice: educational, industrial)

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

27.03.04 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 Engineering and Space Systems Control

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

1. PURPOSE OF THE INTERNSHIP

The purpose of the Technological Practice is to deepen, systematize and consolidate theoretical knowledge, as well as to obtain professional skills and abilities in the field of scientific research in solving practical problems related to the field of information technology, computer technology and modern programming technologies, cybersecurity of information systems, as well as in the field of application of these tools with a professional focus on the study of processes management in information systems and information protection.

The objectives of the practice are:

training in the organization and planning of production and technological activities;

- training in the collection, processing, analysis and systematization of world-class scientific and technical information, including in foreign languages;

- gaining experience in using standard professional software products focused on solving design, technological and scientific problems;

- gaining experience of active interaction with colleagues in the production and technological field of activity;

- preparation of scientific and technical reports, reviews 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

Technological practice 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	He is able to search, critically analyze and synthesize information, apply a systematic approach to solving problems.	 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. Works with scientific texts, distinguishes facts from opinions, interpretations, evaluations and substantiates his/her conclusions using the philosophical conceptual apparatus; GC-1.5. Analyzes and contextually processes information to solve problems with the formation of their own opinions and judgments; GC-1.6. Offers options for solving the problem, analyzes the possible consequences of their use; GC-1.7. Analyzes the ways of solving the problems of the worldview, moral and personal character based on the use of basic philosophical ideas and categories in their historical development and socio-cultural context.

Cipher	Competence	Indicators of Competency Achievement (within the framework of this discipline)	
GC-2	Is able to determine the range of tasks within the framework of the goal and choose the best ways to solve them, based on the current legal norms, available resources and restrictions	GC-2.1. Formulates a problem, the solution of which is directly related to the achievement of the project goal;	
GC-3	Able to carry out social interaction and fulfill his role in a team		
GC-6	Able to manage their time, build and implement a trajectory of self- development based on the principles of lifelong learning	GC-6.1. Controls the amount of time spent on specific types of activities GC-6.2. Develops tools and methods for time management when performing specific tasks, projects, goals GC-6.3. Analyzes his resources and their limits (personal, situational, temporal, etc.) for the successful completion of the task. GC-6.4. Finds and uses sources of additional information to improve the level of general and professional knowledge GC-6.5. Analyzes the main opportunities and tools of continuing education in relation to one's own interests and needs, taking into account the conditions, means, personal capabilities, stages of career growth, time perspective for the development of activities and the requirements of the labor market GC-6.6. Defines the tasks of self-development, goals and priorities of professional growth GC-6.7. Distributes tasks into long-, medium- and short-term with justification of relevance and analysis of resources for their implementation	
GC-12	Is able to: search for the necessary sources of information and data, perceive, analyze, remember and transmit information using digital means, as well	GC-12.1. Searches for the necessary sources of information and data, perceives, analyzes, remembers and transmits 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	

Cipher	Competence	Indicators of Competency Achievement (within the framework of this discipline)	
	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	GC-12.2. Evaluates information, its reliability, builds logical conclusions on the basis of incoming information and data	
GPC-1	information and dataIs able to analyze the tasks ofprofessional activity on thebasis of provisions, laws andmethods in the field ofnaturalsciencesandmathematics	GPC-1.1Has basic knowledge gained in the field of mathematical and (or) natural sciencesGPC-1.2Knows how to use them in professional activitiesGPC-1.3Has the skills to choose methods for solving problems of professional activity based on theoretical knowledge	
GPC-2	Is able to formulate the tasks of professional activity on the basis of knowledge, profile sections of mathematical and natural science disciplines (modules)	 GPC-2.1 Possesses mathematical methods, basics of programming and specialized programming systems for the implementation of algorithms for solving applied problems GPC-2.2 Is able to select and adapt mathematical methods and software to solving practical problems GPC-2.3 Possesses the skills of developing and implementing algorithms for solving applied problems in the field of professional activity 	
GPC-3	Able to use fundamental knowledge to solve basic management problems in technical systems in order to improve professional activities	GPC-3.1 Knows the theoretical foundations and principles of mathematical modeling GPC-3.2 Knows how to develop and use methods of mathematical modeling, information technology to solve problems of applied mathematics GPC-3.3 Possesses practical skills in solving problems of applied mathematics, methods of mathematical modeling, information technologies and the basics of their use in professional activities, skills of professional thinking and an arsenal of methods and approaches necessary for the adequate use of modern mathematics methods in theoretical and applied problems	
GPC-4	Able to assess the effectiveness of management systems developed on the basis of mathematical methods	GPC-4.1 Knows the basic requirements of information security, existing information and communication technologies GPC-4.2 Is able to solve the problems of professional activity using information and communication technologies and taking into account the basic requirements of information security GPC-4.3 Possesses the skills of using existing information technologies to solve the problems of professional activity	
GPC-5	Able to solve the problems of the development of science, engineering and technology	GPC-5.1 Knows the theoretical foundations of digital technologies, the basics of modeling objects of professional activity, the basics of data analysis and	

Cipher	Competence	Indicators of Competency Achievement (within the framework of this discipline)	
	in the field of management in technical systems, taking into account the legal regulation in the field of intellectual property	information presentation GPC-5.2 Is able to solve problems of professional activity using existing methods of modeling, data analysis, and information presentation GPC-5.3 Possesses the skills of developing algorithms and computer programs suitable for practical application	
GPC-9	Is able to perform experiments according to specified methods and process the results using modern information technologies and technical means.	 GPC-9.1 Knows modern information technologies and technical means GPC-9.2 Knows how to use modern information technologies and technical means to process the results of experiments GPC-9.3 Possesses modern information technologies and technical means for performing experiments and processing the results 	
GPC-10	Able to develop (on the basis of current standards) technical documentation (including in electronic form) for routine maintenance of systems and means of control, automation and management	GPC-10.1 Knows the current standards for the development of technical documentation for routine maintenance of systems and means of control, automation and management GPC-10.2 Knows the basic approaches to the development of technical documentation (including in electronic form) for routine maintenance of systems and means of control, automation and management GPC-10.3 Possesses the skills to develop (based on current standards) technical documentation (including in electronic form) for routine maintenance of systems and means of control, automation and management GPC-10.3 Possesses the skills to develop (based on current standards) technical documentation (including in electronic form) for routine maintenance of systems and means of control, automation and management	
GPC-11	Able to understand the principles of modern information technology and use them to solve professional problems	 GPC-11.1 Knows digital methods and technologies used in professional activities GPC-11.2 Is able to apply digital methods and technologies in professional activities to study and model objects of professional activity, analyze data, and present information GPC-11.3 Confidently owns digital methods and technologies in professional activities (in the field of management in technical systems) for: studying and modeling objects of professional activity, data analysis, presenting information 	
PC-1	Able to collect, process and interpret modern scientific research data necessary to form conclusions on relevant scientific research, including Earth remote sensing data	PC-1.1Knows modern methods of how to collect, process and interpret modern scientific research data necessary to form conclusions from relevant scientific researchPC-1.2Knows how to apply modern methods and means for processing and interpreting research dataPC-1.3 Possesses the basic skills of collecting, processing and interpreting data from modern scientific research necessary to form conclusions on relevant scientific research	
PC-3	He is able to carry out work on the processing and analysis of information in the	PC-3.1 Knows the basic concepts in the field of application of mathematical methods and information technologies and the application of space remote sensing	

Cipher	Competence	Indicators of Competency Achievement
	-	(within the framework of this discipline)
	field of the application of mathematical methods and information technologies in the field of the application of remote sensing data from space	systems PP-3.2 He is able to solve problems of an analytical nature, offering a choice from a variety of relevant ways of solving problems, has skills in working in software packages of geographic information systems PP-3.3 Possesses practical skills in solving problems related to the acquisition, processing and application of remote sensing data from space
PP-4	Able to formulate, analyze, and solve engineering problems in ballistics, propulsion mechanics, and spacecraft motion control based on professional knowledge	PP-4.1 Knows the basic concepts and basic algorithms for solving problems in the field of ballistics, motion mechanics and motion control based on automated and automatic systems PC-4.2 Is able to solve engineering problems of an analytical nature in the field of ballistics, mechanics of motion and control of the movement of spacecraft on the basis of professional knowledge PP-4.3 Possesses the skills of using mathematical methods for processing information obtained as a result of experimental research, basic methods for analyzing the mechanics of motion and controlling the movement of spacecraft based on standard methods and software packages
PP-4	Able to develop, debug, test performance, modify software; apply methods and tools of software design, develop and coordinate software documentation for software	 PP-5.1 Knows existing system and application software, methods of design and development of software, structures and databases, program interfaces. Knows the regulatory and technical documentation for the development of software documentation PP-5.2 Is able to apply methods and tools for designing software, data structures, databases, program interfaces. Knows how to analyze regulatory and technical documentation for the development of software documentation PP-5.3 Possesses the basic skills of technologies for the development, debugging, performance testing and modification of system application software, modernization of technical solutions for software development

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

Technological practice refers to the variable component <u>of the mandatory part of block 2</u> <u>of the curriculum</u>.

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 technological practice.

Cipher	Competency Name	Previous Disciplines/Modules, Practices*	Subsequent disciplines/modules, practices*
GC-1	He is able to search, critically analyze and synthesize information, apply a systematic approach to solving problems.	History of Russia / История России Philosophy / Философия Jurisprudence / Правоведение Name Research Work	Undergraduate Training / Pre- Diploma Practice State Final Certification
GC-2	Is able to determine the range of tasks within the framework of the goal and choose the best ways to solve them, based on the current legal norms, available resources and restrictions	Jurisprudence / Правоведение Research Work Technological Training	Undergraduate Training / Pre- Diploma Practice State Final Certification
GC-3	Able to carry out social interaction and fulfill his role in a team	Second Foreign Language (practical course) Business Communications Culture of Scientific and Business Speech Research Work	Undergraduate Training / Pre- Diploma Practice State Final Certification
GC-6	Able to manage their time, build and implement a trajectory of self- development based on the principles of lifelong learning	Physical Culture Research Work	Undergraduate Training / Pre- Diploma Practice State Final Certification
GC-12	Is able 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	Computer Science and Programming Analysis of Geoinformation Data Automatic Control Theory Optimal Control Methods Fundamentals of information security and cyber resilience Fundamentals of Information Security and Cyber Resilience Research Work	Undergraduate Training / Pre- Diploma Practice State Final Certification

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*
GPC-1	Is able to analyze the tasks of professional activity on the basis of provisions, laws and methods in the field of natural sciences and mathematics	Algebra and Geometry Mathematical Analysis Physics / Физика Theory of Probability and Mathematical Statistics Differential Equations Complex Analysis Equations of Mathematical Physics Theoretical Mechanics Space Flight Mechanics Research Work	Undergraduate Training / Pre- Diploma Practice State Final Certification
GPC-2	Is able to formulate the tasks of professional activity on the basis of knowledge, profile sections of mathematical and natural science disciplines (modules)	Algebra and Geometry Mathematical Analysis Theory of Probability and Mathematical Statistics Differential Equations Complex Analysis Equations of Mathematical Physics Computer Science and Programming Space Flight Mechanics Analysis of Geoinformation Data Numerical Methods Automatic Control Theory Research Work	Undergraduate Training / Pre- Diploma Practice State Final Certification
GPC-3	Able to use fundamental knowledge to solve basic management problems in technical systems in order to improve professional activities	Algebra and Geometry Mathematical Analysis Theory of Probability and Mathematical Statistics Differential Equations Complex Analysis Equations of Mathematical Physics Theoretical Mechanics Space Flight Mechanics Analysis of Geoinformation Data Numerical Methods Automatic Control Theory Optimal Control Methods	Undergraduate Training / Pre- Diploma Practice State Final Certification

Cipher	Competency Name	Previous Disciplines/Modules, Practices*	Subsequent disciplines/modules, practices*
GPC-4	Able to assess the effectiveness of management systems developed on the basis of mathematical methods	Analysis of Geoinformation Data Research Work	Undergraduate Training / Pre- Diploma Practice State Final Certification
GPC-5	Able to solve the problems of the development of science, engineering and technology in the field of management in technical systems, taking into account the legal regulation in the field of intellectual property	Theoretical Mechanics Analysis of Geoinformation Data Automatic Control Theory Research Work	Undergraduate Training / Pre- Diploma Practice State Final Certification
GPC-9	Is able to perform experiments according to specified methods and process the results using modern information technologies and technical means.	Computer Science and Programming Analysis of Geoinformation Data Optimal Control Methods	Undergraduate Training / Pre- Diploma Practice State Final Certification
GPC-10	Able to develop (on the basis of current standards) technical documentation (including in electronic form) for routine maintenance of systems and means of control, automation and management	Automatic Control Theory	Undergraduate Training / Pre- Diploma Practice State Final Certification
GPC-11	Able to understand the principles of modern information technology and use them to solve professional problems	Computer Science and Programming Space Flight Mechanics Optimal Control Methods	Undergraduate Training / Pre- Diploma Practice State Final Certification
PC-1	Able to collect, process and interpret modern scientific research data necessary to form conclusions on relevant scientific research, including Earth remote sensing data	Computer Science and Programming Computer Science and Programming Space Flight Mechanics Analysis of Geoinformation Data Numerical Methods Automatic Control Theory Optimal Control Methods Discrete Mathematics Discrete Mathematics	Undergraduate Training / Pre- Diploma Practice State Final Certification

Cipher	Competency Name	Previous Disciplines/Modules, Practices*	Subsequent disciplines/modules, practices*
		Virtual and Augmented Reality Technology Virtual and augmented reality technologies Research Work	
PC-3	He is able to carry out work on the processing and analysis of information in the field of the application of mathematical methods and information technologies in the field of the application of remote sensing data from space	Analysis of Geoinformation Data Research Work Technological Training	Undergraduate Training / Pre- Diploma Practice State Final Certification
PP-4	Able to formulate, analyze, and solve engineering problems in ballistics, propulsion mechanics, and spacecraft motion control based on professional knowledge	Theoretical Mechanics Space Flight Mechanics Optimal Control Methods Research Work	Undergraduate Training / Pre- Diploma Practice State Final Certification
PP-5	Able to develop, debug, test performance, modify software; apply methods and tools of software design, develop and coordinate software documentation for software	Computer Science and Programming Analysis of Geoinformation Data Fundamentals of information security and cyber resilience Fundamentals of Information Security and Cyber Resilience Virtual and Augmented Reality Technology Virtual and augmented reality technologies Research Work	Undergraduate Training / Pre- Diploma Practice 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 Technological Practice is 6 credits (216 academic hours).

5. CONTENT OF THE INTERNSHIP

6. Table 5.1. Internship content*

Name of the practice	Content of the section (topics, types of practical	Labor intensity,
section	activities)	ac.p.
Section 1. Organizational	Receiving an individual assignment for practice from the supervisor	9
and preparatory.	Safety briefing in the workplace (in the laboratory and/or in production)	9
	Introductory lecture	4
	Tour of the enterprise	10
	Lectures on the spacecraft control loop	10
	Practical seminar – analysis of the spacecraft control process	10
Section 2. Research	Computational and graphic part: analysis of individual initial data for calculation, selection and analysis of literature, performance of calculation work	124
	Current control of the internship by the supervisor	14
	Keeping an internship diary	8
Preparation of an internship	9	
Preparation for defense and	9	
	ALTOGETHER:	216

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

7. 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.

8. METHOD OF PRACTICE

Technological practice 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.

9. EDUCATIONAL, METHODOLOGICAL AND INFORMATION SUPPORT OF PRACTICE

Reference citations:

1. Knut Donald E. Iskusstvo premirovanie v 3-kh tomakh [The Art of Programming in 3 Volumes]. Williams House, 2008. - T.1 - 720, T.2 - 832 p., T.3 - 824 p.

2. Aho Alfred V., Hopcroft John, Ullman Jeffrey D., Data Structures and Algorithms - Moscow: Izd. Williams House, 2000. – 384 p.

3. MalyGC A.A., Pazizin S.V., Pogozhin N.S. Introduction to Information Protection in Automated Systems – Moscow: Hot Line-Telecom, 2001, 148 p.

4. Belov E.B., Los V.P., Meshcheryakov R.V., Shelupanov A.A. Osnovy informatsionnoy bezopasnosti [Fundamentals of information security]. Textbook for Higher Educational Institutions, Moscow: Goryachaya liniya – Telekom, 2006. - 544 p.

5. Tikhonov V.A., Raikh V.V. Informatsionnaya bezopasnost': kontseptual'nye, pravovye, organizatsionnye i tekhnicheskie aspekty [Information Security: Conceptual, Legal, Organizational and Technical Aspects]. allowance. – Moscow: Gelios ARV, 2006.- 528 p.

6. Shangin V.F. Informatsionnaya bezopasnost' komp'yuternykh sistem i seti [Information security of computer systems and networks]. Manual .- M.: ID "FORUM": INFRA-M, 2008.-416 p.

7. Moore T., Pym D., Ioannidis C., Economics of Information Security and Privacy, Springer, 2010, - 320 p.

8. Ensuring the information security of business, Ed. Kurilo A.P., Alpina Publishers, 2011, - 392 p.

9. Bondarev V.V. Introduction to Information Security of Automated Systems (2nd Edition). Moscow: BMSTU. 2018. – 252 p.

10. Organizational and legal support of information security. edited by A.A. Aleksandrov, M.P. Sychev – Moscow: BMSTU. 2018. – 292 p.

11. MalyGC A.A. Osnovy politiki bezopasnosti kriticheskikh sistem informatsionnoy infrastrGCtury [Fundamentals of security policy of critical systems of information infrastructure]. – Moscow: Hot Line – Telecom, 2018. – 314 p.

Further reading:

1. Torokin A.A. Fundamentals of engineering and technical protection of information. – Moscow: Oc'-89, 1998.-336 p.

2. Devyanin P.N., Mikhalsky O.O., Pravikov D.I., Shcherbakov A.Yu., Theoretical Foundations of Computer Security, Moscow: Radio and Communication, 2000. - 192 p.

3. Pyarin V.A., Kuzmin A.S., Smirnov S.N. Bezopasnost' elektronnogo biznesa [Security of electronic business]. Moscow, Gelios ARB Publ., 2002. – 432 p.

4. Snytnikov A.A. Licensing and certification in the field of information protection. – Moscow: Gelios ARV, 2003.- 192 p.

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" <u>http://www.biblioclub.ru</u>
- EBS Yurayt <u>http://www.biblio-online.ru</u>
- EBS "Student Consultant" <u>www.studentlibrary.ru</u>
- EBS "Lan" <u>http://e.lanbook.com/</u>
- EBS "Troitsky Bridge"
 - <u>www.cbr.ru</u>
 - <u>http://www.bsi.bund.de/gshb/english/menue.htm</u>
 - (http://www.bsi.bund.de/english/gshb/index.htm)
 - <u>http://www.cacr.math.uwaterloo.ca/hac/</u>, <u>http://www.schneier.com/solitaire.html</u>,
 - <u>http://www.nist.gov/</u>

- <u>http://cbr.ru/credit/Gubzi_docs/</u>
- <u>https://www.bsi-fuer-</u>
 <u>buerger.de/cln_174/EN/Topics/ITGrundschutz/ITGrundschutzCatalogues/itgrundschutzcat</u>
 <u>alogues_node.html</u>
- <u>www.kremlin.ru</u>, <u>www.fsb.ru</u>, <u>www.fstec.ru</u>.
- http://csrc.nist.gov/groups/SMA/prisma/index.html

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/

Software:

1. Specialized software for practicing and generating reporting documentation for students:

- PRIZMA package, developed by the American Standards Institute NIST.

- Python programming language and development environment (freely distributed under the Python Software Foundation License);

- Borland Developer Studio 2006 (License Certificate Number: 33080, 33081, 33082)

- MATLAB

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 the Technological Practice (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

10. 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 the Technological Internship 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

Position

Signature

Surname I.O.

Saltykova O.A.

Associate Professor of the		
Department of Mechanics and		Varfolomeev A.A.
Control Processes		
Position	Signature	Surname I.O.
HEAD OF THE BUP:		
Head of the Department of		Dommy Vu N
Mechanics and Control Processes		Razumny Yu.N.
Name of Dep	Signature	Surname I.O.
HEAD OF THE DEPARTMENT OF	HIGHER EDUCA	ATION:
Professor of the Department of		Razumny Yu.N.
		IXuZuIIIIY I u.IV.

Mechanics and Control Processes

Position

Signature

Surname I.O.