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

Engineering Academy
(name of the main educational unit (POU) - developer of the EP HE)

DISCIPLINE WORK PROGRAM

ENGINEERING SYSTEMS DESIGN
(name of discipline/module)

Recommended by MSSN for the following areas of training/specialty:

01.04.02 APPLIED MATHEMATICS AND INFORMATION SCIENCE
(code and name of the area of training/specialty)

The discipline is mastered as part of the implementation of the main professional educational program of higher education (OP HE):

BALLISTIC DESIGN OF SPACE COMPLEXES AND SYSTEMS
(name (profile/specialization) EP HE)

2024G.

1. GOAL OF DISCIPLINE MASTERING

The discipline "Systems Engineering" is included in the master's program "Ballistic design of space complexes and systems" in the direction of 01.04.02 "Applied mathematics and computer science" and is studied in the 1st semester of the 1st year. The discipline is implemented by the Department of the Partner University. The discipline consists of 3 sections and 12 topics and is aimed at studying the fundamental principles of integrated systems design from a holistic perspective; analysis of the basic methods for solving typical problems and familiarization with the scope of their application in professional activities. The discipline involves viewing the system problem space in its entirety from the initial concept throughout the lifecycle to retirement.

The goal of mastering the discipline is the formation of fundamental knowledge and skills in applying problem solving methods necessary for professional activities, increasing the overall level of student literacy on basic system and systems engineering concepts and terms; introduce systems engineering as a problem solving process / approach, project decision support, and its relationship to program life cycle.

2. REQUIREMENTS FOR THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline “Design of engineering systems” is aimed at developing the following competencies (parts of competencies) in students:

Table 2.1. List of competencies formed in students when mastering the discipline (results of mastering the discipline)

Cipher	Competence	Indicators of Competency Achievement (within this discipline)
UK-2	Able to manage a project at all stages of its life cycle	UK-2.1 Formulates a problem, the solution of which is directly related to achieving the project goal;; UK-2.2 Determines the connections between the assigned tasks and the expected results of their solution;; UK-2.3 Within the framework of the assigned tasks, determines the available resources and limitations, current legal norms;; UK-2.4 Analyzes the project implementation schedule as a whole and selects the optimal way to solve the assigned tasks, based on current legal norms and available resources and limitations;; UK-2.5 Monitors the progress of the project, adjusts the schedule in accordance with the results of control.;
PC-1	Able to formulate goals and objectives of scientific research in the field of applied mathematics and computer science, computer technology and modern programming technologies, select methods and means for solving problems	PC-1.1 Has fundamental knowledge acquired in the field of mathematical and (or) natural sciences, programming and information technology;; PC-1.2 Can find, formulate and solve standard problems in their own research activities in the field of applied mathematics and computer science, computer technology and modern programming technologies;; PC-1.3 Has practical experience in research activities in the field of applied mathematics and computer science, computer technology and modern programming technologies.;
PK-3	Capable of participating in scientific research and development of design solutions in the field of ballistics, dynamics and spacecraft flight control	PC-3.1 Knows basic mathematical methods and modern tools in the field of ballistic design of space complexes and systems;; PC-3.2 Has basic knowledge of standards, norms and rules for the development of design solutions in the field of ballistics, dynamics and spacecraft flight control;; PC-3.3 Able to apply mathematical methods and modern information technologies when conducting scientific research and developing design solutions in the field of ballistics, dynamics and spacecraft flight control.;

Cipher	Competence	Indicators of Competency Achievement (within this discipline)
PK-5	Able to analyze, including in English, methods for studying ballistic and dynamic characteristics when modeling spacecraft flight trajectories	PC-5.1 Knows proven and applied techniques, including from English-language sources, for studying ballistic and dynamic characteristics when modeling spacecraft flight trajectories;; PC-5.2 Able to develop and modernize methods for studying ballistic and dynamic characteristics when modeling spacecraft flight trajectories;; PC-5.3 Proficient in methods and approaches to the study of ballistic and dynamic characteristics when modeling spacecraft flight trajectories;

3. PLACE OF DISCIPLINE IN THE STRUCTURE OF HE EP

Discipline "Design of engineering systems" refers to the part formed by the participants in educational relations of block 1 “Disciplines (modules)” of the educational program of higher education.

As part of the educational program of higher education, students also master other disciplines and/or practices that contribute to achieving the planned results of mastering the discipline “Design of Engineering Systems”.

Table 3.1. List of components of EP HE that contribute to achieving the planned results of mastering the discipline

Cipher	Name of competency	Previous disciplines/modules, practices*	Subsequent disciplines/modules, practices*
UK-2	Able to manage a project at all stages of its life cycle		Practical Training in Receiving Remote Sensing Data from Satellites and its Interpretation (online from RUDN Mission Control Center) / Research; Pre-Graduation Internship in Industry; Aerospace Systems; System Design; Dynamics and Control of Space Systems; Project "Drone Systems Engineering. Part 1"; Project "Drone Systems Engineering. Part 2";
PC-1	Able to formulate goals and objectives of scientific research in the field of applied mathematics and computer science, computer technology and modern programming technologies, select methods and means for solving problems		Pre-Graduation Internship in Industry; Practical Training in Receiving Remote Sensing Data from Satellites and its Interpretation (online from RUDN Mission Control Center) / Research; Practical Training and Research in Dynamics and Control of Space Systems (online from RUDN Mission Control Center) / Research work; Technological Training;

Cipher	Name of competency	Previous disciplines/modules, practices*	Subsequent disciplines/modules, practices*
			Advanced Methods of Remote Sensing and Geoinformation Systems; System Design; Dynamics and Control of Space Systems;
PK-3	Capable of participating in scientific research and development of design solutions in the field of ballistics, dynamics and spacecraft flight control		Pre-Graduation Internship in Industry; Practical Training in Receiving Remote Sensing Data from Satellites and its Interpretation (online from RUDN Mission Control Center) / Research; Practical Training and Research in Dynamics and Control of Space Systems (online from RUDN Mission Control Center) / Research work; Technological Training; Aerospace Systems; Structures & Materials Modeling; System Design; On-board Energy; Dynamics and Control of Space Systems; Project "Drone Systems Engineering. Part 1"; Project "Drone Systems Engineering. Part 2";
PK-5	Able to analyze, including in English, methods for studying ballistic and dynamic characteristics when modeling spacecraft flight trajectories		Pre-Graduation Internship in Industry; Practical Training in Receiving Remote Sensing Data from Satellites and its Interpretation (online from RUDN Mission Control Center) / Research; Practical Training and Research in Dynamics and Control of Space Systems (online from RUDN Mission Control Center) / Research work; Technological Training; Aerospace Systems; Structures & Materials Modeling; System Design; On-board Energy; Dynamics and Control of Space Systems; Advanced Methods of Remote Sensing and Geoinformation Systems;

* - to be filled out in accordance with the competency matrix and SUP EP VO
** - elective disciplines/practices

4. SCOPE OF DISCIPLINE AND TYPES OF STUDY WORK

The total labor intensity of the "Systems Engineering" discipline is "6" credit units.

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

Type of educational work	**TOTAL,**ac.ch.		**Semester(s)**
			1
Contact work, ac.ch.	*20*		*20*
Lectures (LK)	10		10
Laboratory work (LR)	0		0
Practical/seminar sessions (SZ)	10		10
Independent work of students, ac.ch.	*160*		*160*
Control (exam/test with assessment), academic degree.	*36*		*36*
Total labor intensity of the discipline	**ac.ch.**	***216***	*216*
	credit units	***6***	*6*

5. CONTENT OF DISCIPLINE

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

Section number	Name of the discipline section	Contents of the section (topic)		Type of educational work*
Section 1	Introduction to Systems Engineering	1.1	Systems Engineering Overview	LC, NW
		1.2	Life Cycle Stages	LC, NW
		1.3	Decision Making and Risk Assessment in Design and Model-Based System Engineering	LC, NW
Section 2	System Engineering Technical Processes: Down the Systems Vee	2.1	Business and Mission Analysis Process	LC, NW
		2.2	Stakeholder Needs and Requirements Definition Process	LC, NW
		2.3	Architecture Definition Process	LC, NW
		2.4	Interface Design and Definition	LC, NW
		2.5	System Definition Process	LC, NW
Section 3	System Engineering Technical Processes: Up the Systems Vee	3.1	Design Definition Process	LC, NW
		3.2	System Analysis Process and Implementation Process	LC, NW
		3.3	Integration, Verification, Transition, and Validation Processes	LC, NW
		3.4	Operation, Maintenance, Disposal Process, Tailoring SE Processes	LC, NW

* - to be filled out only for full-time education: LC – lectures; LR – laboratory work; SZ – practical/seminar classes.

6. MATERIAL AND TECHNICAL SUPPORT OF DISCIPLINE

Table 6.1. Material and technical support of the discipline

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

* - the audience for independent work of students is MANDATORY!

7. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF DISCIPLINE

Main literature:

1. Donella Meadows, “Thinking in Systems: A Primer”, 2008. 240 pages.

2. Hammond and Keeney, "Smart Choices: A Practical Guide to Making Better Decisions", 2015. 256 pages.

Additional literature:

1. Janine Benyus, "Biomimicry: Innovation Inspired by Nature", 1997/2002. 308 pages

2. Peter Bernstein, “Against the Gods: The Remarkable Story of Risk”, 1998. 400 pages.

Resources of the information and telecommunications network “Internet”:

1. EBS of RUDN University and third-party EBS, to which university students have access based on concluded agreements

- Electronic library system of RUDN - EBS RUDN 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 “Trinity Bridge”

2. Databases and search engines

- electronic fund of legal and regulatory 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 and methodological materials for students’ independent work when mastering a discipline/module:*

1. A course of lectures on the discipline “Design of engineering systems”.

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

8. ASSESSMENT MATERIALS AND POINT-RATING SYSTEM FOR ASSESSING THE LEVEL OF COMPETENCIES FOR A DISCIPLINE

Evaluation materials and point-rating system* for assessing the level of development of competencies (parts of competencies) based on the results of mastering the discipline“Design of engineering systems” are presented in the Appendix to this Work Program of the discipline.

* - OM and BRS are formed on the basis of the requirements of the relevant local regulatory act of RUDN University.

DEVELOPERS:

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