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

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

COURSE SYLLABUS

VIRTUAL AND AUGMENTED REALITY TECHNOLOGY
(name of discipline/module)

Recommended by the Didactic Council for the Education Field of:

27.03.04 CONTROL IN TECHNICAL SYSTEMS
(code and name of the area of training/specialty)

The course instruction is implemented within the professional education programme of higher education:

DATA ENGINEERING AND SPACE SYSTEMS CONTROL
(name (profile/specialization) EP HE)

2024

1. GOAL OF DISCIPLINE MASTERING

The discipline "Virtual and Augmented Reality Technology" is included in the bachelor's program "Data Engineering and Space Systems Control" in the direction of 27.03.04 "Control in Technical Systems" and is studied in the 7th semester of the 4th year. The discipline is implemented by the Department of Mechanics and Control Processes. The discipline consists of 9 sections and 24 topics and is aimed at studying the fundamental principles of building virtual reality systems (virtual reality, VR), building augmented reality systems (augmented reality, AR), remote control, devices for virtual and augmented reality systems, generating three-dimensional models and images, combinations of real and artificial images, examples of applications of virtual reality systems, examples of applications of augmented reality systems, psychophysiological aspects of the human-machine interface in virtual and augmented reality systems, analysis of the main methods for solving typical problems and familiarization with the scope of their application in professional activities.

The goal of mastering the discipline is to develop fundamental knowledge and skills in applying problem-solving methods necessary for professional activities, increasing the overall level of students' literacy in virtual and augmented reality technologies.

2. REQUIREMENTS FOR THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline "Virtual and Augmented Reality Technology" 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)
PC-1	Capable of collecting, processing and interpreting modern scientific research data necessary to draw conclusions on relevant scientific research, including Earth remote sensing data	PC-1.1 Knows modern methods of how to collect, process and interpret modern scientific research data necessary to form conclusions on relevant scientific research; PC-1.2 Able to apply modern methods and tools for processing and interpreting scientific research data; PC-1.3 Possesses the basic skills of collecting, processing and interpreting modern scientific research data necessary to form conclusions on relevant scientific research;
PC-5	Able to develop, debug, test functionality, and modify software; apply software design methods and tools, develop and coordinate software documentation	PC-5.1 Knows existing system and application software, methods of design and development of software, structures and databases, software interfaces. Knows the regulatory and technical documentation for the development of software documentation; PC-5.2 Can apply methods and tools for designing software, data structures, databases, and software interfaces. Able to analyze regulatory and technical documentation to develop program documentation for software; PC-5.3 Possesses basic skills in technologies for development, debugging, performance testing and modification of system application software, modernization of technical solutions for software development;

3. PLACE OF DISCIPLINE IN THE STRUCTURE OF HE EP

Discipline "Virtual and Augmented Reality Technology" 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 "Virtual and Augmented Reality Technology".

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*
PC-1	Capable of collecting, processing and interpreting modern scientific research data necessary to draw conclusions on relevant scientific research, including Earth remote sensing data	Research work / Scientific research work; Technological Training; Space Flight Mechanics; Numerical Methods; Automatic Control Theory; Computer Science and Programming; Optimal Control Methods; *Discrete mathematics***; *Discrete Math***; Analysis of Geoinformation Data;	Technological Training; Undergraduate practice / Pre-graduate practice;
PC-5	Able to develop, debug, test functionality, and modify software; apply software design methods and tools, develop and coordinate software documentation	Research work / Scientific research work; Technological Training; Analysis of Geoinformation Data; *Fundamentals of information security and cyber resilience***; *Fundamentals of information security and cyber resilience***;	Technological Training; Undergraduate practice / Pre-graduate practice;

* - 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 "Virtual and Augmented Reality Technology" discipline is "3" 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)**
			7
Contact work, ac.ch.	*36*		*36*
Lectures (LC)	18		18
Laboratory work (LR)	18		18
Practical/seminar sessions (SZ)	0		0
Independent work of students, ac.ch.	*72*		*72*
Control (exam/test with assessment), academic degree.	*0*		*0*
Total labor intensity of the discipline	**ac.ch.**	***108***	*108*
	credit units	***3***	*3*

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	Principles of constructing virtual reality systems (virtual reality, VR)	1.1	Review of VDR systems.	LK, LR
		1.2	History of the development of VDR systems.	LK, LR
		1.3	Interaction between a human user and a reality model.	LK, LR
		1.4	Simulation of operations possible with real objects.	LK, LR
		1.5	Immersive perception of a model of reality.	LK, LR
Section 2	Principles of building augmented reality (AR) systems	2.1	Three-dimensional models of objects used to complement real scenes.	LK, LR
		2.2	Establishing a correspondence between the user's real space and the data of three-dimensional models.	LK, LR
		2.3	Tracking the user's position to determine his observation point in real space.	LK, LR
		2.4	Display real-time images of real scenes combined with computer graphics generated from the model.	LK, LR
Section 3	Remote control	3.1	Sensors, effectors, communication channels for virtual reality systems.	LK, LR
Section 4	Devices for virtual and augmented reality systems	4.1	Head display.	LK, LR
		4.2	Stereoscopic image output device.	LK, LR
		4.3	Audio input/output devices.	LK, LR
		4.4	Sensors for the spatial location of human body parts or tools.	LK, LR
		4.5	Input/output devices for tactile information.	LK, LR
		4.6	Motion information input/output devices.	LK, LR
Section 5	Generation of 3D models and images	5.1	Types of three-dimensional models. Rendering – creating images based on object models.	LK, LR
		5.2	Defining model surfaces. Calculation of pixel values of the generated image.	LK, LR
Section 6	Combination of real and artificial images	6.1	Texture mapping.	LK, LR
		6.2	Image-based rendering	LK, LR
Section 7	Examples of applications of virtual reality systems	7.1	Inspection of architectural structures. Flight simulation. Interactive segmentation of anatomical structures.	LK, LR
Section 8	Examples of applications of augmented reality systems	8.1	Augmented reality systems used in surgery. Inspection of printed circuit boards. Projecting a car dashboard onto the windshield.	LK, LR
Section 9	Psychophysiological aspects of human-machine interface in virtual and augmented reality systems	9.1	Providing an immersive experience of the virtual environment. The need for individual configuration of devices and parameters of virtual and augmented reality systems.	LK, LR
		9.2	Side effects of virtual and augmented reality systems on humans.	LK, LR

* - 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.	
Laboratory	An auditorium for conducting laboratory work, individual consultations, ongoing monitoring and intermediate certification, equipped with a set of specialized furniture and equipment.	
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. Smolin A.A., Zhdanov D.D., Potemin I.S., Mezhenin A.V., Bogatyrev V.A. Virtual, augmented and mixed reality systems Tutorial. – St. Petersburg: ITMO University. 2018. – 59 p.

2. Azuma, Ronald T. A Survey of Augmented Reality. Presence: Teleoperators and Virtual Environments 6, 4 (August 1997), pp. 355 - 385.

Additional literature:

1. Suvorov K. A. Virtual reality systems and their application //T-Comm-Telecommunications and Transport. – 2013. – No. 9.

2. E. S. Sitnikova, T. A. Kuteneva. Virtual and augmented reality: relationship between concepts,Sociology. – 2018, p. 298-302.

3. Viger I. Virtual reality in industry. – 2016. – No. 5 (65). –CONTROL ENGINEERING RUSSIA, p. 68-71.

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 University - EBS RUDN Universityhttp://lib.rudn.ru/MegaPro/Web
- EBS "University Library Online"http://www.biblioclub.ru
- EBS Lawhttp://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 documentationhttp://docs.cntd.ru/
- Yandex search enginehttps://www.yandex.ru/
- search systemGoogle https://www.google.ru/
- abstract databaseSCOPUS 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 “Virtual and Augmented Reality Technology”.

* - 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 “Virtual and Augmented Reality Technology” 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.

DEVELOPER:

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HEAD OF BUP:

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