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 (MEU) that developed the educational program of higher education)

WORKING PROGRAM OF THE DISCIPLINE

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

Recommended for the field of study/specialty:

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

The discipline is mastered within the framework of the implementation of the main professional educational program of higher education (EP HE):

DATA SCIENCE AND SPACE SYSTEMS
(name (profile/specialization) of the educational institution of higher education)

2025

1. THE GOAL OF MASTERING THE DISCIPLINE

The course "Virtual and Augmented Reality Technology" is part of the bachelor's degree program "Data Science and Space Systems" in the direction 27.03.04 "Control in Technical Systems" and is studied in the 7th semester of the 4th year. The course is implemented by the Department of Mechanics and Control Processes. The course consists of 9 sections and 24 topics and is aimed at studying the fundamental principles of building virtual reality systems (VR), building augmented reality systems (AR), remote control, devices for virtual and augmented reality systems, generation of three-dimensional models and images, combination of real and artificial images, examples of virtual reality system applications, examples of augmented reality system applications, 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 area of their application in professional activities.

The purpose of mastering the discipline is to develop fundamental knowledge and skills in applying methods for solving problems necessary for professional activities, and to increase the general level of literacy of students in virtual and augmented reality technologies.

2. REQUIREMENTS TO 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 developed in students while mastering the discipline (results of mastering the discipline)

Cipher	Competence	**Indicators of Competence Achievement** (within the framework of 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 collecting, processing and interpreting data from modern scientific research necessary for drawing 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 data from modern scientific research necessary for drawing conclusions on relevant scientific research;
PC-5	Able to develop, debug, test performance, modify software; apply software design methods and tools, develop and coordinate software documentation	PC-5.1 Knows existing system and application software, methods of designing and developing software, structures and databases, software interfaces. Knows regulatory and technical documentation for developing software documentation; PC-5.2 Can apply methods and tools for designing software, data structures, databases, and software interfaces. Can analyze regulatory and technical documentation for developing software documentation; PC-5.3 Possesses basic skills in technologies for development, debugging, testing the functionality and modification of system application software, and upgrading technical solutions for software development;

3. PLACE OF THE DISCIPLINE IN THE STRUCTURE OF THE EDUCATIONAL EDUCATIONAL EDUCATION

Discipline “Virtual and Augmented Reality Technology” refers to the part formed by the participants of educational relations of block 1 “Disciplines (modules)” of the educational program of higher education.

As part of the higher education program, students also master other disciplines and/or practices that contribute to the achievement of the planned results of mastering the discipline "Virtual and Augmented Reality Technology".

Table 3.1. List of components of the educational program of higher education that contribute to the achievement of the planned results of mastering the discipline

Cipher	**Name of competence**	**Previous courses/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 Mathematics***; Analysis of Geoinformation Data;	Technological Training; Undergraduate Training;
PC-5	Able to develop, debug, test performance, 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 Training;

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

** - elective disciplines/practices

4. SCOPE OF THE DISCIPLINE AND TYPES OF STUDY WORK

The total workload of the discipline “Virtual and Augmented Reality Technology” is “3” credit units.

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

Type of academic work	**TOTAL,**ac.h.		**Semester(s)**
			7
Contact work, academic hours	*36*		*36*
Lectures (LC)	18		18
Laboratory work (LW)	18		18
Practical/seminar classes (SC)	0		0
Independent work of students, academic hours	*72*		*72*
Control (exam/test with assessment), academic hours	*0*		*0*
General complexity of the discipline	**ac.h.**	***108***	*108*
	credit.ed.	***3***	*3*

5. CONTENT OF THE DISCIPLINE

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

Section number	Name of the discipline section	Section Contents (Topics)		Type of academic work*
Section 1	Principles of building virtual reality systems (VR)	1.1	Review of VDR systems.	LC, LW
		1.2	History of the development of VDR systems.	LC, LW
		1.3	Interaction between a human user and a reality model.	LC, LW
		1.4	Simulation of operations possible with real objects.	LC, LW
		1.5	Immersive perception of the model of reality.	LC, LW
Section 2	Principles of building augmented reality systems (AR)	2.1	Three-dimensional models of objects used to complement real scenes.	LC, LW
		2.2	Establishing a correspondence between the user's real space and the data of three-dimensional models.	LC, LW
		2.3	Tracking the user's position to determine his point of observation in real space.	LC, LW
		2.4	Real-time display of real-world scenes combined with computer graphics generated from the model.	LC, LW
Section 3	Remote control	3.1	Sensors, effectors, communication channels for virtual reality systems.	LC, LW
Section 4	Devices for virtual and augmented reality systems	4.1	Head-up display.	LC, LW
		4.2	Stereoscopic image output device.	LC, LW
		4.3	Audio input/output devices.	LC, LW
		4.4	Sensors for the spatial location of human body parts or instruments.	LC, LW
		4.5	Tactile input/output devices.	LC, LW
		4.6	Motion information input/output devices.	LC, LW
Section 5	Generation of 3D models and images	5.1	Types of 3D models. Rendering – creating images based on object models.	LC, LW
		5.2	Determination of model surfaces. Calculation of pixel values of the generated image.	LC, LW
Section 6	Combination of real and artificial images	6.1	Texture mapping.	LC, LW
		6.2	Image-based rendering.	LC, LW
Section 7	Examples of applications of virtual reality systems	7.1	Inspection of architectural structures. Flight simulation. Interactive segmentation of anatomical structures.	LC, LW
Section 8	Examples of applications of augmented reality systems	8.1	Augmented reality systems used in surgery. Control of printed circuit boards. Projecting a car dashboard onto the windshield.	LC, LW
Section 9	Psychophysiological aspects of human-machine interface in virtual and augmented reality systems	9.1	Providing immersive perception of the virtual environment. The need for individual configuration of devices and parameters of virtual and augmented reality systems.	LC, LW
		9.2	Side effects of virtual and augmented reality systems on humans.	LC, LW

* - filled in only for FULL-TIME education: LC – lectures; LW – laboratory work; SC – practical/seminar classes.

6. LOGISTIC AND TECHNICAL SUPPORT OF DISCIPLINE

Table 6.1. Material and technical support of the discipline

Audience type	Equipping the auditorium	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; a board (screen) and technical means for multimedia presentations.	
Computer class	A computer room for conducting classes, group and individual consultations, ongoing monitoring and midterm assessment, equipped with personal computers (15 units), a board (screen) and technical means for multimedia presentations.	
For independent work	A classroom for independent work of students (can be used for conducting seminars and consultations), equipped with a set of specialized furniture and computers with access to the Electronic Information System.	

* - the audience for independent work of students MUST be indicated!

7. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE

Main literature:

1. Smolin A.A., Zhdanov D.D., Potemin I.S., Mezhenin A.V., Bogatyrev V.A. Systems of virtual, augmented and mixed reality. 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.

Further reading:

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: the relationship between concepts,Sociology. – 2018, p. 298-302.

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

Resources of the information and telecommunications network "Internet":

1. RUDN University EBS and third-party EBSs to which university students have access on the basis of concluded agreements

- Electronic library system of RUDN - ELS RUDNhttp://lib.rudn.ru/MegaPro/Web
- Electronic library system "University library online"http://www.biblioclub.ru
- EBS Yuraithttp://www.biblio-online.ru
- Electronic Library System "Student Consultant" www.studentlibrary.ru
- Electronic library system "Troitsky Bridge"

2. Databases and search engines

- electronic fund of legal and normative-technical documentationhttp://docs.cntd.ru/
- Yandex search enginehttps://www.yandex.ru/
- search engineGoogle https://www.google.ru/

- abstract databaseSCOPUS http://www.elsevierscience.ru/products/scopus/

Educational and methodological materials for independent work of students in mastering a discipline/module:*

1. Lecture course on the subject “Virtual and Augmented Reality Technology”.

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

DEVELOPER:

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