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**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

DIFFERENTIAL EQUATIONS

(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)

1. THE GOAL OF MASTERING THE DISCIPLINE

The course "Differential Equations" is part of the bachelor's program "Data Science and Space Systems" in the direction 27.03.04 "Control in Technical Systems" and is studied in 3, 4 semesters of the 2nd year. The course is implemented by the Department of Mechanics and Control Processes. The course consists of 8 sections and 11 topics and is aimed at studying the foundations of the theory of differential equations, the main methods of analytical, approximate-analytical and numerical integration of differential equations and systems of differential equations, the main methods of stability analysis of solutions, examples of application of the theory and methods for solving differential equations in various applied problems.

The purpose of mastering the discipline is for students to study the theory of differential equations and master methods for solving them, and to improve the general level of mathematical culture of students.

2. REQUIREMENTS TO THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline "Differential Equations" 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)
GPC-3	Able to use fundamental knowledge to solve basic control problems in technical systems in order to improve in professional activities	GPC-3.1 Knows the theoretical foundations and principles of mathematical modeling; GPC-3.2 Able to develop and use methods of mathematical modeling, information technologies 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 methods of modern mathematics in theoretical and applied problems;
GPC-4	Capable of assessing the effectiveness of control 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 Able to solve professional tasks using information and communication technologies and taking into account the basic requirements of information security; GPC-4.3 Possesses the skills to use existing information technologies to solve problems of professional activity;

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

Discipline "Differential Equations" refers to the mandatory part 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 "Differential Equations".

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*
GPC-3	Able to use fundamental knowledge to solve basic control problems in technical systems in order to improve in professional activities	Mathematical analysis; Algebra and Geometry;	Research work / Scientific research work; Technological Training; Undergraduate Training; Space Flight Mechanics; Numerical Methods; Automatic Control Theory; Equations of mathematical physics; Optimal Control Methods; Analysis of Geoinformation Data;
GPC-4	Capable of assessing the effectiveness of control systems developed on the basis of mathematical methods		Analysis of Geoinformation Data; Research work / Scientific research work; 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 “Differential Equations” discipline is 7 credits.

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)	
			3	4
<i>Contact work, academic hours</i>	123		72	51
Lectures (LC)	53		36	17
Laboratory work (LW)	0		0	0
Practical/seminar classes (SC)	70		36	34
<i>Independent work of students, academic hours</i>	102		45	57
<i>Control (exam/test with assessment), academic hours</i>	27		27	0
General complexity of the discipline	ac.h.	252	144	108
	credit.ed.	7	4	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	First order differential equations	1.1	Integration of differential equations with separable variables and differential equations. Integration of homogeneous differential equations.	LC, SC
		1.2	Linear differential equations of the first order. Integration of linear differential equations.	LC, SC
		1.3	Equations not resolved with respect to the derivative. General method of introducing a parameter. Lagrange and Clairaut equations.	LC, SC
Section 2	Higher order equations and systems of equations	2.1	Integrable cases of high-order equations (equations that admit reduction of order).	LC, SC
		2.2	Solution of systems of differential equations by reducing them to higher-order equations	LC, SC
Section 3	Existence and uniqueness theorems	3.1	Lipschitz condition. Theorem of existence and uniqueness of the solution of the Cauchy problem in a bounded domain and in a strip	LC, SC
Section 4	Approximate-analytical and numerical methods for solving the Cauchy problem	4.1	Method of successive approximations. Method of power series. Method of small parameter. Numerical methods	LC, SC
Section 5	Boundary value problems.	5.1	Green's function method. Approximate-analytical methods of integrating boundary value problems.	LC, SC
Section 6	Elements of the qualitative theory of differential equations.	6.1	Singular points of linear autonomous dynamic systems of the 2nd order. Phase plane method.	LC, SC
Section 7	Stability of solutions of linear equations and systems.	7.1	The concept of stability of solutions. The Lyapunov and Chetaev theorem.	LC, SC
Section 8	First order partial differential equations	8.1	Nonlinear systems. First-order partial differential equations.	LC, SC

* - 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.	
Seminar	An auditorium for conducting seminar-type classes, group and individual consultations, ongoing monitoring and midterm assessment, equipped with a set of specialized furniture and technical means for multimedia presentations.	

Audience type	Equipping the auditorium	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
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. Filippov A.F. Introduction to the Theory of Differential Equations. - M.: Lenland, 2013
2. Filippov A.F. Collection of problems on differential equations. - M.: LibrLCom, 2012.
3. Krasnov M.L., Kiselev A.I., Makarenko G.I. Collection of problems on ordinary differential equations. - M.: LibrLCom, 2013

Further reading:

1. FedoryUC M.V. Ordinary differential equations. - M.: LibrLCom, 2012.
2. Elsgolts L.E. Differential equations. - M.: Publishing house LCI, 2013.
3. Stepanov V.V. Course of differential equations. - M.: LCI Publishing House, 2008.

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

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
- Electronic library system "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/>
- search engine Google <https://www.google.ru/>
- abstract database SCOPUS <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 "Differential equations".

* - 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:

Associate Professor		Demidov Alexander Sergeevich
<i>Position, Department</i>	<i>Signature</i>	<i>Surname I.O.</i>

**HEAD OF THE
DEPARTMENT:**

Head of Department		Razumny Yuri Nikolaevich
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