Federal state autonomous educational institution of higher education
«Peoples' Friendship University of Russia »

Faculty of science
Recommended by MSSN

Operative program of the subject

Methodology of scientific research

Recommended for academic field

01.06.01 «Mathematics and mechanics»

1. Aims and purposes of the subject

The main aim of the course «Methodology of scientific research» is to form a concept of the contemporary methodology of scientific research in the field of mathematics.

2. Position of the subject in the structure of the higher educational program:

The course «Methodology of scientific research» is an elective course of part 1 in the study plan.

Table № 1 names preceding and consequent subjects aimed at forming competences of the subject according to the competence matrix.

Table № 1

Preceding and consequent subjects aimed at forming competences 1. Цели и задачи дисциплины

№	Code and name of the competence	Preceding subjects	Consequent subjects
General professional competences			
	GPC-2 readiness to teaching activities in the main educational programs of higher education	-	-
Universal competences			
	UC-3 readiness to participate in the work of Russian and international research teams solving scientific and educational problems	-	-

3. Requirements to the result of studies:

Studying the course is

aimed at forming following competences: GPC-2, UC-3

As a result of studying the course the student must:

Know: The basics of the methodology of research in the field of mathematics.

Be able to: Account for the principles of methodology in his research in the field of mathematics.

Master: The basic skills of scientific research according to the principles of methodology.

Size of the course and types of studies

The course «Nonlinear partial differential equations» gives 5 credits.

Types of studies	Hours	Terms			
Class studies		1	2		
Including:	-	-	-	-	-
Lectures	40	20	20		
Practical studies (PS)	40	20	20		
Seminars (S)					

Laboratory work (LW)					
Home studies	100	68	32		
Total, hours	180	108	72		
credits	5	3	2		

5. Content of the subject

5.1. Content of the sections

Term 1

№	Name of the section	Contents
1.	Introductory remarks	What is history in general and that of mathematics in particular? Their boundlessness. General principles of investigating mathematic discoveries of the past. Historical evidence. Historian of the past and historian of the present. Possibility of history of contemporary mathematics. Necessity of history of mathematics. Difference between history of mathematics and history as such. History of mathematics as science from different viewpoints to the concept of science. Methodology of mathematics in the past and now.
2.	General review of the historical development of mathematics	Pre-Greek mathematics. Mathematics of ancient Greece. Mathematics as science in the ancient world. European mathematics in the Middle Age. Arab mathematics. Mathematics of the Renaissance and of the Modernity. Development of mathematics in the 18^{th} century. Mathematics of the 19^{th} century. Mathematics on the border of centuries. Mathematics in the early 20^{th} century.
3.	History of discovery of non-Euclidean geometry	Euclid's «Elements», the 5^{th} postulate, attempts to prove it. Works of Saccheri, Lambert, and Lagrange. Works of Lobachevsky, their similarity and principal difference with those of his predecessors: attempts of arguments from the opposite, assertion of "imaginary" geometry, solving some problems of analysis with its help. Brief sketch of Lobachevsky's geometry (repeating his own way). Works of Janos Bolyai and Gauss. Further history of non-Euclidean geometries. Works of F. Klein and others. Contemporary approaches to the construction of Lobachevsky's geometry.

Term 2

№	Name of the section	Contents
1.	History of solving quintic equations	Solving quadratic, cubic, and quartic equations. Attempts to construct a general formula for a solution of a quintic equation. Abel and Galois,

		the history of their discoveries. Permutations, Riemannian surfaces and groups. Complete solution of the problem. Significance of Abel's and Galois' discoveries for the further development of mathematics.
2.	History of foundations of mathematics	Brief sketch of history of discovery and foundations of calculus. Sketch of history of the construction of a real number. Different views on the concept of a real number. Dedekind, Peano, and others. Cantor and his set theory. Paradoxes, Russell's paradox. G. Frege. Leibniz, Hilbert and the program of foundation of mathematics. Discoveries of logics in the 20th century (Gödel's theorems, etc.) Axiomatic systems of set theory. Continuum hypothesis. Problems of foundations of mathematics. Attempts to solve these problems. Constructivism and traditional mathematics based on set theory.

5.2. Sections and types of studies

Term 1

№	Sections	Lect.	PS and LW			HS	Total
			PS/S	LW	In PhI		
1.	Introductory remarks	7	7			23	37
2.	General review of the historical development of mathematics	7	7			23	37
3.	History of discovery of non-Euclidean geometry	6	6			22	34
	Total:	20	20			68	108

Term 2

1.	History of solving quintic equations	10	10			16	36
2.	History of foundations of mathematics	10	10			16	36
	Total:	20	20			32	72

6. Laboratory work – none planned

7. Practical studies (seminars)

Term 1

Item №	Section №	Subject of practical studies (seminars)	Hours
1.	**1**	What is history in general and that of mathematics in particular? Their boundlessness. General principles of investigating	2

		mathematic discoveries of the past.	
2.	**1**	Possibility of history of contemporary mathematics. Necessity of history of mathematics. Difference between history of mathematics and history as such.	2
3.	**1**	History of mathematics as science from different viewpoints to the concept of science. Methodology of mathematics in the past and now.	3
4.	**2**	Pre-Greek mathematics. Mathematics of ancient Greece. Mathematics as science in the ancient world.	2
5.	**2**	European mathematics in the Middle Age. Arab mathematics. Mathematics of the Renaissance and of the Modernity. Development of mathematics in the 18th century.	2
6.	**2**	Mathematics of the 19th century. Mathematics on the border of centuries. Mathematics in the early 20th century.	3
7.	**3**	Euclid's «Elements», the 5th postulate, attempts to prove it. Works of Saccheri, Lambert, and Lagrange. Works of Lobachevsky, their similarity and principal difference with those of his predecessors: attempts of arguments from the opposite, assertion of "imaginary" geometry, solving some problems of analysis with its help.	3
8.	**3**	Brief sketch of Lobachevsky's geometry (repeating his own way). Works of Janos Bolyai and Gauss. Further history of non-Euclidean geometries. Works of F. Klein and others. Contemporary approaches to the construction of Lobachevsky's geometry.	3

Term 2

Item №	Section №	Subject of practical studies (seminars)	Hours
1.	**1**	Solving quadratic, cubic, and quartic equations.	3
2.	**1**	Attempts to construct a general formula for a solution of a quintic equation. Abel and Galois, the history of their discoveries.	3
3.	**1**	Permutations, Riemannian surfaces and groups. Complete solution of the problem. Significance of Abel's and Galois' discoveries for the further development of mathematics.	4
4.	**2**	Brief sketch of history of discovery and foundations of calculus. Sketch of history of the construction of a real number. Different views on the concept of a real number. Dedekind, Peano, and others.	3
5.	**2**	Cantor and his set theory. Paradoxes, Russel's paradox. G. Frege. Leibniz, Hilbert and the program of foundations of mathematics. Discoveries of logics in the 20th century (Gödel's theorems, etc.)	3
6.	**2**	Axiomatic systems of set theory. Continuum hypothesis. Problems of foundations of mathematics. Attempts to solve these problems. Constructivism and traditional mathematics based on set theory.	4

8. Technical equipment:

Rooms 495a, 398, 509 in RUDN study building, Ordzhonikidze str., 3; group rooms in RUDN study building, Ordzhonikidze str., 3 (2, 3, and 4th floors), computer classes, laboratories (rooms 510 and 424).

9. Informational equipment:

Only licensed software installed at RUDN is used:
- Microsoft Office program package;
- Multimedia equipment and personal computers;
- Full-text databases and resources accessible from RUDN net;
- RFBR electronic library http://www.rfbr.ru/rffi/ru/library

10. Textbooks and recommended literature and electronic sources:

***a) Main literature**:*

1. Matviyevskaya G.P. History of mathematics: lecture course. URSS. 2019. 208 p.
2. Serovaiskii S. Ya. History of mathematics: Evolution of mathematical ideas (books 1-2). URSS. 2019. 208 p.

b) Supplementary literature:

1. Lakatos I. Proofs and refutations. How theorems are proven. «LKI», 2010.

11. Methodical recommendations for students

At seminars, key ideas of basic text sources of the course are presented. Namely, a student chooses a key idea of the text under discussion, formulates in theses (1–1.5 pages) its understanding and assessment, then presents and defends this at the seminar. The theses are distributed among the participants of the seminar in advance.

An essay should be written on a topic approved by the teacher. Its volume should not exceed 15 thousand symbols including spaces. An essay may consist in translating a paper of a foreign author with its extensive critical assessment and analysis. The author and the text must be approved by the teacher.

An exam takes place in the end of the semester in the form of an essay on one of the topics suggested by the teacher. After an interview a final note is given. The note is determined by intermediary assessment with notes «excellent», «good», «satisfactory», «unsatisfactory» and in the ECTS system (A, B, C, E). The notes are based on the RUDN score rating system.

12. The fund of evaluation funds for conducting intermediate certification of students in the discipline (module)

Materials for assessing the level of development of educational material of the discipline "Methodology of scientific research " (evaluation materials), which include a list of competencies indicating the stages of their formation, a description of indicators and criteria for evaluating competencies at various stages of their formation, a description of assessment scales, standard control tasks or other materials necessary for evaluating knowledge, skills, skills and (or) experience of activities that characterize the stages of competence formation in the process of mastering the educational program, methodological materials defining the procedures for evaluating knowledge, skills, skills and (or) experience activities that characterize the stages of competence formation are fully developed and are available to students on the discipline page in the TUIS PFUR.

The program is compiled in accordance with the requirements of the ES HE PFUR.

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