The RUDN University

Faculty of Physics, Mathematics and Natural Sciences

THE WORKING PROGRAM OF THE DISCIPLINE

Non-Euclidean geometries and their applications

Direction of training / specialty

01.04.01 Mathematics

(указываются код и наименование направления подготовки/специальности)

Profile

"Functional Methods in Differential Equations and Interdisciplinary Research"

(наименование образовательной программы в соответствии с направленностью (профилем)

1. Aims and objectives of the discipline: "Non-Euclidean geometries and their applications" are among the special disciplines that broaden the professional horizons of the student-mathematics, contributing to his acquaintance with a number of both already classical and modern ideas that are in demand in many developing areas of mathematics , including, as a rule, in the one that is chosen by the student as his specialization.

The main goal of the course is to master the concepts, axioms and methods of classical non-Euclidean geometries.

2. Place of discipline in the structure of OOP:

The discipline "Non-Euclidean Geometries and Their Applications" refers to the discipline chosen by the student of block 1 of the curriculum.

Table 1 shows the previous and subsequent disciplines aimed at the formation of discipline competencies in accordance with the competence matrix.

Table № 1

Prior and subsequent disciplines aimed at the formation of competencies

	Code and name of competence	Preceding disciplines	Subsequent disciplines (groups of disciplines)
	Professional competence		
	PC. 1. Able to conduct scientific research and obtain new scientific and applied results independently and as part of a research team	Modern problems of mathematics and applied mathematics	Undergraduate practice, NIR, State exam

3. Requirements for the results of mastering the discipline:

As a result of studying the discipline, the student must:

Know: axioms and basic concepts of non-Euclidean geometries of Lobachevsky and Galileo, as well as spherical geometry.

Be able to: prove basic theorems, as well as solve problems in all sections of the course at the level set by the attached examples.

Own: the beginnings of each of the sections covered in the course.

4. Scope of discipline and types of educational work

The total workload of the discipline is 3 credit units.

№	Type of educational work	Всего часов	Modules			
			1	2	3	4
1.	**Auditory lessons**					48
1.1.	Lectures					16
1.2.	Other occupations					32
1.2.1	*Seminars)*					32
2.	**Independent work**					60
2.1.	Course work					
2.2.	Settlement and graphic works					
2.3.	Essay					

2.4.	Exam					36
	Other types of independent work					24
3.	**Total (lessons)**					108
	Total (credits)					3

5. Discipline content

5.1. Contents of discipline sections

№	Sections	Content of section
1	Non-Euclidean geometry of Lobachevsky	Discovery of non-Euclidean geometry of Lobachevsky. Lobachevsky space models. Fundamentals of Lobachevsky's planimetry. Volumes of bodies in Lobachevsky space
2	Spherical geometry	Basic concepts of spherical geometry. Basic formulas of spherical trigonometry. Volumes of bodies in spherical spaces
3	Galileo's non-Euclidean geometry	Basic definitions and concepts of Galileo's geometry. The simplest examples of theorems for the Galilean plane.

5.3. Sections of disciplines and types of classe

№ п/п	Section	Lectures	Seminars and laboratory works			IW	Total
			Sem	LW	of which interactively		
1.	Non-Euclidean geometry of Lobachevsky	6	12			20	38
2.	Spherical geometry	5	10			20	35
3.	Galileo's non-Euclidean geometry	5	10			20	35
	Total	16	32			60	108

6. Laboratory works

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7. Seminars

№ п/п	Наименование раздела	Sem.
1	Non-Euclidean geometry of Lobachevsky	12
2	Spherical geometry	10
3	Galileo's non-Euclidean geometry	10
	Total	32

8. Course work

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9. Educational-methodical and informational support of the discipline:
a) Literature:

- Розенфельд Б.А. Неевклидовы пространства, любое издание
- Розенфельд Б.А., Замаховский М.П. Геометрия групп Ли – М.: МЦНМО, 2004. – 787 с.
- Розенфельд Б.А., Яглом И.М. Энциклопедия элементарной математики, т.5 (статья «Неевклидовы геометрии») – М.: Наука, 1966 – 625 с.
- Алексеевский Д. В., Винберг Э. Б., Солодовников А. С. Геометрия пространств постоянной кривизны // Итоги науки и техники. Серия «Современные проблемы математики. Фундаментальные направления». 1988. Т. 29. — С. 5–146.
- Берже М. Геометрия. В 2 т. / Пер. с франц. — М.: Мир, 1984. — 928 с. Том II, часть V: Внутренняя геометрия сферы, гиперболическая геометрия.
- Клейн Ф. Неевклидова геометрия. — М.: изд. НКТП СССР, 1936. — 355 с.
- Лаптев Б. Л. Н. И. Лобачевский и его геометрия. — М.: Просвещение, 1976.
- Прасолов В. В. Геометрия Лобачевского. — Изд. 3-е. — М.: МЦНМО, 2004. — ISBN 5-94057-166-2.

b) software: a package of typing and layout of mathematical texts TeX (for example, MikTeX 2.7), OpenOffice.org packages version not lower than 2.2, MSOffice version not lower than 2000, etc.

c) databases, reference and search systems:

provided by free Internet access in the teaching laboratories of the faculty and reading rooms of the RUDN University

10. Material and technical support of the discipline:

classroom for seminars, large audience (lecture hall) for lectures, laptop - 1 pc., projector - 1 pc., screen - 1 pc., copier - 1 pc., printer - 1 pc., scanner - 1 pc.

11. Guidelines for organizing the study of the discipline:

Compliance of grading systems (previously used grades of the final academic performance, ECTS grades and the point-rating system (BRS) of assessments of current performance) (In accordance with the Order of the Rector No. 996 dated December 27, 2006):

Points	Points of RF	Points	Points of RF	Points of ECTS
86 – 100	5	95 - 100	5+	A
		86 - 94	5	B
69 – 85	4	69 - 85	4	C
51 – 68	3	61 - 68	3+	D
		51 - 60	3	E
0 – 50	2	31 - 50	2+	FX
		0 - 30	2	F

1. Students are required to submit all assignments within the timeframe set by the teacher.
2. The point-rating system for assessing knowledge during the semester includes work in class, homework and study of the current material. 4 homework assignments are given on the topics indicated in the FOS, each of which is assessed from 10 points. A survey is conducted for the indicated sections, which is estimated at a maximum of 20 points.
3. The student is admitted to the final control with any number of points scored in the semester. The final control contains 2 tasks. One hour is given to prepare for the answer, after which the student is asked orally. A work of 50 points is evaluated regardless of the number of points received during the semester.
4. If, after the final control, the student received less than 31 points, then he is given an F mark and he must repeat the discipline in the prescribed manner. If, in the end, the student received at least 31 points, i.e. FX, then he is allowed to gain the required (up to 51) number of points by repeated one-time execution of the provided final control measures; at the same time, at the discretion of the teacher, the

corresponding previous results are canceled. The liquidation of debts is carried out in the period from 07.02 to 28.02 (from 07.09 to 28.09) in agreement with the dean's office.

12. Fund of assessment tools for intermediate certification of students in the discipline (module) - attached.

The program is compiled in accordance with the requirements of OS 3 ++ RUDN University.

The developer

Ph.D., senior lecturer **V.A. Krasnov**

Director of the Mathematical Institute,
Doctor of Physical and

Mathematical Sciences, Professor **A.L. Skubachevskii**

Mathematical Institute

APPROVED BY
AT THE MEETING OF THE INSTITUTE
«___»_____20__ г., protocol №___
Director of Mathematical Institute
_____A.L. Skubachevskii
(подпись)

EVALUATION FUND

of discipline

Non-Euclidean geometries and their applications

01.04.01 Mathematics

Master
Квалификация (степень) выпускника

Discipline: Non-Euclidean geometries and their applications

Specialty: 01.04.01 Mathematics

Controlled competence code	Controlled discipline section	Supervised discipline theme	Name of the appraisal tool															Points of section	Points
			Current control											Intermediate certification					
			Interview	Test	Colloquium	Examination	Lab. works	Control works	Homework	Essay			...	...	Exam	...	...		
PC-1	Non-Euclidean geometries and their applications	Non-Euclidean geometry of Lobachevsky							10	10					20			40	100
		Spherical geometry							10	10					20			40	
		Galileo's non-Euclidean geometry								10					10			20	
		TOTAL:							20	30					50			100	100

Appendix 3
(required)

Final control questions (2 questions, 25 points each)

1. Discovery of non-Euclidean geometry of Lobachevsky.
2. Models of Lobachevsky space.
3. Fundamentals of Lobachevsky planimetry.
4. Volumes of bodies in Lobachevsky space
5. Basic concepts of spherical geometry.
6. Basic formulas of spherical trigonometry.
7. Volumes of bodies in spherical spaces.
8. Basic definitions and concepts of Galileo's geometry.
9. The simplest examples of theorems for the Galilean plane.

Option for assignments for home independent work

1. Understand the formulas for calculating the volume of a tetrahedron in the Lobachevsky space (in its various models) (10 points).
2. Prove the spherical cosine theorem (10 points).

Examples of topics for essays (30 points - 15 for writing and 15 for defense)

1. Geometry of pseudo-Euclidean space
2. Non-Euclidean Riemann geometry
3. Lobachevsky special function and its properties
4. Polylogarithms and their relationship with other special functions
5. Battle Surface
6. Geometry of twistors
7. Poincaré models of the Lobachevsky plane
8. Klein's projective model of the Lobachevsky plane