Federal State Autonomous Educational Institution of Higher Education

PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
RUDN University

Faculty of Physics, Mathematics and Natural Sciences

educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

Modern problems of mathematics
course title

Recommended by the Didactic Council for the Education Field of:

01.04.01 Mathematics
field of studies / speciality code and title

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

«Functional methods in differential equations and interdisciplinary research»

higher education programme profile/specialisation title

2025

1. COURSE GOAL(s)

The purpose of mastering the discipline "Modern problems of mathematics" is the development by students of the modern theory of Fourier analysis and the theory of Fourier multipliers and its applications to some problems of modern mathematical analysis, approximation theory and the theory of functional spaces

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the discipline "Modern problems of mathematics" is aimed at developing the following competencies (parts of competencies):

Table 2.1. List of competences that students acquire through the course study

Code	Competence	Competence achievement indicators (within this discipline)
GC-1	Able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy	GC-1.1. Analyzes the problem situation as a system, identifying its components and relationships between them
		GC-1.2. Identifies gaps in information needed to solve a problem situation and designs processes to address them
		GC-1.3. Critically evaluates the reliability of information sources, works with conflicting information from different sources
		GC-1.4. Develops and substantively argues a strategy for solving a problem situation based on a systematic and interdisciplinary approach
		GC-1.5. Uses logical and methodological tools for a critical assessment of modern concepts of a philosophical and social nature in his subject area
PC-1	Able to conduct scientific research and obtain new scientific and applied results independently and as part of a scientific team	PC-1.1. Draws up a general research plan and detailed plans for individual stages
		PC-1.2. Selects experimental and computational-theoretical methods for solving the problem based on the available material and time resources
PC-11	Carrying out work on the processing and analysis of scientific and technical information and research results	PC-11.1 Ability to process scientific and technical information; PC-11.2 Ability to analyze the results of scientific research

3.COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The discipline "Modern problems of mathematics" refers to the obligatory part of block B1 of the EP HE.

As part of the EP HE, students also master other disciplines and / or practices that contribute to the achievement of the planned results of mastering the discipline «Modern problems of mathematics»

Table 3.1. The list of the higher education programme components/disciplines that contribute to the achievement of the expected learning outcomes as the course study results

Code	Competence	Previous disciplines/modules, practices	Subsequent disciplines/modules, practices*
GC-1	Able to carry out a critical analysis of problem situations based on a systematic approach, develop an action strategy	-	Nonlinear evolution equations, State examination
PC-1	Able to conduct scientific research and obtain new scientific and applied results independently and as part of a scientific team	-	Research work, Undergraduate practice, State examination
PC-11	Carrying out work on the processing and analysis of scientific and technical information and research results	Function spaces	State exam

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total labor intensity of the discipline "Modern problems of mathematics" is 6 credits.

*Table 4.1. Types of academic activities during the periods of higher education programme mastering (**full-time training**)**

Type of study work		TOTAL, a.h.	Semester			
			1	2	3	4
Contact academic hours		*72*		*72*		
including:						
Lectures (LC)		36		36		
Lab work (LW)						
Seminars (workshops/tutorials) (S)		36		36		
Self-studies		*108*		*108*		
Evaluation and assessment (exam/ passing/failing grade)		*36*		*36*		
Course workload	a.h.	**216**		**216**		
	credits	**6**		**6**		

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Course Module Title	Brief Description of the Module Content	Type of study work
Section 1. Fourier transforms	Topic 1.1. Fourier transforms of basic and generalized functions Topic 1.2. Fourier transform of functions from L_2 Topic 1.3. Fourier transform of functions from L_2. Plancherel's theory. Topic 1.4. Fourier transform of functions from L_2	Lecture, seminar
Section 2. Definition and basic properties of Fourier multipliers	Topic 2.1. The Fourier space of multipliers in L_2. Sufficient conditions for Fourier multipliers in L_2. Statement and proof of the main theorem on the multipliers of the Fourier integral	Lecture, seminar
Section 3. Subspace of functions with bounded spectrum	Topic 3.1. Integral representation of a function with limited spectrum. Bernstein's inequality for a function with bounded spectrum. Inequality of different Nikolsky metrics for a function with bounded spectrum.	Lecture, seminar
Section 4. Sobolev spaces	Topic 4.1. Averaging of functions according to Sobolev, its connection with generalized differentiation Topic 4.2. Embedding theorems for Sobolev spaces	Lecture, seminar

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

Classroom type	Classroom equipment	Specialized educational/laboratory equipment, software and materials for mastering the discipline
Lecture	An auditorium for lecture-type classes, equipped with a set of specialized furniture; board (screen) and technical means of multimedia presentations.	-
Seminar	An auditorium for conducting seminar-type classes, group and individual consultations, current control and intermediate certification, equipped with a set of specialized furniture and technical means for multimedia presentations.	-
For independent work of students	An auditorium for conducting seminar-type classes, group and individual consultations,	-

Classroom type	Classroom equipment	Specialized educational/laboratory equipment, software and materials for mastering the discipline
	current control and intermediate certification, equipped with a set of specialized furniture and technical means for multimedia presentations.	

7. RESOURCES RECOMMENDED FOR COURSE STUDY

Main literature:

1. S. M. Nikolsky. Approximation of functions of several variables and embedding theorems. M.: Nauka, all years of publication.
2. O. V. Besov, V. P. Ilyin, and S. M. Nikol'skii. Integral representations of functions and embedding theorems. M.: Nauka, all years of publication.
3. L. Hermander. Estimates for shift-invariant operators. Moscow: IL, all years of publication.
4. V. I. Burenkov. functional spaces. Sobolev spaces. M.: RUDN University, all years of publication

Additional literature:

1. V. G. Mazya. Sobolev spaces. Leningrad State University, all years of publication.
2. G. Triebel. Theory of interpolation. functional spaces. Differential operators. M.: Mir, all years of publication

Resources of the information and telecommunications network "Internet":

1. RUDN ELS and third-party ELS, to which university students have access on the basis of concluded agreements:
- RUDN Electronic Library System - RUDN EBS http://lib.rudn.ru/MegaPro/Web
- ELS "University Library Online" http://www.biblioclub.ru
- EBS Yurayt http://www.biblio-online.ru
- ELS "Student Consultant" www.studentlibrary.ru
- EBS "Lan" http://e.lanbook.com/
- EBS "Trinity 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/
- Google search engine https://www.google.ru/
- abstract database SCOPUS http://www.elsevierscience.ru/products/scopus/

8. ASSESSMENT TOOLKIT AND GRADING SYSTEM* FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL UPON COURSE COMPLETION

Evaluation materials and a point-rating system* for evaluating the level of formation of competencies (parts of competencies) based on the results of mastering the discipline "Modern problems of mathematics" are presented in the Appendix to this Work Program of the discipline

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