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

Nonlinear evolution equations
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 "Nonlinear evolution equations" is the teaching of the modern achievements of the theory of evolution partial differential equations with the emphasis on equations of odd orders: properties of function spaces of evolutionary type, the theory of semigroups, and the theory of boundary value problems for the Korteweg-de Vries equation.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the discipline "Nonlinear evolution equations" is aimed at developing the following competencies (parts of competencies):

Table 2.1. The list of competencies formed by students in the course of mastering the discipline (the results of mastering the discipline)

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

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The discipline "Nonlinear evolution equations" refers to the part formed by the participants in the educational relations 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 "Nonlinear evolution equations".

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	Modern problems of mathematics	State exam

Code	Competence	Previous disciplines/modules, practices	Subsequent disciplines/modules, practices*
	approach, develop an action strategy		

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total labor intensity of the discipline "Nonlinear evolution equations" is 3 credits.

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

Type of study work	TOTAL, a.h.	Semester			
		1	2	3	4
Contact academic hours	*40*			*40*	
including:					
Lectures (LC)	20			20	
Lab work (LW)					
Seminars (workshops/tutorials) (S)	20			20	
Self-studies	*41*			*41*	
Evaluation and assessment (exam/passing/failing grade)	*27*			*27*	
Course workload a.h.	**108**			**108**	
credits	**3**			**3**	

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. Functional spaces of evolutionary type	Topic 1.1. Bochner measurability Topic 1.2. Bochner integral. Topic 1.3. Sobolev spaces.	Lecture, seminar
Section 2. Semigroups and groups of operators	Topic 2.1. Theory of semigroups. Topic 2.2. Theory of groups. Topic 2.3. Abstract initial value problem.	Lecture, seminar
Section 3. Initial value problem for the Airy equation	Topic 3.1. General properties of solutions. Topic 3.2. Special properties of solutions.	Lecture, seminar
Section 4. Initial value problem for the Korteweg-de Vries equation	Topic 4.1. Definition and properties of generalized solutions. Topic 4.2. Theorems on existence and uniqueness.	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, 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. Faminskii A.V. Functional spaces of evolutionary type. 2-d edition. Moscow: RUDN, 2016.
2. Faminskii A.V. Selected chapters of the theory of evolution equations. Moscow: RUDN, 2014.

Additional literature:

1. Josida K. Functionsl analysis. Moscow: LKI, 2007.
2. Gaevskii H., Greger K., Zakharias K. Nonlinear operator equations and operator differential equations. Moscow: Mir, 1978.

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 "Nonlinear evolution equations" are presented in the Appendix to this Work Program of the discipline

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