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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

Function spaces
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

1. COURSE GOAL(s)

The purpose of mastering the discipline "Functional Spaces" is to master the basics of the modern theory of functional spaces and its applications to problems of mathematical and functional analysis and differential equations, to study the basic properties of Sobolev spaces (generalized derivatives, Sobolev integral representation, approximation by infinitely differentiable functions, embedding theorems, theorem on traces, theorems on extension beyond the domain of definition).

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the discipline "Function spaces" 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)
PC-4	Able to develop and analyze conceptual and theoretical models of the tasks to be solved in design and production and technological activities	PC-4.1. Capable of compiling mathematical models in solving practical problems
PC-9	Able to teach mathematical disciplines and informatics in general educational organizations, professional educational organizations and educational institutions of higher education.	PC-9.1. Formation of pedagogical skills and abilities
		PC-9.2. Ability to work and interact with a team

3.COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The discipline "Function spaces" 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 "Function spaces".

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*
PC-4	Able to develop and analyze conceptual and theoretical models of the tasks to be solved in design and production and technological activities	-	Interdisciplinary term paper, State examination
PC-9	Able to teach mathematical disciplines and informatics in general educational organizations, professional educational organizations and educational institutions of higher education.	-	Pedagogical training, Interdisciplinary term paper, State examination

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total labor intensity of the discipline "Function spaces" is 3 credits.

Table 4.1. Types of educational work by periods of mastering EP HE for full-time education

Type of study work		Total a.h.	Semester			
			1	2	3	4
Contact work, academic hours		*36*	*36*			
Lectures (LC)		18	18			
Lab work (LW)						
Seminars (workshops/tutorials) (S)		18	18			
Self-studies		*63*	*63*			
Evaluation and assessment (exam/passing/failing grade)		*9*	*9*			
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 [1]
Section 1. Basic properties of Sobolev spaces	Topic 1.1. Equivalent definitions of generalized derivatives. Examples	Lecture, seminar
	Topic 1.2. Properties of generalized derivatives. Closedness of the operation of generalized differentiation	Lecture, seminar
	Topic 1.3. Properties of Sobolev spaces. Completeness	Lecture, seminar
Section 2. Sobolev integral representation	Topic 2.1. Averaging operators with constant and variable step	Lecture, seminar
	Topic 2.2. Density of the set of infinitely continuously differentiable functions in Sobolev spaces	Lecture, seminar
	Topic 2.3. Sobolev integral representation for regions stellar with respect to the ball. Inequalities of integral representation type	Lecture, seminar
Section 3. Embedding theorems for Sobolev spaces	Topic 3.1. An embedding theorem for Sobolev spaces in the space of continuous functions for open sets satisfying the cone condition	Lecture, seminar
	Topic 3.2. An embedding theorem for Sobolev spaces in a Lebesgue space Lq for open sets satisfying the cone condition	Lecture, seminar
	Topic 3.3. Nikol'skii-Besov spaces. Trace theorem for Sobolev spaces	Lecture, seminar

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

1 - заполняется только по ОЧНОЙ форме обучения: ЛК – лекции; ЛР – лабораторные работы; СЗ – семинарские занятия.

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. S. L. Sobolev. Some applications of functional analysis in mathematical physics. Any edition.
2. O. V. Besov, V. P. Ilyin, and S. M. Nikol'skii. Integral representations of functions and embedding theorems. Any edition.
3. V. I. Burenkov. Sobolev spaces on domains, B.G. Teubner, Stuttgart-Leipzig, 1998.

Additional literature:

1. V. I. Burenkov Function spaces. Sobolev spaces. Part 1. M.: RUDN, 1991.
2. V. I. Burenkov Function spaces. Sobolev spaces. Part 2. M.: RUDN, 1994.

Educational and methodological materials for independent work of students in the development of the discipline / module:

1. V.I. Burenkov. Lecture notes on the discipline "Function spaces".
2. V.I. Burenkov. Function spaces. Basic integral inequalities related to the spaces Lp. M.: RUDN, 1989.

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 "Function spaces" are presented in the Appendix to this Work Program of the discipline

Developer:

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signature name and surname

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HEAD
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