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

Elements of perturbation theory
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 "Elements of perturbation theory" is to master the master the main concepts and some mathematical methods of analysing the change of the spectrum of a compact operator under small perturbations.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the discipline "Elements of perturbation theory" 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	Is able to search, critically analyze and synthesize information, apply a systematic approach to solving tasks	**GC-1.1.** Analyzes the problem situation as a mathematical system, identifying its components and the connections between them **GC-1.2.** Identifies gaps in the information needed to solve a problem situation and designs processes to eliminate them; **GC-1.3.** Critically assesses the reliability of information sources, works with contradictory information from different sources. **GC-1.4.** Develops and substantiates a strategy for solving a problem situation on the basis of systemic and interdisciplinary approaches. **GC-1.5.** Uses logical and methodological tools for a critical assessment of modern concepts of a philosophical and social nature in its subject area

3.COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The discipline "Elements of perturbation theory" 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 "Elements of perturbation theory".

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	Is able to search, critically analyze and synthesize information, apply a systematic	Modern problems of mathematics	State examination

Code	Competence	Previous disciplines/modules, practices	Subsequent disciplines/modules, practices*
	approach to solving tasks		

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total labor intensity of the discipline "Elements of perturbation theory" is 3 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 work, academic hours		*40*			*40*	
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. Analysis in operator spaces	Topic 1.1. Analysis in a normed space	Lectures, seminars
	Topic 1.2. Operator space	Lectures, seminars
	Topic 1.3. Operator-valued functions	Lectures, seminars
Section 2. Spectral representation of a finite-dimensional operator	Topic 2.1. Resolvent and its Laurent series	Lectures, seminars
	Topic 2.2. Dependence of eigenvalues of a finite-dimensional operator on its small perturbation	Lectures, seminars
	Topic 2.3. Singularities of the resolvent. Spectral projector	Lectures, seminars
Section 3. Method of Newton's diagrams for analyzing bifurcations of solutions to algebraic equations	Topic 3.1. Classical implicit function theorems	Lectures, seminars
	Topic 3.2. Newton's diagram. Bifurcation equation. Cases of simple and multiple roots	Lectures, seminars
	Topic 3.3. Finding the principal term of the decomposition. Specification of the asymptotic	Lectures, seminars
Section 4. Bifurcation of eigenvalues	Topic 4.1. Jordan chains and sets of Fredholm operators	Lectures, seminars
	Topic 4.2. Bifurcation equation. Method of	Lectures, seminars

Course Module Title	Brief Description of the Module Content	Type of study work
	indefinite coefficients	

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
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. Ovchinnikov A.V., Kolybasova V.V., Krutitskaya N.Ch. Jordan form of operator matrix. 2009. MSU Publishers.
2. Kashchenko I.S. Asymptotic expansion for solutions of equations. YaSU Publishers. 2011.

Additional literature:

1. Kato T. Perturbation theory for linear operators. M.: Mir, 1972.
2. Vainberg M.M., Trenogin V.A. Bifurcation theory for solutions of nonlinear equations. Nauka, 1969.
3. Giacaglia G.E.O. Methods of perturbation theory for nonlinear systems. Nauka, 1979.

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 "Non-Euclidean geometries and their applications" are presented in the Appendix to this Work Program of the discipline

Developer:

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