MINISTRY OF HIGHER EDUCATION, SCIENCE AND INNOVATION OF THE REPUBLIC OF UZBEKISTAN

CHIRCHIK STATE PEDAGOGICAL UNIVERSITY

"Approved by"
Acting vice-rector for
educational affairs
_____ D.B.Akhmadjanov
2024 year "___" _____

SYLLABUS FOR THE FUNCTIONAL ANALYSIS

Fields of knowledge:	100000 - Education
Fields of education:	110000 - Education
Educational direction:	60110600 - Mathematics and informatics

CHIRCHIK- 2024

The curriculum (syllabus) of the subject was approved by the Council of Chirchik State Pedagogical University dated "___" _____ 2024 of the meeting of No .

Authors:

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The curriculum (syllabus) of the subject was approved and recommended to the council of the faculty «Mathematics and informatics» at the meeting of the department «Algebra and mathematical analysis» by protocol No. ____ of «_____» 2024 year

The dean of the faculty **D.M .Makhmudova**

The curriculum (syllabus) of the subject was discussed and recommended for use by the faculty council of the Faculty of Mathematics and Informatics of Chirchik State Pedagogical University by protocol No. ____ of «_____» 2024 year.

The head of the department **G'.X.Djumabayev**

A student must not engage in any activity that may lead to academic misconduct (misconduct). For example, plagiarism, collusion, falsification of results, irregularities in the examination process, i.e. use of notes and handouts, telephone and other means of communication, communication with others inside or outside the examination room are prohibited. Students who are guilty of this will be excluded from the control or examination process, and their grade will be zero.

Depending on the characteristics of the subject (course), changes and additions may be made to the evaluation and control criteria.

	Basic literature
1.	T. A. Sarimsoqov. Functional Analysis. Tashkent, 1991.
2.	A. N. Kolmogorov, S. V. Fomin. Elements of the Theory of Functions and Functional Analysis. Moscow, Nauka, 1989.
3.	Sh. A. Ayupov, M. Ibragimov, K. K. Kudayberganov. Problems and Exercises in Functional Analysis. "Bilim" Nukus, 2009.
	Additional literature
1.	Reed, M., Simon, B. Methods of Modern Mathematical Physics. Vol. 1. Functional Analysis. Moscow: "Mir", 1976.
2.	Kadets, V.M., Course of Functional Analysis, Kharkiv: "V.N. Karazin KhNU", 2006.
3.	Rudin, W. Functional Analysis. Moscow: "Mir", 1975.
4.	Sarimsakov, T.A. Course of Functional Analysis. Tashkent: "O'qituvchi", 1980.

Internet addresses

http://www.edu.uz– Ministry of Higher Education, Science, and Innovations of the Republic of Uzbekistan.
http://www.gov.uz- Uzbekistan Republic Government Portal.
www.ziyonet.uz - Information Education Network of the Republic of Uzbekistan
www.cspi.uz - CSPU website
www.natlib.uz - (A. Navoi National Library of Uzbekistan)

Type of training	A dedicated hour
Lecture	30
Practical training	30
Self-education	60
Total student hours of study and teaching	120

To ensure students thoroughly master a subject, it is important to utilize advanced and modern teaching methods and apply new informational-pedagogical technologies. In mastering the subject, textbooks, study and methodological guides, handouts, and electronic materials are used. Advanced pedagogical technologies are selected in accordance with the topics of lectures and practical lessons. Teaching the subject involves the use of pedagogical technologies such as "Networks," "Brainstorming," "Boomerang," "Balance," "Cluster," "Venn Diagrams," and "Model-Based Education." Each topic's uniqueness is taken into account. Furthermore, audio, video, and computer equipment is utilized.

Criteria for Assessing and Monitoring Students' Knowledge in the Subject

Monitoring and evaluation of student knowledge is carried out through student activity, mid-term control, final control and assessment of independent learning.

- **Mid-term supervision** is an important stage of assessment by the teacher of the student's knowledge and practical skills acquired in the first part of the module, and is an indicator of future mastery of this subject. Assessment of students' knowledge in mid-term control is carried out through oral question-and-answer and written work. If the student does not pass the mid-term examination, he will be given the opportunity to retake it 2 more times. **20 percent of the total assessment.**
- **Assessment of independent learning** is carried out through students' completion of assigned practical projects in a group and individually. Each student is given one team project and two individual projects. The student studies the given issue and conducts research, understanding the goals and objectives of the given project. Analyzes the obtained results, prepares presentations with conclusions and defends them. The number, subject, content of the projects, methods of implementation and deadlines are fully disclosed in the working science program. **50 percent of the total evaluation.**
- **Final control is** a summative stage of evaluation of the student's knowledge and practical skills by the professor-teacher . Final control is conducted in the form of written work. **30 percent of the total evaluation.**

Assessment, intermediate and final control tasks (tasks) are developed by the course professors, pre-moderated and approved by the head of the department.

The content of the assignments for conducting the types of control should allow an objective, transparent and accurate assessment of the student's learning.

CURRICULUM (SYLLABUS)

Mathematics and Informatics Faculty

60110600 - Mathematics and Informatics Education Program

General information		
Subject name: Functional analysis		
Subject code: Math 5354	**Amount of credit: 4**	**Semester: 5**
Department name: Algebra and mathematical analysis		
Teacher: Raupova Mokhinur Haydar qizi		
Email: r.mokhinur@gmail.com		
Subject Type: Elective		
Form of education:	Full-time	
Evaluation form:	Exam	
Science language:	Uzbek	

Summary of science
Subject and content of the course: To effectively educate young people with high qualifications, it is essential to train highly skilled specialists. The main content of the course on lectures and problem-solving in functional analysis focuses on enhancing the scientific-methodological preparation of future mathematics teachers. It aims to develop their independent and creative thinking, ensure their competitiveness, and foster the necessary methodological knowledge, skills, and competencies for pedagogical activity by utilizing mathematical problems and exercises. The goal of teaching the course is to acquaint students with the necessary body of mathematical information (concepts, theorems and their proofs, methods for solving practical problems, etc.). Simultaneously, it serves to train students in logical thinking, drawing correct conclusions, enhancing their mathematical culture, and introducing them to the fundamentals of modern mathematics. It also involves the conscious study of profession-related issues, explaining the essence of the opportunities presented by mathematical analysis for problem-solving and teaching them how to apply them effectively. The objectives of the course are: - To master the culture of thinking, understanding information, generalizing and analyzing concepts, setting objectives, and choosing strategies to achieve them

through the conscious assimilation of the content, rules, and methods of mathematical concepts in functional analysis.

- To express one's ideas logically, clearly, and rationally, both orally and in writing;

Achieving competencies in applying the principal methods of functional analysis, including theoretical and experimental research methods, to professional activities is essential. This understanding underscores the importance of the mathematical analysis discipline in studying engineering, physics, technology, economics, and other fields. It is particularly crucial in solving their problems and analyzing mathematical models of various processes.

Learning outcomes:
Students who completed the course: - Students study the theoretical foundations, key concepts, principles, and laws of the theory of functions with complex variables, and develop skills to apply them in practice; - They conduct an in-depth analysis of the essence of the methods within the theory of functions with complex variables; - They apply appropriate tools of functional analysis to solve problems in professional activities; **Competencies to be acquired as a result of the course:** • In future professional activities, will possess knowledge, skills, and competencies in elementary mathematics, mathematical analysis, and probability theory **(KK-1)**; • Participates in conducting scientific research **(KK-3)**.

Science content	
Form of education: Lecture (L)	
L1	Metric spaces. Open and closed sets. Complete metric spaces.
L2	Compactness in metric spaces. Theorems regarding Hausdorff, Baire, and nested balls.
L3	The contraction mapping principle and its applications.
L4	Linear spaces. The basis of a space and its dimension. Linear functionals.
L5	Convex sets and convex functionals. The Hahn-Banach theorem.
L6	Normed spaces. Norms of classical spaces.
L7	Linear normed spaces. Euclidean spaces.
L8	Hilbert and Banach spaces.
L9	Linear continuous operators and their properties.
L10	Linear functionals in normed spaces. Inverse operators and their properties.
L11	Continuous and bounded operators. The relationship between them for linear operators.
L12	Operator norms. Formulas for the norm. The space of linear bounded operators.
L13	Dual space and its completeness. Dual spaces of classical spaces.
L14	Adjoint operators and their properties.
L15	The connection between Euclidean space and normed space. The parallelogram law theorem. Hilbert space.
Form of education: practical lesson (P)	
P1	Metric spaces. Open and closed sets. Complete metric spaces.
P2	Compactness in metric spaces. Theorems regarding Hausdorff, Baire, and nested balls.
P3	The contraction mapping principle and its applications.
P4	Linear spaces. The basis of a space and its dimension. Linear functionals.
P5	Convex sets and convex functionals. The Hahn-Banach theorem.
P6	Normed spaces. Norms of classical spaces.
P7	Linear normed spaces. Euclidean spaces.
P8	Hilbert and Banach spaces.
P9	Linear continuous operators and their properties.
P10	Linear functionals in normed spaces. Inverse operators and their properties.
P11	Continuous and bounded operators. The relationship between them for linear operators.
P12	Operator norms. Formulas for the norm. The space of linear bounded operators.
P13	Dual space and its completeness. Dual spaces of classical spaces.
P14	Adjoint operators and their properties.
P15	The connection between Euclidean space and normed space. The parallelogram law theorem. Hilbert space.

Teaching and learning methods

The module is organized through lectures, practical classroom sessions, and independent study activities by students. In the lectures, theoretical information necessary to analyze topics in the theory of functions of a complex variable is provided. In practical classroom sessions, issues (examples and problems) of the course in the theory of functions of a complex variable are presented, and students are given the opportunity to practice applying the necessary mathematical methods and techniques to solve these issues. During independent study activities, students are expected to study the topics in depth and analyze them using literature, scientific journals, and sources.