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

**CHIRCHIK STATE PEDAGOGICAL UNIVERSITY**

**"APPROVED BY"**
Vice-rector for educational affairs
D. B. Akhmadjanov
"___" _____ 2024 year

# WORKING CURRICULUM (SYLLABUS)
# BY DISCIPLINE
# ALGEBRA
**(Full-time 1-year course)**

| | |
|---|---|
| **Field of knowledge:** | 500000 - Natural Sciences, Mathematics and Statistics |
| **Field of education:** | 540000 - Mathematics and Statistics |
| **Direction of education:** | 60540200- Mathematics |

**Chirchik-2024**

## SUBJECT SYLLABUS

| | | | |
|---|---|---|---|
| **Academic year:** | 2024/2025 | | |
| **Subject name:** | Mathematical Analysis | | |
| **Subject Type:** | Mandatory | | |
| **Subject Code:** | ALG 112318 | | |
| **Year:** | 4 | | |
| **Form of training:** | Full-time | | |
| **Type of education:** | Bachelor | | |
| **The format of classes and hours allocated per semester:** | **Total** | **1 semester** | **2 semester** |
| | **360** | 180 | 180 |
| Lecture | **88** | 44 | 44 |
| Practical | **92** | 46 | 46 |
| Laboratory work | — | — | — |
| Seminar | — | — | — |
| Independent work | **180** | 90 | 90 |
| **Credit quantity:** | **12** | 6 | 6 |
| **Assessment form:** | **M. E. 1,2** | In written and oral | In written and oral |
| | **Final control** | In written | in written |
| **Responsible department for the subject:** | **Algebra and Mathematical Analysis** | | |

**Information about the teacher**

| | |
|---|---|
| **Author(s):** | Raupova Mokhinur Haydar qizi |
| **E-mail:** | r.mokhinur@gmail.com |
| **Phone number:** | (90) 336-37-11 |
| **Organization:** | Chirchik State Pedagogical University, Department of Algebra and Mathematical Analysis |
| **Reviewers:** | Z.K. Adashev – Senior Researcher at the V. Ramanovsky Mathematical Institute, Professor.<br>B.O. Abraev – Chirchik State Pedagogical University, Department of "Algebra and Mathematical Analysis," Acting Associate Professor. |

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|---|---|---|---|---|
| "2" | 0 – 2,99 | "F " | 0-59.9 | Unsatisfied |

**Basic and additional educational literature and information resources**

| | |
|---|---|
| | **Basic literature** |
| 1. | Д.М.Махмудова, "Алгебра ва сонлар назаряси". Унверситет2020-йил ТВЧДПИ |
| 2. | Л.Аллаков, "Сонлар назариясидан мисол ва масалалар". Тошкент 2020 ЎРОЎМТВ |
| 3. | Jabbbarov N.M., "Oliy matematika 1,2-jild". T:Unversitet 2017 ЎзМУ |
| | **Additional literature** |
| 1. | Ҳожийев Ж., Файнлейб А.С. Алгебра ва сонлар назарияси курси, Тошкент, Узбекистон 2001 й. 304б. |
| 2. | Курош А.Г. Курс высшей алгебры. 2008. – 432 с. |
| 3. | D.Yunusova, A. Yunusov "Algebra va sonlar nazariyasi" Toshkent 2007 |
| 4. | Д.К.Фадеев, Лекции по алгебре, Спб.: Лан, 2005. |
| 5. | А.Л.Кострикин, Сборник задач по алгебре, М.: Физматлит, 2001. |
| | **Internet sites** |
| 1. | http: // www. edu. uz-Ministry of Higher Education, Science and Innovation of the Republic of Uzbekistan. |
| 2. | www.ziyonet.uz -Educational information network of the Republic of Uzbekistan |
| 3. | www.cspi.uz -website of Chirchik State Pedagogical University |
| 4. | www.natlib.uz - Alisher Navoi National Library of Uzbekistan |

This curriculum was approved by the Department of Algebra and Mathematical Analysis at the meeting no. _ _ of ___- _____ 2024.

This curriculum was approved by the Faculty of Mathematics and Computer Science at the meeting no. _ _ of ___- _____ 2024.

This curriculum was approved by the Council of Chirchik State Pedagogical University at the meeting no. _ _ of ___- _____ 2024.

**Head of the Educational and Methodological Department** — **M.J. Boltaev**

**Dean of the Faculty** — **D.M. Makhmudova**

**Head of the Department** — **G'.X. DJumabaev**

**Compiled by** — **M.H.Raupova**

| Midterm exam | The final exam |
|---|---|
| For answers during the midterm assessment – midterm assessment score (MAS);<br>For completing independent study assignments – independent work assessment (ISA);<br>The performance of the student in practical, seminar, laboratory classes, and independent study assignments, as well as their activity in these exercises, is evaluated by the natural science teacher.<br>When assessing the student based on the type of midterm assessment, the grades received in the academic classes are taken into account.<br>For answers during the midterm exam – midterm assessment score (MES);<br>For completing independent study assignments – independent work assessment (ISA);<br>The performance of the student in practical, seminar, laboratory classes, and independent study assignments, as well as their activity in these exercises, is evaluated by the natural science teacher.<br>When assessing the student based on the type of interim assessment, the grades received in the academic classes are taken into account. | Assessment for the final control for participation in the final exam (AFE) |
| ***The maximum point midterm exam score is 5 points:***<br>ΣME = MAS + ISA | ***Maximum score of the final exam (MSFE)***<br>***5 points*** |
| ***A student with a score of ΣPE ≥ 3 is allowed to pass the final exam.***<br>Module Assimilation Rate (MAR):<br>Σ MAR = MAS<br>***The module is considered mastered when Σ MAR ≥ 3 is obtained.*** | |
| **Criteria for Assessing Educational Outcomes of Students:** | |

| | | | | |
|---|---|---|---|---|
| "5" | 4.5 – 5 | " A " | 90-100 | Excellent |
| "4" | 3.5 – 4.4949 | "B+" | 80 — 89.9 | Good |
| | | "B" | 70 – 79,9 | |
| "3" | 3 – 3,49 | "C+" | 65 — 69.9 | Satisfied |
| | | "C" | 60 — 64,9,9 | |

| 1. The Purpose of Science (PS) | |
|---|---|
| **PS 1** | The main goal of the algebra course is to provide students with an understanding of sets and operations on them, reflections, matrices and determinants, systems of linear equations and methods for solving them, as well as the application of these topics to examples; |

| 2. Basic knowledge required to master science | |
|---|---|
| 1 | Mathematics |
| 2 | Algebra |

| 3. Learning Outcomes (LO) | |
|---|---|
| | **In terms of knowledge:** |
| **LO1** | Demonstrate a deep understanding of the concepts and principles of algebra and number theory; |
| **LO2** | Conduct an in-depth analysis of the essence of methods in algebra and number theory; |
| **LO3** | To solve problems in his professional activities, he acquires knowledge, qualifications, and skills in the fields of mathematical analysis, algebra and number theory, geometry, differential equations, and probability theory, and participates in scientific research. |
| **LO4** | The course includes problems in algebra and number theory (examples and exercises), and students are given the opportunity to practice applying the mathematical methods and techniques necessary for their solutions. |
| | ***In terms of skills:*** |
| **LO5** | It is implemented through the collective and individual implementation by students of assigned practical examples or tasks. |
| **LO6** | The student studies the assigned problem, conducts research, understanding the goals and objectives and the essence of the given examples or problems. |
| **LO7** | Analyzes the obtained results, prepares presentations with solutions and defends them. |
| **LO8** | It is implemented through the collective and individual implementation by students of assigned practical examples or tasks. |

| 4. Content of science | | |
|---|---|---|
| **Form of study: lecture (L)** | | **Hours** |
| **1st half of the year** | | |
| **L1** | Reflections. | 2 |

| | | |
|---|---|---|
| **L2** | Substitutions and Permutations. | 2 |
| **L3** | Matrices and Operations on Them. | 2 |
| **L4** | Determinants and Their Properties. | 2 |
| **L5** | Minors and Algebraic Complements. | 2 |
| **L6** | The Theorem on the Rank of a Matrix. | 2 |
| **L7** | Some Methods for Calculating Determinants of n-th Order. Upper Triangular Form, Recurrence Relation. | 2 |
| **L8** | Some Methods for Calculating Determinants of n-th Order. Upper Triangular Form, Recurrence Relation. | 2 |
| **L9** | Laplace's Theorem. | 2 |
| **L10** | Inverse Matrix and Additional Properties of the Determinant. | 2 |
| | **Midterm Exam** | |
| **L11** | Systems of Linear Equations and Their Solution by Gauss's Method. | 2 |
| **L12** | Methods for Solving Systems of Linear Equations: Cramer's Method and the Inverse Matrix Method. | 2 |
| **L13** | Homogeneous Systems of Equations. Kronecker-Capelli Theorem. | 2 |
| **L14** | Complex Numbers and Operations on Them. De Moivre's Formula. | 2 |
| **L15** | Geometric Representation of Complex Numbers and Trigonometric Form. | 2 |
| **L16** | Extracting the Root of a Complex Number. Roots of Unity. | 2 |
| **L17** | Polynomials with One Unknown. Horner's Scheme. Bezout's Theorem. | 2 |
| **L18** | Remainder Division.. Finding the GCD of Polynomials. | 2 |
| | **Midterm Exam** | |
| **L19** | Irreducible Polynomials and Their Properties. | 2 |
| **L20** | Rational Fractions and Their Decomposition into Simplest Fractions. | 2 |
| **L21** | Solving Cubic Algebraic Equations. Solving Quartic Algebraic Equations. | 2 |
| **L22** | Bounds of Roots, Sturm's Theorem. | 2 |
| | **Total** | **44** |
| | **Form of classes: Lecture (L)** | |
| | **2nd half of the year** | |
| **L1** | n-dimensional vector linear spaces. Basis and dimension of a vector space. | 2 |
| **L2** | Linear spaces. Dimension and basis of a linear space. | 2 |
| **L3** | Linear subspace. Sum and intersection of subspaces. | 2 |
| **L4** | Euclidean space. Cauchy-Bunyakovsky inequality. | 2 |
| **L5** | Orthogonal and orthonormal systems. | 2 |
| **L6** | Isomorphism of linear and Euclidean spaces. The process of orthogonalization. | 2 |

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|---|---|---|
| **IL22** | Binary Relations. | 4 |
| **IL23** | Equivalence Relations. | 4 |
| **IL24** | Binary Operation, Semigroup. | 4 |
| **IL25** | Monoids and Groups. | 4 |
| **IL26** | Permutation Group. | 4 |
| **IL27** | Normal Subgroups and Factor Groups. | 4 |
| **IL28** | Centralizer, Normalizer, and Commutant. | 4 |
| **IL29** | Group Homomorphism. | 4 |
| **IL30** | Canonical Form of a Quadratic Function. | 4 |
| **IL31** | Lagrange's Method. Jacobi's Method. | 4 |
| **IL32** | Law of Inertia. | 4 |
| **IL33** | Linear Transformations and Their Matrices. | 4 |
| | **Total** | **90** |

**6. Educational technologies and methods:**

***Lectures*** - interactive case studies; seminars (reasoning, quick questions and answers); working in groups; conducting presentations; individual projects; projects for collaboration and defense.

***Practical classes*** include solving problems related to the topic, making practical observations, making measurements, and working with astronomical tables.

***Independent work*** - it is recommended to carry out in the following types:

- preparation of reports;
- preparation of presentations;
- problem solving;
- individual and group educational project;
- work with information and analytical materials;
- working with resources.
- drawing and illustrative models (smart map, frame, logical graph, etc.) k.) create;
- creation of multimedia presentations;
- preparation of methodological developments of lessons;
- preparation of extracurricular developments;

**7. Requirements for obtaining credits:**

It is necessary to fully master the theoretical and methodological concepts related to science, be able to correctly reflect the results of analysis, independently observe the processes and concepts being studied, perform tasks and tasks in the form of current and intermediate control, perform written tasks based on options for final control.

**8. Criteria for evaluating and controlling knowledge of students on the subject**

Student educational outcomes are assessed using a 100-point grading system. The conversion of scores based on students' learning outcomes is carried out according to the YeCTS (European Credit Transfer System).

**The points for assessing educational outcomes are determined in the following manner:**

| | | |
|---|---|---|
| **IL24** | Linear transformations in real Euclidean space. | 2 |
| **IL25** | The Jordan normal form of a linear transformation. | 2 |
| **IL26** | Polynomials and operations on them. | 2 |
| **IL27** | Euclid's algorithm for polynomials. | 2 |
| **IL28** | Bezout's theorem. | 2 |
| **IL29** | Horn's scheme. | 2 |
| **IL30** | The fundamental theorem of algebra. | 2 |
| **IL31** | Solving algebraic equations of the third degree. | 2 |
| **IL32** | Solving algebraic equations of the fourth degree. | 2 |
| **IL33** | Bounds of roots. | 2 |
| **IL34** | Sturm's theorem. | 2 |
| **IL35** | n-dimensional vector linear spaces. | 2 |
| **IL36** | Basis and dimension of a vector space. | 2 |
| **IL37** | Subspaces, their intersection. | 2 |
| **IL38** | Subspaces, their sum, direct sum. | 4 |
| **IL39** | Euclidean spaces. | 4 |
| **IL40** | Orthogonal and orthonormal systems. | 4 |
| **IL41** | Biquadratic and quadratic forms. | 4 |
| | **Total:** | **90** |
| | | |
| **2nd half of the year** | | |
| **IL1** | Canonical Form of a Quadratic Function. | 2 |
| **IL2** | Lagrange's Method. Jacobi's Method. | 2 |
| **IL3** | Law of Inertia. | 2 |
| **IL4** | Linear Transformations and Their Matrices. | 2 |
| **IL5** | Invariant Subspaces. | 2 |
| **IL6** | Eigenvalues of a Linear Transformation. | 2 |
| **IL7** | Eigenvectors of a Linear Transformation. | 2 |
| **IL8** | Complexification of a Linear Transformation. | 2 |
| **IL9** | Self-Adjoint, Unitary, and Normal Linear Transformations. | 2 |
| **IL10** | Divisibility Tests. | 2 |
| **IL11** | Greatest Common Divisor and Least Common Multiple of Numbers. | 2 |
| **IL12** | Continued and Convergent Fractions. | 2 |
| **IL13** | Prime Numbers. | 2 |
| **IL14** | Fundamental Theorem of Arithmetic. | 2 |
| **IL15** | Congruences and Their Properties. | 2 |
| **IL16** | Multiplicative Functions. | 2 |
| **IL17** | Euler's and Fermat's Theorems. | 2 |
| **IL18** | First-Order Congruences. | 2 |
| **IL19** | Chinese Remainder Theorem. | 2 |
| **IL20** | Congruences of n-th Order Modulo Any Number. | 2 |
| **IL21** | Legendre and Jacobi Symbols. | 2 |

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|---|---|---|
| **L7** | Orthogonal complement and orthogonal projection. | 2 |
| **L8** | Linear, bilinear, and quadratic forms. Change of the matrix of a bilinear form when changing the basis. | 2 |
| **L9** | Methods for reducing a quadratic form to canonical form. | 2 |
| **L10** | Positive definite quadratic forms. Law of inertia. | 2 |
| | **Midterm exam.** | |
| **L11** | Complex Euclidean spaces. Complex spaces with linear forms. | 2 |
| **L12** | Linear transformations and their matrices. Operations on linear transformations. | 2 |
| **L13** | Inverse transformations. Image and kernel of linear transformations. | 2 |
| **L14** | Relationship between matrices of linear transformations in different bases. | 2 |
| **L15** | Invariant subspaces. Eigenvalues and eigenvectors of a linear transformation. | 2 |
| **L16** | Composite transformations. Composite transformation for a given transformation. | 2 |
| **L17** | Autocomposite transformations and their canonical form. | 2 |
| **L18** | Unitary transformations, their eigenvalues, and canonical representation. | 2 |
| | **Midterm exam.** | |
| **L19** | Interchangeable and normal transformations. | 2 |
| **L20** | Linear transformations in real Euclidean space. Orthogonal transformations. | 2 |
| **L21** | Jordan normal form of the matrix of a linear transformation. | 2 |
| **L22** | Reduction of the matrix of a linear transformation to Jordan normal form. | |
| **Total** | | **44** |
| **Form of classes: Practical (P)** | | **Hours** |
| **1st half of the year** | | |
| **P1** | Reflections. | 2 |
| **P2** | Permutations and Substitutions. | 2 |
| **P3** | Matrices and Operations on Them. | 2 |
| **P4** | Determinants and Their Properties. | 2 |
| **P5** | Minors and Algebraic Complements. | 2 |
| **P6** | The Theorem on the Rank of a Matrix. | 2 |
| **P7** | Some Methods for Calculating Determinants of n-th Order. Upper Triangular Form, Recurrence Relations. | 2 |
| **P8** | Some Methods for Calculating Determinants of n-th Order. Upper Triangular Form, Recurrence Relations. | 2 |
| **P9** | Laplace's Theorem. | 2 |
| **P10** | Inverse Matrix and Additional Properties of the Determinant. | 2 |

| | | |
|---|---|---|
| **P11** | Systems of Linear Equations and Their Solution by the Gauss Method. | 2 |
| **P12** | Methods for Solving Systems of Linear Equations: Cramer's Method and the Inverse Matrix Method. | 2 |
| **P13** | A System of Homogeneous Equations. Kronecker-Capelli Theorem. | 2 |
| **P14** | Complex Numbers and Operations on Them. De Moivre's Formula. | 2 |
| **P15** | Geometric Representation of Complex Numbers and Trigonometric Form. | 2 |
| **P16** | Extracting the Root of a Complex Number. Roots of Unity. | 2 |
| **P17** | Polynomials with One Unknown. Horner's Scheme. Bezout's Theorem. | 2 |
| **P18** | Remainder Division. The Greatest Common Divisor of Polynomials. | 2 |
| **P19** | Irreducible Polynomials and Their Properties. | 2 |
| **P20** | Rational Fractions and Their Decomposition into Simplest Fractions. | 2 |
| **P21** | Solving Algebraic Equations of the Third Degree. | 2 |
| **P22** | Solving Algebraic Equations of the Fourth Degree. | 2 |
| **P23** | Bounds of Roots, Sturm's Theorem. | 2 |
| **Total** | | **46** |
| **Form of classes: Practical (P)** | | |
| **2nd half of the year** | | |
| **P1** | n-Dimensional Vector Linear Spaces. Basis and Dimension of a Vector Space. | 2 |
| **P2** | Linear Spaces. Dimension and Basis of a Linear Space. | 2 |
| **P3** | Linear Subspace. Sum and Intersection of Subspaces. | 2 |
| **P4** | Euclidean Space. Cauchy-Bunyakovsky Inequality. | 2 |
| **P5** | Orthogonal and Orthonormal Systems. | 2 |
| **P6** | Isomorphism of Linear and Euclidean Spaces. Orthogonalization Process. | 2 |
| **P7** | Orthogonal Complement and Orthogonal Projection. | 2 |
| **P8** | Linear, Bilinear, and Quadratic Forms. Transformation of the Matrix of a Bilinear Form under a Change of Basis. | 2 |
| **P9** | Methods of Reducing a Quadratic Form to Canonical Form. | 2 |
| **P10** | Positive-Definite Quadratic Forms. Law of Inertia. | 2 |
| **P11** | Complex Euclidean Spaces. Bilinear Forms in Complex Space. | 2 |
| **P12** | Linear Transformations and Their Matrices. Operations on Linear Transformations. | 2 |
| **P13** | Inverse Transformation. Image and Kernel of a Linear Transformation. | 2 |
| **P14** | Relationship Between the Matrices of a Linear Transformation in Different Bases. | 2 |
| **P15** | Invariant Subspaces. Eigenvalues and Eigenvectors of a Linear Transformation. | 2 |
| **P16** | Adjoint Transformation. Adjoint to a Given Transformation. | 2 |
| **P17** | Self-Adjoint Transformations and Their Canonical Form. | 2 |
| **P18** | Unitary Transformations, Their Eigenvalues, and Canonical Form. | 2 |
| **P19** | Commuting and Normal Transformations. | 2 |
| **P20** | Linear Transformations in Real Euclidean Space. Orthogonal Transformations. | 2 |
| **P21** | Jordan Normal Form of the Matrix of a Linear Transformation. | 2 |
| **P22** | Reducing the Matrix of a Linear Transformation to Jordan Normal Form. | 4 |
| **Total** | | **46** |

| | | |
|---|---|---|
| **5. Independent learning (IL)** | | |
| **1st half of the year** | | |
| | | |
| **IL1** | Sets and operations on them. | 2 |
| **IL2** | Mappings. | 2 |
| **IL3** | Substitutions and permutations. | 2 |
| **IL4** | Matrices and operations on them. | 2 |
| **IL5** | Determinants and their properties. | 2 |
| **IL6** | Minors and algebraic complements. | 2 |
| **IL7** | The theorem on the rank of a matrix. | 2 |
| **IL8** | Some methods for calculating determinants of n-th order. | 2 |
| **IL9** | Upper triangular form, through recursive relations. | 2 |
| **IL10** | Upper triangular form, through recursive relations. | 2 |
| **IL11** | Laplace's theorem. | 2 |
| **IL12** | Additional properties of the inverse matrix. | 2 |
| **IL13** | Additional properties of the determinant. | 2 |
| **IL14** | Systems of linear equations and their solution by the Gauss method. | 2 |
| **IL15** | Cramer's method for solving systems of linear equations. | 2 |
| **IL16** | The method of the inverse matrix for solving systems of linear equations. | 2 |
| **IL17** | Homogeneous system of equations. | 2 |
| **IL18** | The Kronecker-Capelli theorem. | 2 |
| **IL19** | Complex numbers and operations on them. | 2 |
| **IL20** | Geometric interpretation of complex numbers. | 2 |
| **IL21** | Trigonometric form of complex numbers. | 2 |
| **IL22** | De Moivre's formula, extracting the root of a complex number. | 2 |
| **IL23** | Roots of unity. | 2 |