CURRICULUM

Affirm:
Dean:

MA101

HIGHER MATHEMATICS PART I

Accepted: Updated: Prot. №7/30.01.2019
Lecturer: Associate Professor Evgenia Nikolova, PhD

ANNOTATION

The course covers fundamental topics from Linear Algebra and Analytical Geometry. The methods of linear algebra find broad application in solving various applied problems. Additionally, elements of analytical geometry serve as a fundamental tool for investigation not only in modern mathematics but also in several areas of engineering and computer science. Introducing students to the basic knowledge from both mathematical branches enables them to handle conceptual and analytical tools when solving mathematical, engineering, and applied problems.

MAIN OBJECTIVES

The content of the curriculum is divided into two parts.

The first part, "Linear Algebra," aims to introduce the basic principles of matrix theory, determinants, complex numbers, polynomials, and systems of linear equations. Concepts of linear space, linear operators, eigenvectors, eigenvalues, and quadratic forms are also covered.

In the second part, "Analytical Geometry," some fundamental aspects of analytical geometry in the plane and space are examined.

PREREQUISITES

To successfully grasp the material outlined in the Linear Algebra and Analytical Geometry course, knowledge within the scope of basic mathematics courses from secondary educational institutions is required.

STATUTE AND STRUCTURE

specialty	status	Credits	full-time study				part-time study			
			lectures	seminars	exercises	total	lectures	seminars	exercises	total
Computer systems and technologies	Mandatory	7	30	40		70	20	15		35
Software engineering	Mandatory	7	30	40		70	20	15		35
Electricity supply and electrical equipment	Mandatory	7	30	40		70	20	15		35

specialty	status	Credits	full-time study				part-time study				distance learning			
			lectures	seminars	exercises	total	lectures	seminars	exercises	total	lectures	seminars	exercises	total
Systems engineering in industry and tourism	Mandatory	7	30	40		70	20	15		35	6	8		14

COURSE CONTENT

Topic 1. Complex numbers, algebraic form, operations, properties. Trigonometric form of complex numbers. Exponentiation and rooting, De Moivre's formulas.

Topic 2. Polynomials. Definition and operations. Division, roots of polynomials. Horner's rule. Decomposition of fractional rational functions into a sum of elementary fractions.

Topic 3. Determinants, properties. Definition and properties of determinants of nth order. Adjoint quantities and subdeterminants. Cramer's rule.

Topic 4. Matrices and matrix operations. Matrix rank. Inverse matrix. Gauss-Jordan method.

Topic 5. Systems of linear equations. Rouché–Capelli theorem. Elementary transformations and the Gauss method. Homogeneous systems of equations.

Topic 6. Linear spaces. Linear dependence, basis, dimension, and coordinates. Subspaces. Rank of a system of vectors.

Topic 7. Euclidean spaces. Scalar product. Quadratic forms and canonical form reduction.

Topic 8. Eigenvectors and eigenvalues.

Topic 9. Vectors and coordinates in the plane and space. Vector product. Scalar triple product. Area of a triangle and volume of a tetrahedron.

Topic 10. Equations of lines in the plane: general, Cartesian, segment, and normal forms. Distance from a point to a line. Mutual position of two lines in the plane.

Topic 11. General equation of a plane. Equation of a plane through three points. Segment equation of a plane. Normal equation of a plane. Distance from a point to a plane. Mutual position of two planes.

Topic 12. Analytical representation of curves and surfaces. Equations of circles and spheres.

Topic 13. Canonical equations of curves of the second order in plane. Ellipse, hyperbola, and parabola. Focal properties. Polar equations of curves of the second order in plane.

Topic 14. Canonical equations of second-order surface. Ellipsoids, hyperboloids, and paraboloids..

SEMINAR EXERCISES

Topic 1. Complex Numbers.

Topic 2. Polynomials.

Topic 3. Determinants and Matrices.

Topic 4. Systems of Linear Equations. Gauss Method.

Topic 5. Linear Spaces, Basis, Rank of a System of Vectors.

Topic 6. Eigenvectors and Eigenvalues of a Linear Operator.

Topic 7. Scalar, Vector, and Cross Product.

Topic 8. Quadratic Forms and Reduction to Canonical Form.

Topic 9. Equations of Lines.

Topic 10. Equations of Planes.

Topic 11. Analytical Representation of Curves and Surfaces.

COURSE PROJECT

The course project in Linear Algebra and Analytical Geometry aims to activate students' independent work and complement the seminar exercises. The assignments are individual for each student and are given by the lecturer at the beginning of the course. The solutions obtained are documented in a protocol consisting of two modules. In the first module, the student presents solutions to basic problems from linear algebra, and in the second module – from analytical geometry.

PLANNED EDUCATIONAL ACTIVITIES AND TEACHING METHODS

1. The first lecture aims to familiarize students with the content of the program, the goals and tasks of the discipline, as well as the requirements for preparation in the discipline.
2. Lectures cover topics from the lecture notes. Each topic ends with questions and tasks for self-preparation.
3. Students work on individual assignments during seminar sessions, which contribute to ongoing assessment.
4. Ongoing assessment is also carried out through the course project and control tests.
5. Electronic materials on the Moodle platform support students' preparation and provide opportunities to expand their knowledge on some topics. The theoretical material is presented using various resources:
    - Books contain theoretical material on the topics.
    - Pages contain brief theoretical material or additional explanations.
    - Web resources include articles, online journals, templates, and other materials.
    - Video materials include video tutorials.
    - Files.

Practical work is realized through the following resources and activities:

- Assignments: Students independently solve tasks assigned by the instructor, and the solutions are evaluated by the instructor.
- Tests: Self-preparation and self-assessment tests.
- Web resources: Articles, online journals, templates, and other materials.
- Video materials: Video tutorials for creating specific models.
- Forum: Used for consultation between students and instructors and for information exchange among students.
- Video conferencing: Used for periodic real-time consultations between students and instructors.

ASSESSMENT METHODS

Throughout the semester, ongoing assessment of acquired knowledge is conducted, with results being recorded using a points system. Ongoing assessment includes three control tests. The course project is accepted and evaluated by the seminar exercises supervisor. Students who have passed and defended both modules are allowed to take the exam. The exam is conducted in two parts – problems and theory. Only students with a positive grade on problems are allowed to take the theoretical part of the exam. The final grade is comprehensive and includes assessments from ongoing assessment,

the course project, and the exam. The total number of points determines the size of the final six-point grade according to the following scheme:

- Grade from ongoing assessment: Up to 34 points
- Grade from the course project: Up to 12 points
- Grade from the semester exam: Up to 54 points

The overall grade is determined by the sum of points throughout the semester and the exam procedure: 36-50 points – Average (3); 51-65 points – Good (4); 66-80 points – Very Good (5); Above 81 points – Excellent (6).

Students must have a minimum of 14 points from ongoing assessment during the semester and a minimum of 22 points from the exam procedure to receive a comprehensive grade.

RECOMMENDED LITERATURE

1. Е. Николова, Лекции и упражнения по линейна алгебра и аналитична геометрия, ISBN 978-619-7126-35-8, 2017
2. И. Стамова, Г. Стамов, Лекции по линейна алгебра и аналитична геометрия, Светлина, Ямбол, 2006
3. И. Стамова, Г. Стамов, Висша математика: Първа част, Светлина, Ямбол, 2008
4. Е. Николова, Ръководство за упражнения по линейна алгебра и аналитична геометрия, Янита ЯС, Бургас, 2009
5. П. Георгиева, Е. Николова, Формули по висша математика – трето преработено и допълнено издание, Полиграф, Бургас, 2018
6. П. Паскалев, К. Димитрова, Ц. Дончев, Методическо ръководство за решаване на задачи по висша математика, Ч.1. Линейна алгебра. Аналитична геометрия. Линейно оптимиране, Архимед, 2006

EXAM QUESTIONNAIRE

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