



Силабус освітнього компонента

Програма навчальної дисципліни



Analytical Geometry

Шифр та назва спеціальності
122 – Applied Mathematics

Інститут
Institute of Computer Modeling, Applied Physics
and Mathematics

Освітня програма
Computer and Mathematical Modeling

Кафедра
Applied Mathematics (170)

Рівень освіти
Bachelor

Тип дисципліни
General Education Course, mandatory

Семестр
1

Мова викладання
English

Викладачі, розробники



Anna B. Linnik

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Candidate of Sci. in Engineering, Associate Professor

With 24 years of work experience, I have authored over 60 scientific and educational-methodological works, including contributions to high-rank international journals indexed in science metrics databases such as Scopus and Web of Science. I have presented reports at distinguished international conferences. My extensive teaching experience encompasses a diverse range of mathematics courses, involving linear algebra, analytic geometry, mathematical analysis, differential equations, series theory, and field theory.

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Candidate of Sci. in Engineering, Associate Professor, Head of the Department of Applied Mathematics NTU "KhPI"

With 25 years of work experience, I have authored over 90 scientific and educational-methodological works, including contributions to high-rank international journals indexed in science metrics databases such as Scopus and Web of Science. I have presented reports at distinguished international conferences. My extensive teaching experience encompasses a diverse range of mathematics courses, involving linear algebra, analytic geometry, mathematical analysis, differential equations, series theory, and field theory.

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Загальна інформація

Анотація

The "Analytical geometry" course is tailored to form students' theoretical understanding and foster practical skills in the application of mathematical concepts and mathematical methods of specific sections of higher mathematics relevant to engineering disciplines. This course contributes to the development of skills in analyzing and modeling various processes, utilizing information and communication technologies when necessary.

Мета та цілі дисципліни

The purpose of this course is to equip students with the essential mathematical knowledge and skills required for successful professional engagement in the fields of mechanical engineering and electrical engineering. This knowledge serves as a crucial foundation for the subsequent study of disciplines incorporated into the training program within this field. The course fosters the development of logical thinking and the establishment of a solid mathematical groundwork, which is particularly vital for conducting research and solving applied problems.

Формат занять

Lectures, practical classes, individual independent work, consultations. The final control is an exam.

Компетентності

GC01. Ability to abstract thinking, analysis and synthesis.

GC02. Ability to apply knowledge in practical situations.

GC05. Ability to search, process and analyze information from various sources.

GC06 Ability to learn and master modern knowledge.

GC12. The ability to solve practical problems involving the methods of mathematics, physics and engineering.

Результати навчання

LR01. Students are expected to acquire proficiency in linear and vector algebra, analytic geometry, and the theory of limits. Furthermore, they should be adept at applying fundamental concepts and methods from the course to solve specialized problems within the domains of industrial and electric power engineering.

Обсяг дисципліни

120 hours (5 ECTS credits): lectures – 32 hours, practical classes – 16 hours, individual independent work – 72 hours

Передумови вивчення дисципліни (пререквізити)

To successfully pass the course, you need to have knowledge and skills from the elementary mathematics course of high school.

Особливості дисципліни, методи та технології навчання

The Analytical geometry course is delivered through a combination of lectures, practical classes, and consultations that incorporate multimedia technologies, in particular, Microsoft Office 365 Teams. Additionally, students engage in individual independent study to master the educational material and complete individual educational tasks. All educational materials are accessible to students via OneNote Class Notebook

Програма навчальної дисципліни

Теми лекційних занять

Topic 1 – Elements of linear algebra.

Introduction to matrices and their types. Matrix operations, including addition, subtraction, multiplication, and transposition. Determinants of second- and third-order matrices: calculation methods and main properties. Inverse matrices: definition, computation, and properties. Solving systems of linear algebraic equations (SLAE) using the inverse matrix method and Cramer's rule. Solving SLAE using Gaussian elimination and Gauss–Jordan elimination methods.

Topic 2 – Elements of vector algebra.

The concept of a vector. Linear operations on vectors, including addition, subtraction, and scalar multiplication. Decomposition of a vector in a given basis. Projection of a vector onto an axis. Representation of vectors in the Cartesian coordinate system and determination of vector coordinates. Vector operations in coordinates, including addition, scalar multiplication, and component-wise calculations. Dot product of vectors and the condition for perpendicularity. Cross product of vectors and the condition for collinearity. Mixed (triple) product of vectors and the condition for coplanarity.

Topic 3. – Elements of analytic geometry.

General equation of a plane in the Cartesian coordinate system. Various forms of plane equations and their interpretations. Lines in space: different representations of a straight line, including parametric, symmetric, and vector forms. Mixed problems involving planes and lines in three-dimensional space. Lines in a plane and their equations. Canonical equations of second-order curves: circle, ellipse, hyperbola, and parabola. Reduction of general second-order equations to canonical forms and identification of the corresponding curve type.

Теми практичних занять

According with lectures:

Topic 1 – Elements of linear algebra

Matrix operations. Computing determinants of 2-nd and 3-d order. Solving SLAE by Cramer's rule. Computing inverse matrix. Solving SLAE using inverse matrix. Solving SLAE using Gaussian elimination and Gauss–Jordan elimination methods.

Topic 2 – Elements of vector algebra.

Linear operations on vectors. Decomposition of vector. Coordinates in new basis. Vectors dot product. Vector cross product. Vector mixed product.

Topic 3. - Elements of analytic geometry

Solving the problems on finding the equation of plane in space. Line in space. Mixed problems on a plane and a straight line in space. Problems on finding the equation of straight line in plane. Second order curves, determining curve type (circle, ellipse, hyperbola, parabola), plotting curves. Finding the canonical equations of the second order curves by completing the full square.

Теми лабораторних робіт

Not provided

Самостійна робота

The course involves students' engagement with lecture materials, preparation for practical classes, completion of individual tasks, and readiness for tests. Supplementary materials for individual independent study on course topics are also provided to students. Throughout the semester, students are evaluated on their performance in individual home tasks (IHZ), which are composed of assignments aligned with the semester's themes, namely:

1. Solving homogeneous systems of linear algebraic equations using the Gauss and Jordan-Gauss methods.
2. Applying vectors to solve geometric problems..
3. Using analytical geometry methods to solve a series of geometric tasks in both the plane and space.

Література та навчальні матеріали

Basic references

1. Rudnyeva G.V. Elements of linear algebra and analytic geometry. Second revised and expanded edition: textbook / G.V.Rudnyeva – Kharkiv: Panov A.M., 2020. – 236 p..
2. Higher mathematics. Problem solving and variants of typical calculations. Edited by Dr.Sci.Tech. Kurpa L.V. – Kharkiv: NTU “KhPI”, 2004. – Volume 1.

Additional references

3. Barry Spain. Analytical Geometry. Pergamon Press New York. 1963. - 143 p.
Howard Anton, Calculus with Analytic Geometry, 3rd ed., New York, John Wiley & Sons, 1988.
4. Tolasa F.T. Matrix and Determinant: Matrix, determinant, system of linear equation and methods of solving linear equation. LAP LAMBERT Academic Publishing, 2021. - 52 p.

Система оцінювання

Критерії оцінювання успішності студента та розподіл балів

The final grade for the semester is determined by combining the points earned during the semester (80 points) and those obtained in the exam (20 points). The exam comprises a written assignment, which includes one theoretical question and two practical problem-solving questions, followed by an oral presentation.

The current evaluation, accounting for 80%, comprises three control works, three individual obligatory tasks, and two tests. During the intervals between modular knowledge assessments, students are engaged in independent work, as outlined in the educational program.

Шкала оцінювання

Сума балів	Національна оцінка	ECTS
90–100	Відмінно	A
82–89	Добре	B
75–81	Добре	C
64–74	Задовільно	D
60–63	Задовільно	E
35–59	Незадовільно (потрібне додаткове вивчення)	FX
1–34	Незадовільно (потрібне повторне вивчення)	F

Норми академічної етики і політика курсу

The student is required to adhere to the Code of Ethics for Academic Relations and Integrity of NTU 'KhPI,' demonstrating discipline, education, benevolence, honesty, and responsibility. Any conflict situations should be openly discussed within study groups with the teacher. If it proves impossible to resolve the conflict at this level, it should be brought to the attention of the institute's directorate employees.

The regulatory and legal support for implementing the principles of academic integrity at NTU 'KhPI' is available on the website: <http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/>

Погодження

Syllabus approved by

Date of approval, signature

Head of the AM Department
Vyacheslav BURLAYENKO

Date of approval, signature

Garantee of EP
Oksana TATARINOVA