



Силабус освітнього компонента Програма навчальної дисципліни



Higher Mathematics Part 1

Шифр та назва спеціальності
133 – Industrial engineering
141 - Electric power engineering

Інститут
IES in Mechanical Engineering and Transport
IES in Power Engineering, Electronics and Electromechanics

Освітня програма
Industrial engineering
Electric power engineering

Кафедра
Applied Mathematics (170)

Рівень освіти
Bachelor

Тип дисципліни
General Education Course, mandatory

Семестр
1

Мова викладання
English

Викладачі, розробники



Vyacheslav N. Burlayenko

Viacheslav.Burlaienko@khi.edu.ua

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.

More details on the web-page: <https://web.kpi.kharkov.ua/apm/personal-nistorinki/burlayenko-v-yacheslav-mikolajovich/>

Загальна інформація

Анотація

The "Higher Mathematics" 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

180 hours (6 ECTS credits): lectures – 32 hours, practical classes – 48 hours, individual independent work – 100 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 'Higher Mathematics' 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.

Програма навчальної дисципліни

Теми лекційних занять

Topic 1 – Elements of linear algebra.

Matrices. Matrix operations. Determinants of 2-nd and 3-d order, computation. Solving system of linear algebraic equations (SLAE) by Cramer's rule. Cofactors. Main properties of determinants. Inverse matrix. Solving SLAE using inverse matrix. Basic minors and matrix rank. Matrix elementary transforms. Computing matrix rank. SLAE. Kronecker-Capelli theorem. Gaussian elimination method for solving SLAE. Methods by Jordan-Gauss for solving SLAE. Finding the fundamental system of solutions of homogeneous SLAE.

Topic 2 – Elements of vector algebra.

Concept of vector. Linear operations on vectors. Decomposition of the vector in basis. Projection of vector on axis. Coordinates in Cartesian coordinate system. Vector coordinates. Vector operations in coordinates. Vectors dot product. Condition of perpendicularity. Vector cross product. Condition of collinearity. Vector mixed product. Condition of coplanarity.

Topic 3. – Elements of analytic geometry

General equation of plane in Cartesian coordinate system. Different types of planes' equations. Line in space - various types of equations of straight line in space. Mixed problems of plane and line in 3-D space.

Line in plane. Canonic equations of second order curve: circle, ellipse, hyperbola, parabola. Reducing of the general second order equations to canonical equations of the curves

Topic 4. Limits and continuity of functions.

Elements of theory of sets. Number sequences. Limit of number sequence. Basic elementary functions. Limit of function at point and at infinity. Infinitesimals and infinitesimals. Properties of infinitesimals. Main theorems of function limits. Limit existence tests. Comparing infinitesimals. Properties of equivalent infinitesimals. First and second remarkable limits. Continuous functions. Properties of continuous functions. Classification of discontinuities.

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. Computing matrix rank. Studying consistence of SLAE. Gaussian elimination method for solving SLAE. Solving SLAE by the Jordan-Gauss method. Homogeneous systems.

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.

Topic 4. Limits and continuity of functions.

Basic functions. Domain of function. Limit of number sequence. Limit of function. Evaluating

indeterminate forms $\left\| \frac{\infty}{\infty} \right\|$, $\|\infty - \infty\|$, $\left\| \frac{0}{0} \right\|$, $\|0 \cdot \infty\|$. Computing limits using first and second remarkable limits. Evaluating indeterminate form $\|1^\infty\|$. Studying function continuity property.

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. Studies on revising school material in algebra and geometry.
2. Solving homogeneous systems of linear algebraic equations using Jordan-Gauss method.
3. Double Vector product.
4. Equation of lines in plane in the polar coordinate system.
5. Surfaces in space.
6. Comparison of infinitesimals.

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.

3. Kurpa L.V., Shmatko T.V. Differential and Integral Calculus for One Variable Functions: Textbook. – Kharkiv: NTU KhPI: 2017.-324 pages

Additional references

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 pages
 5. Terri Manthey, College Algebra for the Managerial Sciences.
 6. Howard Anton, Calculus with Analytic Geometry, 3rd ed., New York, John Wiley & Sons, 1988
 7. Mahmudov E. Single Variable Differential and Integral Calculus: Mathematical Analysis. Atlantis Press, Paris, France, 2013. - 369 pages

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 for Industrial engineering
Iryna TYNIAKOVA

Date of approval, signature

Garantee of EP for Electric power engineering
Hanna OMELIANENKO