



Силабус освітнього компонента Програма навчальної дисципліни



Higher Mathematics Part 4

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
4

Мова викладання
English

Викладачі, розробники



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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.

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. Proficiency in finding solutions of ordinary differential equations and system of ordinary differential equations of the first order, computing multiple integrals and curvilinear integrals, and applying them to solve geometric and mechanical problems. This mastery is crucial for utilizing mathematical tools and methods in the study of other mathematical courses and their application in the fields of industrial and electric power engineering.

Обсяг дисципліни

90 hours (3 ECTS credits): lectures – 16 hours, practical classes – 32 hours, individual independent work – 42 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 and the topics of the first, second and third semesters.

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 Vector Calculus.

Definitions of scalar and vector fields. Level surfaces and lines, directional derivatives, gradient of scalar fields. Vector lines of vector fields. Concept of the flux of the vector field. The divergence of the field. The theorem by Ostrogradsky-Gauss. Linear integral of the vector field. Circulation. Concept of the curl. The theorem by Stokes in vector form. Types of the vector fields. Finding the potential of the potential fields.

Topic 2. – Numerical Series.

The concept of the numerical series. Properties of the convergent series. Necessary condition for convergence. Comparison tests of the series with positive terms. D'Alembert's ratio test for convergence. Integral and root tests by Cauchy for convergence. Alternating series. Absolute and conditional convergence. Alternating series. Theorem by Leibniz.

Topic 3. - Functional Series.

The concept of functional series. Uniform convergence. Test by Weierstrass. Integration and differentiation of the functional series. Power series. Abel's theorem. Taylor's series and Maclaurin's

series. Expansion the functions in Taylor's series and Maclaurin's series. Fourier's series. Problem formulation. Orthogonality of the trigonometric system of functions. The Fourier's series for a function with period $2l$. Fourier's series for even and odd functions. The expansion of a nonperiodic function in a Fourier's series.

Теми практичних занять

According with lectures:

Topic 1 – Elements of Vector Calculus.

Calculation of curvilinear and surface integrals of the first and the second kind. Finding the level surfaces and lines, the directional derivatives and the gradient of scalar fields. Finding the vector lines of the vector field. Calculation of the flux and the divergence of the vector field. Application of the theorem by Ostrogradsky-Gauss to find the flux. Finding the circulation and the curl of the vector field. Application of the Stokes's theorem. Analyzing the type of the vector field.

Topic 2 – Numerical Series.

Finding the sums of convergent series. Comparison tests for convergence: standard and limited test. Application of the convergence tests to the series with positive terms - D'Alembert's ratio, Integral and root tests. Investigation of the absolute and conditional convergence of alternating series by Leibniz theorem.

Topic 3. - Functional Series.

Finding the domains of convergence of the functional and power series. Integration and differentiation of the functional series. Integration and differentiation of the functional series. Power functions. Intervals of the convergence. Expansion the functions in Taylor's series and Maclaurin's series. Application of the Series for approximate calculations. The expansion of a function in a Fourier's series.

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. Revising lecture contents on multiple integrals and curvilinear and surface integrals.
2. Application of Ostrogradsky-Gauss and Stokes's theorems in mechanical problems.
3. Application of Taylor's, Maclaurin's and Fourier's series for approximate calculations.

Література та навчальні матеріали

Basic references

1. Higher mathematics. Problem solving and variants of typical calculations. Edited by Dr.Sci.Tech. Kurpa L.V. – Kharkiv: NTU “KhPI”, 2004. – Volume 3.
2. Higher mathematics. Problem solving and variants of typical calculations. Edited by Dr.Sci.Tech. Kurpa L.V. – Kharkiv: NTU “KhPI”, 2004. – Volume 4.
3. L.V. Kurpa, T.V.Shmatko. Differential and integral calculus for functions with several variables: Textbook. – Kharkiv: NTU KhPI: 2012.

Additional references

4. Wrede R., Spiegel M. Schaum's Outline of Advanced Calculus, 3rd Ed. McGraw-Hill Companies, Inc. 2010.
5. Bromwich T. J. I'a. An Introduction To The Theory Of Infinite Series. Multicultural Books & Videos. 2017. - 528 pages.
6. Pramod S. Joag. An Introduction to Vectors, Vector Operators and Vector Analysis. Cambridge University Press. 2016. - 520 pages.

7. Marsden Jerrold E. and Tromba Anthony. Vector Calculus. W. H. Freeman and Company Publishers. 6th Ed. 2012. - 578 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