



Syllabus Course Program



Higher Mathematics, Part 3

Specialty

141 – Electric power engineering
171 – Electronics

Educational program

Electronics; Electric cars and automotive electronics

Level of education

Bachelor

Semesters

3

Institute

IES in Power Engineering, Electronics and Electromechanics

Department

Applied Mathematics (170)

Course type

General Education Course, mandatory

Language of instruction

English

Lecturers and course developers

**Larysa Dzyubak**

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Ph.D. in Physics and Mathematics,
Associate Professor of the Department of Applied Mathematics NTU “KhPI”

Work experience: over 25 years

Number of scientific and educational-methodological works: over 70

Number of papers indexed in Scopus and Web of Science: 19

Chapters in books: 3

Number of presentations at international scientific conferences: 30

Main courses: Higher Mathematics, Mathematical Analysis, Linear Algebra, Analytic Geometry

More details on the web-page:

<https://web.kpi.kharkov.ua/apm/personal/larisa-p-dzyubak/>

General information

Summary

The present Higher Mathematics Part 3 course covers the following main topics: Differential equations, Differential and integral calculus of functions of several variables, Curvilinear integrals and Surface Integrals.

Course objectives and goals

The primary aim of Higher Mathematics Part 3 is to deepen students' understanding of advanced mathematical concepts and techniques essential for modeling, analyzing, and solving complex problems in science and engineering. By the end of the course, students will be able to: understand and solve ordinary differential equations (ODEs) and apply them to real-world systems; master the calculus of multivariable functions, including multiple integrals and their applications in optimization and physical modeling; evaluate curvilinear and surface integrals, and understand their significance in vector calculus, particularly in the context of physics and engineering; apply key theorems such as Green's, Stokes', and

Gauss' Theorem to interpret and solve problems involving vector fields; prepare for advanced coursework in applied mathematics, physics, engineering, or related disciplines.

Format of classes

Lectures, practical classes, tests, self-study, consultations. The final control is an exam.

Competencies

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.

Learning outcomes

LR01. By the end of this course, students will be able to: solve first-order and higher-order ordinary differential equations, compute multiple integrals and apply them to real-world problems in physics and engineering, evaluate curvilinear integrals and surface integrals, and interpret their physical significance; apply Green's Theorem, Stokes' Theorem, and Gauss' Divergence Theorem to problems involving vector fields, use mathematical reasoning to formulate and solve complex problems involving multivariable functions and differential equations.

Student workload

90 hours (3 ECTS credits): lectures – 16 hours, practical classes . 32 hours, individual independent work – 55 hours.

Course prerequisites

To succeed in Higher Mathematics Part 3, students should have completed the following: Higher Mathematics Part 1 and Part 2, or equivalent coursework covering: single-variable calculus (limits, derivatives, integrals), basic linear algebra (matrices, vectors, systems of equations), ability to follow and construct rigorous mathematical arguments, work with abstract concepts, and solve problems independently.

Features of the course, teaching and learning methods, and technologies

The 'Higher Mathematics Part 3' course is delivered through lectures, practical classes, tests, 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.

Program of the course

Topics of the lectures

Topic 1. Introduction to Differential Equations. First-Order Linear Differential Equations

Topic 2. Special Forms and Higher-Order Equations

Topic 3. Second-Order Linear Differential Equations

Topic 4. Higher-Order and Systems of Differential Equations

Topic 5. Double and Triple Integrals

Topic 6. Curvilinear Integrals (First Kind)

Topic 7. Line Integrals and Green's Theorem

Topic 8. Surface Integrals and Vector Calculus Theorems

Topics of the workshops

- Topic 1. Separable and Homogeneous Equations
- Topic 2. First-Order Linear Equations
- Topic 3. Exact Differential Equations
- Topic 4. Special Forms of First-Order Equations
- Topic 5. Second-Order Equations Reducible to First-Order
- Topic 6. Homogeneous Linear Equations of Second Order
- Topic 7. Inhomogeneous Linear Equations of Second Order
- Topic 8. Higher-Order and Systems of Differential Equations
- Topic 9. Double Integrals in Cartesian Coordinates
- Topic 10. Applications of Double Integrals
- Topic 11. Double Integrals in Polar Coordinates
- Topic 12. Triple Integrals in Various Coordinate Systems
- Topic 13. Curvilinear Integrals of the First Kind
- Topic 14. Curvilinear Integrals of the Second Kind & Green's Theorem
- Topic 15. Surface Integrals of the First and Second Kind
- Topic 16. Vector Calculus Theorems

Topics of the laboratory classes

Not provided

Self-study

The course involves students studying lecture material, preparing for practical classes, completing individual assignments, preparing for tests, and independently processing material on course topics.

The topics for individual assignments and tests throughout the course are as follows:

1. Differential equations and systems of differential equations.
2. Integral calculus of a function of several variables.

Course materials and recommended reading

1. L.V. Kurpa, O.S. Mazur, T.V.Shmatko. Differential Equations and Series: Textbook. – Kharkiv: NTU "KhPI": 2013.
2. L.V. Kurpa, T.V.Shmatko. Differential and integral calculus for functions with several variables: Textbook. – Kharkiv: NTU "KhPI": 2012.
3. Higher mathematics. Problem solving and variants of typical calculations. Edited by Dr.Sci.Tech. Kurpa L.V. – Kharkiv: NTU "KhPI", 2004. – Volume 3.
4. Higher mathematics. Problem solving and variants of typical calculations. Edited by Dr.Sci.Tech. Kurpa L.V. – Kharkiv: NTU "KhPI", 2004. – Volume 4.

Assessment and grading

Criteria for assessment of student performance, and the final score structure

Individual homework assignments (30%),
Control works / Tests (30%),
Colloquium (20%),
Final Exam (20%).

Grading scale

Total points	National	ECTS
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.

Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: <http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/>

Approval

Approved by

Date, signature

Head of the AM Department
Vyacheslav BURLAYENKO

Date, signature

Guarantor of the educational
program
Viacheslav KULICHENKO