



## Syllabus Course Program

# Higher Mathematics

### Specialty

073 – Management

### Institute

Educational and Scientific Institute of  
MECHANICAL ENGINEERING AND TRANSPORT

**Educational program** Management  
of organization and administration /  
Business administration

### Department

Higher Mathematics (155)

### Level of education

Bachelor's level

### Course type

Fundamental.  
Mandatory

### Term

1

### Language

English

## Lecturers and course developers



### Tetyana SHMATKO

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PhD, Associate Professor of Higher Mathematics Department

Experience is 25 years. Author and co-author of more than 100 scientific and methodological works. Leading lecturer in the discipline "Higher Mathematics"

General information, number of publications, main courses, etc  
More about the lecturer on the department's website

<http://web.kpi.kharkov.ua/vm/pro-kafedru/personaliyi/shmatko-ukr/>

## General information

### Summary

The course covers the basic concepts of linear algebra, analytical geometry and mathematical analysis, it is the basis of special mathematical disciplines of economic-mathematical modeling. This provides all aspects of students' formation of a system of basic theoretical and practical mathematical knowledge and competences that are necessary for solving complex specialized tasks and problems in the fields of business, trade and stock exchange activities, development of skills in mathematical research of applied problems, formation of logical thinking.

### Course objectives and goals

The goal of mathematical training of students is to teach research methods and solve mathematically formalized problems, search for optimal solutions, develop the ability to analyze results, give skills for successful independent work.

### Format of classes

Lectures, practical classes, consultations. A final exam is an estimation of the course.

## Competencies

GC03 - Ability to abstract thinking, analysis, synthesis.

GC09 - Ability to learn and master modern knowledge.

## Learning outcomes

LO16. Demonstrate the skills of independent work, flexible thinking, openness to new knowledge, be critical and self-critical.

## Student workload

The total volume of the course is 180 hours (6 ECTS credits): lectures - 32 hours, practical classes - 48 hours, self-study- 100 hours

## Course prerequisites

To successfully complete the course, you must have knowledge and practical skills in the following basic disciplines: algebra, geometry (planimetry, stereometry), mathematical analysis (school course)

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

Interactive lectures with presentations, discussions

## Program of the course

### Topics of the lectures

#### Topic 1. Elements of linear algebra

Matrices. Determinants. Solution of the systems of linear algebraic equations by Kramer's rule, by method of an inverse matrix and the Gauss method

#### Topic 2. Elements of vector algebra and analytic geometry

Coordinates of the vector. Scalar, vector, mixed products of vectors and their application. Plane. Straight line in plane and space. Curves of the second order.

#### Topic 3. Limits. Continuity of functions

Number set. Actions on sets. Elementary functions. Function definition and its basic properties. The limit of a numerical sequence. The limit of a function. Calculation of limits using the first and second remarkable limits. Continuity of the functions. Discontinuity points of a function and their classification.

#### Topic 4. Derivative. Differentiation technique

Definition of the derivative, its mechanical and geometric applications. Differentiation rules. Derivatives of basic elementary functions. Differential of the function. Application of the derivative in economic analysis. Derivatives and differentials of the higher orders.

#### Topic 5. Investigation of the function using the differential calculus of one variable function

Basic theorems of differential calculus: theorems of Rolle, Cauchy and Lagrange. Monotonicity intervals, extremum points of a function. Convexity, concavity of the function graph, inflection points: necessary and sufficient conditions. Asymptotes of the function graph.

#### Topic 6. Indefinite integral

Concept of indefinite integral. Table of integrals. The simplest methods of integration. Basic integration methods.

#### Topic 7. The definite integral and its application

Properties of the definite integral. Newton-Leibniz formula. Integration by parts and replacement of the variable in the definite integral. Calculation of the area of the flat figures. Improper integrals.

### Topic 8. Functions of several variables

Domain definition of a function of several variables. Partial derivatives of functions of several variables. Differentiation of implicit functions. Extrema of a function of two variables. Equations of normal and tangent plane using the partial derivatives.

### Topics of the classes

#### Topic 1. Elements of linear algebra

Operations on matrices. Calculation of determinants of arbitrary order by various methods. Solution of SLAE by means of Kramer's formulas, inverse matrix and the Gauss method.

#### Topic 2. Elements of vector algebra and analytic geometry

Arithmetic operations with vectors. Solving problems using the concept of the scalar, vector and mixed products. Solving the problem about straight line and plane in space. Solution of problems for the curves of the second order: ellipse, circle, parabola, hyperbola.

#### Topic 3. Limits. Continuity of functions

Basic elementary functions, their properties and graphs. The simplest rules for calculating limits. Application of the first and second remarkable limits to calculate the limits. Properties of continuous functions. Discontinuity points of the function.

#### Topic 4. Derivative. Differentiation technique

The derivative, its geometric and economic meaning. Table of derivatives, rules for calculating derivatives. Differentiation of the complicate, implicit and parametrically defined function.

#### Topic 5. Investigation of the function using the differential calculus of one variable function

Investigation on extremum and monotonicity intervals of the function. Investigation and constructing the graph of the function using the main concepts of differential calculus.

#### Topic 6. Indefinite integral

The simplest methods of integration. Integration by the method of variable substitution. Integration by parts.

#### Topic 7. The definite integral and its application

Application of the Newton-Leibniz formula. Integration by parts and replacement of the variable in the definite integral. Calculation of the area of flat figures by means of the definite integral.

#### Topic 8. Functions of several variables

Problems with domain definition of a function of several variables. Partial derivatives of functions with two or three variables. Mixed partial derivatives. Extrema of a function of two variables.

### Topics of the laboratory classes

This field is filled in the same way if the curriculum includes laboratory classes.

### Self-study

Students' independent work consists of studying lecture material, preparing for practical classes, and completing individual tasks (research and development).

### Course materials and recommended reading

1. Kurpa L. V. Higher mathematics: Problems solving and variants of typical calculation. Volume 1. Kharkiv: NTU KhPI - 316 p.

2. Kurpa L.V., Shmatko T.V. Differential and Integral Calculus for One Variable Functions – Kharkiv: NTU KhPI: 2017. – 324 p.
3. Kurpa L.V., Linnik A.B., Shmatko T.V. Mathematical analysis in examples and problems. – Volume 1. – Харків: HTY «XIII», 2024. – 209с.
4. Mulyk O. Calculus: part I. Differential calculus of function of one variable - Kyiv : Igor Sikorsky Kyiv Polytechnic Institute, 2022. – 117 p.
5. Zhuravska G.V. Higher Mathematics. Differential Calculus of a Function of One Variable. Elements of Theory – Kyiv : Igor Sikorsky Kyiv Polytechnic Institute, 2019. – 81 p.

## Evaluation and grading

### Criteria for evaluation of student study, and the final score structure

In each term, 100% of the final grade consists of evaluating results in the form of an exam (20%) and current evaluation (80%).

Exam: writing task and oral presentation.

Current evaluation: independent works, control works and individual home tasks.

### 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

**Head of the department**  
Iuliia PERSHYNA

**Guarantor of the educational program**  
Olena PROKHORENKO