HIGHER MATHEMATICS

COURSE SYLLABUS

Code and name of specialty	**073 – Management**	**Faculty**	**Computer Science and Software Engineering**
Program name	**Management of Organizations and Administration / Business Administration (in English)**	**Department**	**Computer mathematics and data analysis**
Type of program	**Educational and Professional**	**Language of instruction**	**English / Ukrainian**

LECTURER

Олег Тоніца, ***Oleh.Tonitsa@khpi.edu.ua***

PhD in Physics & Mathematics,Associate professor of Computer mathematics and data analysis Department (NTU "KhPI")
Authored and co-authored over 50 scientific publications. Course: Higher mathematics

GENERAL DESCRIPTION OF THE COURSE

Summary	The course covers the basic concepts of linear algebra, analytical geometry and mathematical analysis, Is the basis for special mathematical disciplines of economic and mathematical modeling.
Course objectives	The purpose of mathematical training of students - to teach methods of research and solving mathematically formalized problems, finding optimal solutions, developing the ability to analyze the results, to give the skills of independent work with scientific literature.
Types of classes and control	Lectures, workshops, consultations. The course ends with a final exam
Term	1

Student workload (credits) / Type of course	6 / Mandatory	**Lectures (hours)**	32	**Workshops (hours)**	48	**Self-study (hours)**	100

Program competences	GC03. The ability to abstract thinking, analysis, synthesis. GC09. The ability to learn and to master the modern knowledge.

Learning outcomes	**Teaching and learning methods**	**Forms of assessment (continuous assessment CAS, final assessment FAS)**
LO 16. To demonstrate skills of independent work, flexible thinking, openness to new knowledge, be critical and self-critical.	Interactive lectures with presentations, discussions	Written Individual Assignments (CAS), Exam as individual task (FAS)

ASSESSMENT AND GRADING

	core (points) for all types of learning activities	ECTS grading scale	The national grading scale		
Ranges of points corresponding to grades	90-100	A	excellent	**Allocation of grade points**	100% final assessment in the form of EXAM (40%) and current assessment (60%). 40% EXAM: individual task (calculation task) and its oral presentation 60% current rating: • 30% assessment of tasks in practical classes (task solving); • 30% intermediate control (2 online tests)
	82-89	B	good		
	74-81	C			
	64-73	D	satisfactory		
	60-63	E			
	35-59	FX	Unsatisfactory (with the exam retake option)		
	0-34	F	Unsatisfactory (with mandatory repetition of the course)		

Course policy	Students are expected to attend classes regularly, to get to class on time and stay for the duration of the class. In the case of absence, students will be required to submit all assignments to make up for the missed classes. Students are also expected to come to class having read all the required material and being ready to productively participate in the class discussions. Written assignments should be submitted before the specified deadlines.

COURSE STRUCTURE AND CONTENT

Lecture 1	Definition of a matrix, types of matrices, performance of actions with matrices. Determinants of arbitrary order, their properties and calculations. Inverse matrix and its calculations. Solving matrix equations AX = B using an inverse matrix. Cramer's formulas for solving SLAE.	**Workshop 1-2**	Performing actions on matrices. Calculation of determinants of arbitrary order by different methods. SLAR solution by Cramer's formulas.	**Self-study**	Studying the main notions of linear algebra.
Lecture 2	Rank and minor of the matrix. Base minor. Elementary matrix transformations. Jordan-Gauss method. Homogeneous SLAE.	**Workshop 3-5**	SLAE solution by Jordan-Gauss method. Solution of homogeneous SLAE.		Solution of systems of linear algebraic equations.
Lecture 3	Vectors: basic definitions. Linear dependence and independence of vectors. Decomposition of a vector by three non-coplanar vectors in space. Projection of the vector on the axis. Vector product of two vectors, properties, calculations. Mixed product of three vectors, properties, calculations, geometric content.	**Workshop 6-7**	Arithmetic operations with vectors. Solving problems using the concept of scalar product of two vectors. Solving problems on the vector product of two vectors and on the mixed product of three vectors.		Studying the main notions of vector algebra.
Lecture 4	Plane: its vector and general equations. Different means of setting the plane, the distance from the point to the plane. Direct in space: its vector, canonical and parametric equations. Mutual location of the line and the plane. Right on the plane. Types of equations, the angle between two lines, the distance from a point to a line.	**Workshop 8**	Problem solving: line and plane in space. Solving problems about a line in a plane. Application of line equations in problems with economic content.		Solving of problems on straight and plane in space.

Lecture 5	Second order curves: circle and ellipse: definition, equation, eccentricity, directrix. Hyperbola and parabola: definitions, equations.	**Workshop 9**	Solving problems: ellipse, circle, parabola, hyperbola.		Solving problems related to the study of properties of ellipse, circle, parabola, hyperbola.
Lecture 6	Limit of numerical sequence and function, its economic content. Properties of convergent sequences. Infinitely small and infinitely large numerical sequences: definitions, properties. The first and second important border. Continuity of the function. Properties of continuous functions. Breakpoints of the function and their classification.	**Workshop 10-13**	Basic elementary functions, their properties and graphs. The simplest rules for calculating boundaries. Apply the first important boundary to calculate boundaries		Studying of main notions of mathematical analysis.
Lecture 7	Derivative, its geometric and economic meaning. Table of derivatives, rules for calculating derivatives. Derived from a complex, inverse and parametrically given function. Differential, its geometric and economic meaning.	**Workshop 14-15**	Differentiation using a table of derivatives. Application of the derivative in economic analysis		Studying of main notions of differential calculus.
Lecture 8	Derivatives and higher order differentials. Leibniz formula. Lopital's rule.	**Workshop 16**	Calculation of derivatives of a complex, inverse and parametrically given function. Calculation of derivatives of a function that is given implicitly. Derivatives and higher order differentials.		Study of methods for finding derivatives.
Lecture 9	Growth, decline of functions. Extreme function. Necessary and sufficient conditions of the extremum. Convexity and concavity. Intersection points. Necessary and sufficient conditions of convexity, concavity, asymptotes.	**Workshop 17**	Research of functions.		Function research and graphing.
Lecture 10	Indefinite integral, its properties. Table of the simplest integrals.	**Workshop 18**	Integration by variable replacement method.		Investigation of methods for substituting a variable in the indefinite integral.
Lecture 11	Variable replacement and integration by parts in the indefinite integral.	**Workshop 19**	Integration by parts.		Application of variable replacement and part integration methods.
Lecture 12	Defined integral, its properties, Newton-Leibniz formula. The simplest means of integration	**Workshop 20**	Integration by replacing a variable in a definite integral.		Study of basic concepts related to the definite integral.
Lecture 13	Improper integrals. Signs of convergence.	**Workshop 21**	Calculation of improper integrals of the first kind. Calculation of improper integrals of the second kind.		Study of basic concepts related to the improper integral.

Lecture 14	Functions of many variables: general concepts. Partial derivatives, gradient. First order differentials.	**Workshop 22**	Calculation of partial derivatives of the function of many variables.		Study of basic concepts related to the functions of many variables.
Lecture 15	Extremes of functions of many variables. Necessary and sufficient living conditions. Conditional extremum, the method of indefinite Lagrange factors.	**Workshop 23**	Calculation of function extremum of many variables.		Investigation of functions of mane variables.
Lecture 16	The concept of double integral, basic properties, calculations.	**Workshop 24**	Calculation of double integrals.		Study of main notions related to the double integrals.

RECOMMENDED READING

Compulsory

1. Kurpa, L. V. (2004). Higher mathematics: Problems solving and variants of typical calculation. Volume 1.Kharkiv: NTU KhPI.
2. David Cherney, Tom Denton, Rohit Thomas and Andrew Waldron (2013). Linear algebra. Davis California.
3. Gilbert Strang (2020) Linear Algebra and Its Applications. Davis California.
4. Piskunov NS Differential and integral calculus. - M: Nauka, 1985.
5. Mathematics for economists. Textbook, ed. Kurpa LV - Kharkiv: KhGPU, 2002.
6. Timchenko LS, Kirillova NA, Garder SE, Dubinina ON Probability theory and mathematical statistics. - Kharkiv: NTU "KhPI", 2006.
7. Bugrov JS, Nikolsky SM Elements of linear algebra and analytic geometry. - M: Nauka, 1984.
8. Ilyin VA, Poznyak EG Analytical geometry. - M: Nauka, 1988.
9. Berman G.N. Collection of problems for the course of mathematical analysis. - M: Nauka, 1985.

Recommended

1. Elihman Mahmudov. (2013) Single variable differential and integral calculus. Paris: Atlantis Press.
2. Kletenik DV Collection of problems in analytical geometry. - M.: Fizmatgiz, 1970.
3. Proskuryakov IV Collection of problems in linear algebra. - M .: Fizmatgiz, 1970.
4. Linear algebra. Textbook, ed. prof. Л.В.Курпы. - Kharkiv, KhGPU, 2000.
5. Fichtenholtz GM Fundamentals of mathematical analysis.- M .: GITL, 1956. - Vol.1,2.
6. Ilyin VA, Poznyak EG Fundamentals of mathematical analysis. – M .: Nauka, 1973.
7. Zamkov OO, Tolstopyatenko AV, Cheremnykh Yu.N. Mathematical methods in economics.- M .: "DIS", 1998.

Academic integrity

Students are expected to adhere to the Code of Ethics of Academic Relations and Integrity of NTU “KhPI”.

The content of this syllabus is consistent with the Higher mathematics course program.