

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
 NATIONAL AVIATION UNIVERSITY
 Faculty of Transportation, Management and Logistics
 Higher Mathematics Department

AGREED

Dean of Faculty of Economy and Business
 Administration

_____ S. Smerichevskiy

«__» _____ 2021

APPROVED

Vice-Rector for Academics

_____ A. Polukhin

«__» _____ 2021



Quality Management System

COURSE TRAINING PROGRAM

on

«Higher Mathematics»

Field of Study: 07 «Management and Administration»


Specialty: 075 «Marketing»

Educational Professional Program: «Marketing»

Training Form	Semesters	Total (hours/credits ECTS)	Lectures	Practical classes	Self-study	HW/C GP	Semester Grade
full-time	1	150/5	34	34	82	1 HW-1s.	Exam-1s

Index CB - 6-075-1/21 -2.1.1

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Course Training Program on "Higher Mathematics" is developed on the basis of the Educational Professional Program on «Marketing», Bachelor Curriculum and Extended Curriculum №CB-6-075-1/21, №ECB-6-075-1/21 for Speciality 075 “Marketing” and corresponding normative documents.

Developed by:

Senior lecturer
of the Higher Mathematics Department _____ T. Levkovska
Ph.D in Mathematics, Associate Professor
of the Higher Mathematics Department _____ I.Klyus

Discussed and approved by the Department of Higher Mathematics, Minutes № ___ of
"___" _____2021.

Head of the Department _____ I. Lastivka


Discussed and approved by the Graduate Department for Speciality 075 «Marketing»,
Specialization 075 «Marketing» and Educational Professional Program «Marketing» -- Marketing
Department, Minutes № ___ of "___" _____ 2021.

Guarantor of the educational professional program _____ V.Sibruk

Head of the Department _____ T.Kniazieva


Vice Rector on International
Collaboration and Education
_____ I. Zarubinska
«___» _____2021

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INTRODUCTION

The Course Training Program of the subject "Higher mathematics" is developed on the basis of the "Methodical guidance for the development of a course training program of the subject", approved by the order № 249/оД. dated 29.04.2021 p. correspondent normative documents.

1. EXPLANATORY NOTE

1.1. Place: this training course is the theoretical basis of knowledge and skills required to master the vast majority of disciplines of professional and practical training in the field of economics.

Objectives of teaching the discipline is to teach students to master the appropriate mathematical tools, which should be sufficient to develop mathematical models related to the further practical activities of specialists.

Tasks of the subject are:

- development of logical and algorithmic thinking of students;
- mastering the necessary theoretical knowledge and the main directions of their application in the system of disciplines in the specialty;
- mastering the methods of research and solving mathematical problems;
- instilling primary skills in mathematical research of applied problems;
- developing the ability to independently use the necessary methods and special literature in solving problems.

1.2. Learning outcomes the subject makes it possible to achieve.


As a result of studying this discipline, the student must acquire the following **learning outcomes:**

- to realize the main features of the modern world and national economy of the institutional structure of the directions of social, economic and foreign economic policy of the state;
- use information and communication technologies to solve social and economic problems of preparation and presentation of analytical reports;
- demonstrate flexibility and adaptability in new situations, in working with new objects and in uncertain conditions;
- know and use economic terminology, explain the basic concepts of micro- and macroeconomics;
- apply appropriate economic and mathematical methods and models to solve economic problems;

1.3. Competences the subject makes it possible to acquire

As a result of studying this discipline, the student must acquire the following competencies:

- ability to learn and master modern knowledge;
- ability to abstract thinking, analysis and synthesis;
- use mathematical tools for the study of socio-economic processes, solving applied problems in the field of accounting, analysis, control, audit, taxation;
- ability to diagnose the state of financial systems (public finances, including budget and tax systems, finances of economic entities, household finances, financial markets, banking system and insurance);
- ability to apply economic and mathematical methods and models to solve financial problems;

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- the ability to identify knowledge and understanding of information and analytical methods that have practical application in a market environment and implement a close link between analytics and forecasting of financial and economic results of the enterprise.

1.4. Interdisciplinary Connections

The discipline "Higher Mathematics" is the basis for the study of further disciplines, namely: "Probability Theory and Mathematical Statistics", "Statistics", "Theory of Economic Analysis", "Economic and Mathematical Methods in Accounting and Analysis", "Economic and Mathematical Methods and models", "Macro and microeconomics" and others.

2. COURSE TRAINING PROGRAM ON THE SUBJECT

2.1. The subject content

Training material is structured according to the module principle and consists of **two educational modules**:

Module №1 "Linear, vector algebra. Introduction to mathematical analysis",

Module №2 "Differential calculus of functions. Integral calculus of functions of one variable. Differential equations",

each of which is a logically complete, relatively independent, holistic part of the discipline, the mastering of which involves a modular test and analysis of the results of its implementation.

2.2. Modular structuring and integrated requirements for each module

Module №1 "Linear, vector algebra. Introduction to mathematical analysis. Differential calculus of functions ",

Integrated requirements for module №. 1. As a result of mastering the educational material of the educational module №1 the student must:

Know:

- definition and notation of determinants, matrices, systems of linear algebraic equations;
- Cramer's formulas;
- methods of assignment and classification of functions;
- defining the limit of a numerical sequence and the limit of a function at a point;
- formulas of important limits and basic theorems about limits;
- definition of continuity of functions and classification of the points of discontinuity.

Be able to:

- investigate and solve systems of linear algebraic equations;
- perform linear operations on vectors;
- find the products of vectors and apply them to solving problems of geometry and physics;
- find the limit of the function and investigate the function for continuity.

Topic 1. Determinants, properties and methods for calculation.


Content. *The determinants of the second and third order, their properties. Determinants of the nth order. Cofactors and minors. Different ways to calculate n-order determinants.*

Topic 2. Matrices, properties, operations on matrices. Inverse matrix.

Content. *Types of matrices. Operations on matrices and their properties. Inverse matrix. Rank of the matrix. Finding the rank of the matrix by means of elementary transformations.*

Topic 3. Systems of linear algebraic equations.

Content. *Methods for solving systems of linear equations. The concept of equation system and its solution. Consistent and inconsistent systems. Criterion for consistency of a system of*

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equations. Solving linear equation systems by Cramer's formulas and by Gauss method. Solving systems of linear equations using an inverse matrix.

Topic 4. Vectors and linear operations on them.

Content . Vectors in the coordinate system Linear operations on vectors. The projection of the vector onto the axis and its basic properties. Cartesian rectangular coordinates in the plane and in space. Coordinates, length and directional cosines of a vector.

Topic 5. Scalar, vector and mixed products of vectors.

Content. Scalar product of vectors, its properties. Scalar product in coordinates. Angle between vectors. Vector and mixed products, their properties, geometric content.

Topic 6. Function. Definition of the function and its properties. Application of functions in economic theory.

Content. The concept of a variable value and a function. Methods of representation and classification of functions. Basic elementary functions and their graphs. Application of functions in economy.

Topic 7. Application of functions in economy.

Content. Utility function, production function, output function, cost function, demand, consumption and supply function.

Topic 8. Limit of a function. Important limits. Continuity of functions

Content. Calculation of a limit of a function . One-sided limits. The limit of a function at infinity. Basic limits theorems. Infinitesimal functions, their properties. Infinitely large functions, their properties. Comparisons of infinitesimal. The first important limit. The number e . Second important limits.

Continuity of function at a point. Continuity of the function. Points of discontinuity of the function.

Module №2 " Differential calculus of functions .Integral calculus of functions of one variable. Differential equations ",


Integrated requirements for module №2. As a result of mastering the study material of the training module №2 the student must:

Know:

- definition of the derivative, table of derivatives and rules of differentiation
- definition and properties of the differential
- basic theorems of differential calculus;
- application of differential calculus to investigation of functions;
- definition of function of several variables, domains, limits and continuity;
- definition of partial derivatives, total differential of the function of several variables
- definition of the indefinite integral and its properties;
- integrals of basic elementary functions and methods of integration of functions;
- definition, conditions of existence and properties of the definite integral; Newton-Leibniz formula;
- application of a definite integral;
- application of an improper integral;
- separable and homogeneous equations;
- linear differential equations of the first order;
- linear differential equations of the second order with constant coefficients.

Be able to:

- find derivative and differential of different orders of elementary functions;

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- find derivative of composite functions, implicitly and parametrically given functions, perform logarithmic differentiation;
 - investigate the behavior of the function and sketch its graph;
- find partial derivatives of functions and total differential of functions of several variables;
 - write the equation of the tangent plane and the normal to a surface;
 - find the derivative by direction and gradient of the function;
 - find local extrema, the smallest and largest values of the function of two variables;
 - find the conditional extremum of the function of two variables.
- apply methods of integration by parts and substitution;
- integrate rational, some irrational and trigonometric functions;
- calculate the area of flat figure, the length of the arc of the curve, the volume of the body, the surface area of rotation by using a definite integral;
- calculate improper integrals with infinite limits of integration;
- find the solutions of separable, homogeneous, linear differential equations of the first order.
 - variables, homogeneous and linear first-order differential equations;
 - find the general and partial solutions of linear differential equations of the second order with constant coefficients

Topic 1. Differential calculus of functions of one variable. Derivative of the functions at a point.

Content. *Definition of the derivative, its geometric and economic meaning. Rules of differentiation. Table of derivatives. Differentiation of a composite function. Differentiation of the inverse function. Differentiation of an implicitly given function. Derivative of a function given parametrically. Logarithmic differentiation.*

Topic 2. Differential of the function. Derivative and differentials of the higher order.

Content. *Definition, geometric and mechanical content of the differential. Rules for calculating differentials. Derivative and differentials of the higher order.*

Topic 3. Investigation the behaviour of functions and sketching the graphs. Application of the derivative in economic theory.


Content. *Monotonicity of the function. Local extremes of the function. A necessary condition of local extremum. Sufficient conditions of local extremum. The largest and smallest values of the function. Investigation of functions on convexity and concavity. Inflection points. Asymptotes of curves. The general scheme of construction the graph. Application of the derivative in economic theory. Elasticity of function. Properties of elasticity. Application of elasticity in economic analysis.*

Topic 4. The concept of function of several variables. Partial derivatives. Derivative by direction. Gradient of the function. Local extremes. The largest and smallest values of the function.

Content. *The concept of functions of several variables. Domain of the function. Partial derivatives. Economic content of partial derivatives. Total differential and its application. Direction derivative Gradient of the function. Local extrema of the function of two variables. Necessary and sufficient conditions for the existence of extremum. The largest and smallest values of the function in a closed domain.*

Topic 5. The concept of the primitive function and indefinite integral. Basic properties of the indefinite integral. Table of integrals.

Content. *Primitive function and indefinite integral. Properties. Table of basic integrals. Methods of integration: direct integration, method of substitution, method of integration by*

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parts. Integration of rational functions.

Topic 6. Definite integral. Basic methods for calculating definite integrals.

Content. *The definite integral as the limit of integral sums. Properties of a definite integral. Newton-Leibniz formula. Basic methods for calculating definite integrals.*

Topic 7. Application of the definite integral. Improper integrals of the first kind.

Content. *Geometric applications of a definite integral: calculation of areas of flat figures, length of curve arc, body volume. Economic applications of a definite integral. The concept of improper integrals of the first kind. Tests of convergence.*

Topic 8. Differential equations of the first order.


Content. *Definition of a first order differential equation. Cauchy's problem. The theorem of existence and uniqueness of the solution of the Cauchy problem. General solution. The concept of a particular solution. Separable differential equations. Homogeneous differential equations. Linear differential equations of the first order.*

Topic 9. Linear differential equations of the second order with constant coefficients.

Content. *Linear homogeneous differential equations of the second order with constant coefficients. Characteristic equation and its roots. Inhomogeneous second order differential equations with constant coefficients.*

2.3. Training schedule of the subject

№	Theme (thematic section)	Total, hours			
		Full-time			
		t o t a l	Lectur e	Practice	Self- Study
1	2	3	4	5	6
Module №1 “Linear, vector algebra. Introduction to mathematical analysis”					
1.1	Determinants, properties, operations on determinants	First semester			
		8	2	2	4
1.2	Matrices, properties, operations on matrices. Inverted matrix	8	2	2	4
1.3	Systems of linear algebraic equations Methods for solving systems of linear equations	8	2	2	4
1.4	Vectors and linear operations over them. Vectors in coordinate system	8	2	2	4
1.5	Scalar, vector and mixed product vectors	8	2	2	4
1.6	Definition of function and its properties.	8	2	2	4
1.7	Application of functions in economic theory				
1.8	Limit of Functions . Important limits Calculation of limits functions Continuity of functions. Function breakpoints	8	2	2	4
1.9	Homework 1.1	4	-	-	4
1.10	Module test #1	4	-	2	2

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Total by the module №1		70	16	16	38
Module №2 «Differential calculus of functions. Integral calculus of functions of one variable. Differential equations»					
2.1	Differential calculus of functions of one variable. Derivative functions at a point	8	2	2	4
2.2	Differential of the function. Derivatives and differentials of higher orders.	8	2	2	4
2.3	Investigation of functions and sketching of graphs of functions. Application of the derivative in economic theory	8	2	2	4
2.4	The concept of the function of several variables. Partial derivatives. Derivative by direction. Gradient function. Local extremes. The largest and smallest values of the function	8	2	2	4
2.5	The notion of primitive and function and indefinite integral. Basic methods of integration	8	2	2	4
2.6	Definite integral . Basic methods for calculating definite integrals.	8	2	2	4
2.7	Application of a definite integral. Improper integrals of the first kind	8	2	2	4
2.8	First order differential equations	8	2	2	4
2.9	Second-order linear differential equations with constant coefficients.	6	2	-	4
2.10	Homework 1.2	4	-	-	4
2.11	Module test #2	6	-	2	4
Total by the module №2		80	18	18	44
In total by the discipline		150	34	34	82

2.4. Homework


Homeworks 1.1, 1.2 are performed in the first semester. The purpose of homework: to improve theoretical knowledge and practical skills while studying the material of training modules.

Performance, execution, design and defense of homework is carried out by the student individually in accordance with the guidelines.

The time required to complete each homework is up to 4 hours of independent work.

2.5. Questions list for the examination

The list of questions and content of tasks for preparation for the exam are developed by the leading teacher of the department in accordance with the course training program, approved at the meeting of the department and distributed among students.

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3. Basic concepts of guidance on the subject

3.1. Teaching methods

The following teaching methods are used in the study of the discipline:

- explanatory and illustrative method;
- method of problem presentation;
- reproductive method;
- research method.

The implementation of these methods is carried out during lectures, demonstrations, independent problem solving, work with educational literature, analysis and solving economic problems.


3.2. List of references

Basic literature

- 3.2.1. Математика для економістів : навч. посіб. У 3 ч. Ч. 1 / І.О. Ластівка, В.С. Коновалюк, І.В. Шевченко [та ін.]. – К.: НАУ, 2012. – 432 с.
- 3.2.2. Математика для економістів : навч. посіб. У 3 ч. Ч. 2 / І.О. Ластівка, Н.І. Затула, Є.Ю. Корнілович [та ін.]. – К.: НАУ, 2012. – 312 с.
- 3.2.3. Математика для економістів : навч. посіб. У 3 ч. Ч. 3 / І.О. Ластівка, В.В. Михайленко. – К.: НАУ, 2012. – 272 с.
- 3.2.4. Дубовик В.П., Юрик І.І. Вища математика: Навч. посібник. – К.: А.С.К., 2001. – 681с.
- 3.2.5. Вища математика: Збірник задач: Навч. посібник / В.Дубовик, І. Юрик, І. Вовкодав та ін.; За ред. В.Дубовика, І. Юрика. – К: 2001 – 480 с.
- 3.2.6. Higher Mathematics. Part 1. Calculus and Differential Equations: manual/ V.P. Denisiuk, V.G. Demydko and others. - K. NAU, 2018. – 384 p.
- 3.2.7. Higher mathematics. Linear algebra. Algebra of vectors. Elements of analytic geometry: Method Guide / compilers: A.O.Antonova, I. S. Klyus, I. O. Lastivka, V. I. Trofymenko. – K. : NAU, 2018. – 60 p
- 3.2.8. Higher mathematics. Introduction to mathematical analysis: Method Guide / compilers: I. S. Klyus, I. O. Lastivka. – K. : NAU, 2019. – 48 p.
- 3.2.9. Higher mathematics. Differential calculus of one variable: Method Guide / compilers: I. S. Klyus, I. O. Lastivka. – K. : NAU, 2021. – 48 p.
- 3.2.10. Higher mathematics. Integral calculus: Method Guide / compilers: I. S. Klyus, I. O. Lastivka. – K. : NAU, 2021. – 72 p.

Additional Literature

- 3.2.11. Ластівка І.О. Вища математика. Лінійна та векторна алгебра: методичні рекомендації до самостійної роботи / І.О. Ластівка, Н.І. Затула, В.П. Петрусенко. – К. : НАУ, 2019. – 72 с.
- 3.2.12. Ластівка І.О. Вища математика. Вступ до математичного аналізу: методичні рекомендації до самостійної роботи / І.О. Ластівка, І.Ю. Ковтонюк, Л.О. Чуб. – К.: НАУ, 2019. – 44 с.
- 3.2.13. Вища математика. Диференціальне числення функцій багатьох змінних: методичні рекомендації до самостійної роботи для студентів технічних та економічних спеціальностей / І.О. Ластівка, О.С. Давидов, І.В. Шевченко, Т.А. Левковська. – К. : НАУ, 2021. – 52 с.

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Internet resources

3.3.1. https://erudyt.net/dubovyk-yuryk-vyscha-matematyka-navch_posibnyk.html

3.3.2. <https://pns.hneu.edu.ua/course/view.php?id=929>

3.3.3. <https://books.google.com.ua/books?isbn=9663825383>

4. RATING SYSTEM OF KNOWLEDGE AND SKILLS ASSESSMENT

4.1. Assessment of certain kinds of student academic work is carried out in accordance with table 4.1.

Table 4.1

Kind of Academic Work	Maximum Grade Values	Kind of Academic Work	Maximum Grade Values
1 semester			
Module № 1		Module № 2	
Kind of academic work	Grade values	Kind of academic work	Grade values
Problem solving, answers to theoretical questions, etc. during classroom work	20 (total)	Problem solving, answers to theoretical questions, etc. during classroom work	20 (total)
Carrying out and defense of homework 1.1	5 (total)	Carrying out and defense of homework 1.2	5 (total)
<i>For admission to complete module test №1, a student must receive not less than</i>	<i>15 points</i>	<i>For admission to complete module test №2, a student must receive not less than</i>	<i>15 points</i>
Carrying out Module Test №1	15	Carrying out Module Test №2	15
Total by the Module №1	40	Total by the Module №2	40
Total by the Modules №1, №2			80
Semester examination			20
Total by the subject			100

4.2. Completed types of educational work are credited to the student, if he received a positive rating for them.


4.3. The sum of rating assessments received by the student for certain types of completed academic work is the current modular rating assessment, which is recorded in the module control.

4.4. The final semester rating is converted into a grade on the national scale and the ECTS scale.

4.5. The final semester rating in points, on the national scale and the ECTS scale is entered in the test report, study card and individual curriculum of the student (record book), for example, as follows: **92 / Excellent / A, 87 / Good / B, 79 / Good / C, 68 / Sat./D, 65 / Sat./E, etc.**

4.6. The Total Grade for the subject is equal to the average grade from Total Semester Grades with its further transformation into national scale and ECTS system.

The Total Grade is recorded to the Diploma Appendix.

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(Ф 03.02 – 01)

АРКУШ ПОШИРЕННЯ ДОКУМЕНТА

№ прим.	Куди передано (підрозділ)	Дата Видачі	П.І.Б. отримувача	Підпис отримувача	Примітки

(Ф 03.02 – 02)

АРКУШ ОЗНАЙОМЛЕННЯ З ДОКУМЕНТОМ

№ пор.	Прізвище ім'я по-батькові	Підпис ознайомленої особи	Дата ознайомлення	Примітки

(Ф 03.02 – 04)

АРКУШ РЕЄСТРАЦІЇ РЕВІЗІЇ

№ пор.	Прізвище ім'я по-батькові	Дата ревізії	Підпис	Висновок щодо адекватності

(Ф 03.02 – 03)

АРКУШ ОБЛІКУ ЗМІН

№ Зміни	№ листа (сторінки)				Підпис особи, яка внесла зміну	Дата внесення зміни	Дата введення зміни
	Зміненого	Заміненого	Нового	Анульованого			

(Ф 03.02 – 32)

УЗГОДЖЕННЯ ЗМІН

	Підпис	Ініціали, прізвище	Посада	Дата
Розробник				
Узгоджено				