NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE
Department of Higher and Applied Mathematics

APPROVED
Faculty of Agrarian Management
"29".05. 2025

CURRICULUM OF ACADEMIC DISCIPLINE
HIGHER MATHEMATICS

Area of knowledge: D Business, administration and law
Specialty: D3 "Management"
Academic programme: Management
Faculty of Agrarian Management
Developed by: associate professor Artemchuk L.M., candidate of pedagogy, associate professor; professor Shydlich A.L., doctor of science (physics & mathematics), senior research fellow.

Kyiv – 2025

Description of the discipline

"Higher Mathematics" is a basic discipline necessary for the development of students' intellect and the development of their abilities to logical and algorithmic thinking, self-learning skills. The purpose of teaching the discipline is to master the mathematical apparatus necessary for the analysis, modeling and solution of theoretical and practical problems in the management activities of a future manager.

The main objectives of the discipline "Higher Mathematics":

- mastering the basics of the mathematical apparatus necessary for solving theoretical and practical management problems;
- ability to independently find, study and apply scientific literature and other information sources and resources in higher mathematics;
- development of skills in mathematical research of applied problems, namely the ability to translate a specific management problem into mathematical language with the subsequent construction of its mathematical model;
- the ability to study the built mathematical models of certain economic processes;
- mastering the methods of processing and analyzing the results obtained in the study of the developed mathematical models.

Area of knowledge, specialty, academic programme, academic degree		
Academic degree	Bachelor	
Area of knowledge	D Business, administration and law	
Specialty	D3 "Management"	
Academic programme	Management	
Characteristics of the discipline		
Type	compulsory	
Total number of hours	150	
Number of ECTS credits	5	
Number of modules	2	
Course project (work) (if any)	-	
Form of assessment	*exam*	
Indicators of the discipline for full-time and part-time forms of university study		
	University study	
	Full-time	**Part-time**
Year of study	1	1
Term	1	1
Lectures	*15 hours*	*4 hours*
Practical classes and seminars	*45 hours*	*2 hours*
Laboratory classes	—	—
Self-study	*90 hours*	*144 hours*
Number of hours per week for full-time students	*4 hours*	—

1. **Aim, competences and expected learning outcomes of the discipline**

The **aim** of the educational discipline "Higher Mathematics" is to form students' personalities, develop their intelligence and abilities to logical and algorithmic thinking, master mathematical methods for solving managerial problems in the economic sphere.

The main **objectives** of the discipline "Higher Mathematics" are as follows:

- mastery of the basics of the mathematical apparatus necessary for solving theoretical and practical management problems in the economic sphere;
- development of skills in mathematical research of applied problems, namely, the ability to translate a specific economic problem into mathematical language with the subsequent construction of its mathematical model;
- development of the ability to research the constructed mathematical models of certain management processes.

As a result of studying the discipline, the student should acquire the following **competencies**:

Integral competences (IC)*:*

The ability to solve complex specialized tasks and practical problems characterized by complexity and uncertainty of conditions in the field of management or in the learning process, which involves the application of theories and methods of social and behavioral sciences.

General competences (GC):

GC 8. Skills in the use of information and communication technologies.

Special (professional) competences (SC):

SC 10. Ability to evaluate the work performed, ensure its quality and motivate the staff of the organization.

SC 12. Ability to analyze and structure the problems of the organization, to formulate to formulate reasonable solutions.

Expected Learning Outcomes (ELO):

ELO 6. To demonstrate skills in searching, collecting and analyzing information, calculating indicators to justify management decisions.

2. Programme and structure of the discipline

Modules and topics	**Number of hours**											
	full-time						**part-time**					
	total	including					total	including				
		l	p	lab	ind.	s.st.		l	p	lab	ind.	s.st.
Module 1. Linear and vector algebra												
Topic 1. Determinants.	**6**	**1**	**2**			**4**						
Topic 2. Matrices.	**10**	**1**	**4**			**8**						
Topic 3. Systems of linear equations, their application in solving economic and management tasks.	**16**	**2**	**6**			**12**						
Topic 4. Linear economic models: • Leontiev model (balance analysis). • Model of equilibrium prices. • Linear model of equilibrium trade.	**16**	**2**	**6**			**12**						
Total for module 1	**48**	**6**	**18**			**36**	**2**	**1**				**66**

Module 2. Differential and integral calculus												
Topic 1. Application of functions in economic theory.	**6**	**1**	**2**			**4**						
Topic 2. The limit of a function. Continuity of function.	**10**	**1**	**4**			**8**						
Topic 3. The derivative of a function. Differential function.	**8**	**1**	**4**			**4**						
Topic 4. Application of the derivative for the study of the function when solving problems of an economic and managerial nature.	**10**	**1**	**4**			**8**						
Topic 5. Definition of antiderivative and indefinite integral.	**14**	**1**	**6**			**10**						
Topic 6. The definite integral. Application of the definite integral to geometric and economic problems.	**12**	**1**	**5**			**9**						
Topic 7. Definition of DE of the 1st order.	**6**	**1**	**2**			**6**						
Topic 8. Linear DEs of the 2nd order with constant coefficients.	**6**	**1**	**2**			**5**						
Total for module 2	**72**	**9**	**27**			**54**	**72**	**2**	**1**			**78**
Total hours	**120**	**15**	**45**			**90**	**—**	**4**	**2**			**144**

3. **Topics of lectures**

No.	Topic	Hours
1	**Lecture 1:** Determinants. Matrices.	2
2	**Lecture 2:** Systems of linear equations, their application in solving economic and managerial problems.	2
3	**Lecture 3:** Linear economic models: -Leontief model (balance sheet analysis); -Equilibrium price model; -Linear model of equilibrium trade.	2
4	**Lecture 4:** Application of functions in economic theory.	2
5	**Lecture 5:** Using the derivative to study a function in solving economic and managerial problems**.**	2
6	**Lecture 6:** Definition of antiderivative and indefinite integral.	2
7	**Lecture 7:** The definite integral. Application of the definite integral to geometric and economic problems.	2
8	**Lecture 8:** Definition of first order DEs. Linear DEs of the second order with constant coefficients.	1
	Total hours	**15**

4. Topic of practical classes

No.	Topic	Hours
1	**Topic 1**. Determinants.	2
2	**Topic 2**. Matrices.	4
3	**Topic 3**. Systems of linear equations, their application in solving economic and management tasks.	6
4	**Topic 4.** Linear economic models.	6
5	**Topic 5**. Application of functions in economic theory.	2
6	**Topic 6**. The limit of a function. Continuity of function.	4
7	**Topic 7**. The derivative of a function. Differential function.	4
8	**Topic 8**. Application of the derivative for the study of the function when solving problems of an economic and managerial nature.	4
9	**Topic 9.** Definition of antiderivative and indefinite integral.	6
10	**Topic 10**. The definite integral. Application of the definite integral to geometric and economic problems.	5
11	**Topic 11.** Definition of DE of the 1st order.	2
12	**Topic 12**. Linear DEs of the 2nd order with constant coefficients.	2
	Total hours	**45**

5. Topics of self-study

No.	Topic	Hours
1	**Topic 1**. Determinants. Determinants of the nth order.	4
2	**Topic 2**. Matrices. Rank of a matrix. Inverse matrix.	8
3	**Topic 3**. Systems of linear equations, their application in solving economic and management tasks. Gauss method. SLAE compatibility. Homogeneous SLAE	12
4	**Topic 4.** Linear economic models. Leontiev's model of n-branches.	12
5	**Topic 5**. Application of functions in economic theory. Graphs of functions.	4
6	**Topic 6**. The limit of a function. Continuity of function.	8
7	**Topic 7**. The derivative of a function. Differential function**.** Derivative of higher orders. Differential of a function.	4
8	**Topic 8**. Application of the derivative for the study of the function when solving problems of an economic and managerial nature.	8
9	**Topic 9.** Definition of antiderivative and indefinite integral. Integration methods.	10
10	**Topic 10**. The definite integral. Application of the definite integral.	9
11	**Topic 11.** Linear DE of the 1st order.	6
12	**Topic 12.** Linear DEs of the 2nd order with constant coefficients.	5
	Total hours	**90**

6. Methods of assessing expected learning outcomes:

- oral or written questioning;
- interview
- testing;

– defense of practical work;
– self-assessment.

7. Teaching methods*:*

– method of problem-based learning;
– method of practice-oriented learning;
– case method;
– project-based learning method;
– method of flipped classroom, blended learning;
– method of learning through research;
– method of educational discussions and debates;
– method of teamwork, brainstorming.

8. Results assessment.

The student's knowledge is assessed by means of a 100-point scale converted into the national grades according to the "Exam and Credit Regulations at NULES of Ukraine" in force

8.1. Distribution of points by types of educational activities

Educational activity	Results	Assessment
Module 1. Linear and vector algebra		
Practice 1: Determinants.	To know and be able to calculate determinants of the 2nd and 3rd order.	**5**
Practice 2: Matrices.	To know the definition and properties of matrices.	**5**
Practice 3: Matrices.	To apply matrices to solve problems.	**5**
Practice 4: Systems of linear equations, their application in solving economic and managerial problems. Matrix matrix.	To use the matrix method for solving SLAE	**10**
Practices 5-6. Systems of linear equations, their application in solving economic and managerial problems. Cramer's method. Gaussian method.	To use SLAR to solve economic and management problems.	**10**
Practice 7: Systems of linear equations, their application in solving economic and managerial problems. Compatibility of SLAE.	To identify the SLAE compatibility	**10**
Practice 8: Linear economic models. Leontiev model (balance sheet analysis)	To know and understand the Leontiev model (balance sheet analysis)	**10**
Practice 9: Linear economic models. Equilibrium price model	To know and understand the equilibrium price model.	**5**
Module control work 1.		**40**
Total for module 1		**100**
Module 2. Differential and integral calculus		
Practice 10: Function.	Definition of a function, domain of definition. Ways of defining functions. Inverse, complex, even, odd, periodic functions.	**-**
Practice 11: The limit of a function.	To know the basic theorems about bounds. To apply the first and second remarkable limits.	**5**
Practice 12: Continuity of a function.	To understand breakpoints and their classification. To use local and global properties of functions	**5**

Practice 13: Derivative.	To know the table of derivatives. geometric, economic and mechanical meaning of a derivative.	**5**
Practice 14: Derivative of a function. Differential of a function.	To be able to find the derivatives of a complex, inverse, implicitly given function. Use logarithmic differentiation.	**5**
Practices 15-16: Using the derivative to study a function in solving economic and managerial problems.	To be able to investigate functions and build their graphs. To analyze the indicators of the enterprise.	**10**
Practice 17: Definition of antiderivative and indefinite integral.	To know the definition, properties, and table of integrals.	**5**
Practices 18-19. Indefinite integral. Methods of integration	To know the simplest methods of integration	**5**
Practice 20: The definite integral.	To know the definition and properties of a definite integral	**5**
Practice 21: Defined integral.	To apply the definite integral to solve geometric and economic problems	**5**
Practice 22: Application of the definite integral.	Using the definite integral to calculate the average of economic functions, determine the capital gains from a known investment.	**5**
Practice 23: Ordinary differential equations.	To know the problem and Cauchy's theorem, three types of PDEs. To know and understand linear DPs of the second order of the first order: with separable variables, homogeneous, linear.	**5**
Module control work 2.		**40**
Total for module 2		**100**
Class work		**(M1 + M2)/2*0,7 ≤ 70**
Exam/credit		**30**
Total for year		**(Class work + exam) ≤ 100**

8.2. Scale for assessing student's knowledge

Student's rating, points	National grading (exam/credits)
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactory

8.3. Assessment policy

Deadlines and exam retaking rules	*EXAMPLE:* works that are submitted late without valid reasons will be assessed with a lower grade. Module tests may be retaken with the permission of the lecturer if there are valid reasons (e.g. a sick leave).
Academic integrity rules	*EXAMPLE:* cheating during tests and exams is prohibited (including using mobile devices). Term papers and essays must have correct references to the literature used
Attendance rules	*EXAMPLE:* Attendance is compulsory. For good reasons (e.g. illness, international internship), training can take place individually (online by the faculty dean's consent)

9. Teaching and learning aids:

- e-learning course of the discipline (*https://elearn.nubip.edu.ua) MANDATORY*;
- references to digital educational resources;
- textbooks, manuals, tutorials;
- guidelines for studying a discipline by full-time and part-time students;
- internship programmes of the discipline (if included in the curriculum).

1. E-learning course of the discipline “Higher Mathematics” on the educational portal of National University of Life and Environmental Sciences of Ukraine eLearn. URL: https://elearn.nubip.edu.ua/course/view.php?id=1284.
2. Artemchuk L.M. Lecture notes and their presentations in electronic form. URL: https://elearn.nubip.edu.ua/course/view.php?id=1284.
3. Artemchuk L.M. Methodical recommendations for practical classes and individual tasks in electronic form. URL: https://elearn.nubip.edu.ua/course/view.php?id=1284.
4. Batechko N.G., Pantalienko L.A., Shostak S.V., Tsypiy T.I., Ruzhylo M.Y. Higher Mathematics. Collection of tasks. Kyiv: NULES Publishing House, 2021. 352 pp.

10.Recommended sources of information

1. Artemchuk L.M., Khaydurov V.V., Tsyupii T.I., Shcherbak T.M. Higher and Applied Mathematics: Textbook. Kyiv: NUBiP of Ukraine 2024. 307 p.
2. Yeremina T.O., Povarova O.A. Higher Mathematics. Elements of linear algebra and analytical geometry: a textbook. Igor Sikorsky Kyiv Polytechnic Institute; Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2021. 115 pp. URL: https://ela.kpi.ua/handle/123456789/41267
3. Pasichnyk YA Higher mathematics: a textbook. Ostroh: Publishing House of the National University of Ostroh Academy, 2021. 432 c
4. Panchenko N. G. Rezunenko M. E. Higher mathematics: a textbook. Part 1 - Kharkiv: UkrDUZT, 2022. 232 pp. URL: http://lib.kart.edu.ua/handle/123456789/10149
5. Batechko N.G., Pantalienko L.A., Khaidurov V.V., Tsyupiy T.I., Shostak S.V. Mathematics textbook for students of preparatory courses. Kyiv: FOP Yamchynskyi O.V., 2020. 248 pp.
6. Meish Yu.A., Arnauta N.V. Higher Mathematics. Theory, examples, tasks for independent work. Part 1. Textbook. - K.: OOO “TSK “KOMPRINT”, 2023. 391p.
7. Meish Yu.A., Arnauta N.V. Higher Mathematics. Theory, examples, tasks for independent work. Part 2: textbook - K.: OOO “TSK “KOMPRINT”, 2024. 310 p.