MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE
SUMY NATIONAL AGRARIAN UNIVERSITY

Faculty of Economics and Management
Department of Higher Mathematics

WORK PROGRAM (SYLLABUS)
of the mandatory educational component

EC 8 Higher Mathematics and Probability Theory

(mandatory)

Specialty	073 Management
Educational program	Educational and professional program "Management"
Level of higher education	First (bachelor's) level

SUMY 2024

Developer: _____ **Anatoliy ROZUMENKO, Candidate of Physical and Mathematical Sciences, Associate Professor**
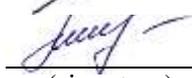
Considered, approved and ratified at the meeting of the Department of Higher Mathematics(	protocol 28.05.2024p. № 10
	Head of department _____ Anatoliy ROZUMENKO)

Approved by:

Guarantor of the educational program

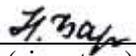Natalia STOYANETS
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Syllabus review (attached) is provided by:

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Registered in electronic data base:

06.08.2024
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(date)

1. 1. MODULE OVERVIEW

1.	Title	Higher Mathematics and Probability Theory
2.	Faculty/Department	Faculty of Agrotechnology and Environmental Management
3.	Type (compulsory or optional)	compulsory
4.	Program(s) to which module is attached (*to be filled in for compulsory types*)	«Management» Academic Program, area of specialization 073 «Management»
5.	Module can be suggested for (*to be filled in for optional types*)	
6.	Semester and duration of module	1 semester (1-15 weeks), 2 semester, 1-15 weeks
7.	ECTS credits number	5 credits (150 hours)

8.	Total workload and time allotment	Directed study		Self-directed study
		Lectures	Practicals	
		16	30	44/16
		14	30	

9.	Language of instruction	English
10.	Module leader	Rozumenko Anatoly Mykhailovych., Candidate of Physical and Mathematical Sciences, Associate Professor, Associate Professor of the Candidate of Physical and Mathematical Sciences, Associate Professor
11.1	Module leader contact information	anrozumenko@gmail.com Consultation time every Monday 13:00
11.	Module description	Higher mathematics and probability theory is a mandatory educational component of general education, natural science training, which forms the worldview of future specialists, is the basis for the formation of mathematical knowledge and skills necessary for the study of special, economic disciplines at the appropriate level.
12.	Module aim	- formation of a system of theoretical knowledge and practical skills from the basics of the mathematical apparatus necessary for the analysis and solution of applied problems of a professional direction; - development of logical and algorithmic thinking, promotion of the formation of a scientific worldview in higher education applicants.
13.	Module Dependencies (prerequisites, co-requisites, incompatible modules)	1. The educational component is based on the elementary mathematics course (standard level) 2. The educational component is the basis for micro-, macroeconomics, econometrics, statistics 3. The educational component is incompatible with (no restrictions)
14.	The policy of academic integrity	Adherence to academic integrity for higher education applicants involves: independent completion of educational tasks, tasks of current and final control of learning outcomes; provision of reliable information about the results of one's own educational or scientific activities. Attendance at classes is mandatory. For objective reasons, distance

		learning may be provided. Missing a class for an unworthy reason is worked out by the student in accordance with the requirements of the department (interview, testing, notes, processing of recommended literature) according to the consultation schedule. Current "unsatisfactory" grades received by the student during the mastering of the relevant topic are recalculated by the teacher before the final control. The final control is carried out in the form of a written test using the external assessment method. Using electronic devices during the final knowledge control, cheating - suspension from work, retaking the final control System of linear equations, vector, function, limit, derivative, extremum, indefinite (definite) integral, differential equations, random event, probability
15.	Link in Moodle	https://cdn.snau.edu.ua/moodle/course/view.php?id=683

2. LEARNING OUTCOMES BY EDUCATIONAL COMPONENT AND THEIR RELATIONSHIP WITH PROGRAM LEARNING OUTCOMES

MLOs: On successful completion of the module the student will be able to:	Program learning outcomes that the EC aims to achieve (indicate the number according to the numbering given in the EP)	How assessed
	PLO	
- - perform operations on matrices; calculate determinants of the 3rd order; solve systems of n linear algebraic equations; perform actions on vectors; solve basic problems on a line in the plane, a plane and a line in space; find equations and construct a circle, ellipse, hyperbola, parabola using known equations;		Oral survey; test control (current, thematic, final). Performing independent work.
- - find limits of functions; investigate functions for continuity; find derivatives, differentials of functions; apply the concept of a derivative when studying functions and constructing their graphs; find the largest and smallest value of a function on a segment; apply elements of differential calculus when solving economic problems;	x	Oral survey; test control (current, thematic, final). Performing independent work.
- - apply basic integration methods; calculate definite integrals; find areas of plane figures and volumes of solids of revolution; investigate improper integrals for convergence;		Oral survey; test control (current, thematic, final). Performing independent work.
- solve first-order differential equations: with separable variables, homogeneous, linear; solve second-order differential equations: incomplete, linear with constant coefficients;		Oral survey; test control (current, thematic, final). Performing independent work.

		Oral survey; test control (current, thematic, final). Performing independent work.
- - solve problems on calculating probability; calculate the probabilities of complex random events using basic probability theorems and limit theorems		

PLO 12. Evaluate the legal, social and economic consequences of the organization's functioning.

3. MODULE INDICATIVE CONTENT

Topic. List of issues to be considered within the topic	Distribution of hours			Distribution of hours
	Directed study		Individual study	
	LC	PRC.		
1 SEMESTR				
Module 1. Elements of linear, vector algebra and analytic geometry. Introduction to mathematical analysis.				
Topic 1. Matrices. Determinants. . Matrices. Linear operations on matrices. Inverse matrix and its finding. Determinants of the 2nd, 3rd and nth orders and their properties.	2	2	2	1,2,3,5
Topic 2. Systems of linear equations. Basic definitions. Solving systems of linear algebraic equations by Cramer's formulas, Gauss's method. Matrix form of writing a system of linear equations. Homogeneous systems of linear equations. General solution of a non-homogeneous system of linear equations.		2	4	1,2,3,5
Topic 3. Elements of vector algebra. Arithmetic vectors of the space Rn. Linear operations on vectors. Scalar, vector, mixed products of vectors and their properties. n-dimensional vector and vector space. Linear dependence of a system of vectors, basis and dimensionality of a vector space. Decomposition of a vector by basis.	2	2	4	1,2,3,5
Topic 4. Elements of analytical geometry. Line on a plane, line and plane in space. Different types of equations of a line on a plane, line and plane in space. Basic problems on a line on a plane, plane in space. Mutual location of a line and plane in space.	2	2	4	1,2,3,5
Topic 5. Introduction to analysis. The concept of a function. Elementary functions, classification of functions and their graphs..		2	4	1,2,3,5
Topic 6. Limit of a function. Continuity. Limit of a function at a point, at infinity, one-sided limits. Infinitely small and infinitely large functions. Important limits. Technique for calculating limits. Continuity of a function at a point and on a segment. Points of discontinuity of a function, and their classification	2	4	4	1,2,3,5
Total module 1: 44 hours.	8	14	22	
Module 2. Differential and integral calculus of functions of one variable. Functions of many variables.				
Topic 7. Derivative of a function. Differential. Derivative of a function. Problems leading to the concept of a derivative. Geometric and physical meaning of a derivative. Rules for finding derivatives. Table of derivatives of basic elementary functions. Differentiation of a complex function. Differential of a function of one variable, its geometric meaning.	2	4	6	1,2,4,5
Topic 8. Differentiable functions: Extremum. Study of functions. Derivatives and differentials of higher orders. Basic theorems on differentiable functions. L'Hôpital's rule. Study of a function	2	4	4	1,2,4,5

using derivatives. Increase, decrease of a function, sufficient condition of monotonicity. Extremum of a function, necessary and sufficient conditions for the existence of an extremum of a function.				
Topic 9. Indefinite integral. Initial and indefinite integral (definition, properties). Table of indefinite integrals. Basic integration methods: direct, method of substitution of variables, integration by parts. Integration of fractional-rational, irrational, trigonometric functions.	2	4	4	1,2,4,5, 7
Topic 10. Definite integral. Definition of a definite integral, geometric meaning. Properties of a definite integral. Newton-Leibniz formula. Methods of calculating a definite integral. Application of a definite integral to solving geometric problems. Improper integrals, their properties.	2	4	4	1,2,4,5, 7
Topic 11. Complex numbers. Complex numbers. Algebraic and geometric form of a complex number. Operations on complex numbers. Euler's formulas.			4	1,2,4,5
Total for module 2: 46 hours.	8	16	22	
Total for 1 semester: 90 hours.	**16**	**30**	**44**	
Module 3. Ordinary differential equations. Numerical and power series.				
Topic 12. Differential equations of the 1st order. Problems that lead to the concept of a differential equation. Differential equations of the 1st order. Basic concepts. The theorem of existence and unity of the solution, Cauchy's problem. Differential equations with separable variables. Homogeneous differential equations. Linear differential equations of the first order, Bernoulli's equation.	4	6	2	1,2,4,5
Topic 13. Differential equations of the 2nd order. Differential equations of the 2nd order, Cauchy's problem. Differential equations of the 2nd order, allowing reduction of the order. Linear homogeneous differential equations of the 2nd order, structure of the general solution. Structure of the general solution of a linear inhomogeneous differential equation of the 2nd order. Linear homogeneous differential equations of the 2nd order with constant coefficients. Linear inhomogeneous differential equations of the 2nd order with constant coefficients. Method of variation of arbitrary constants of solutions of linear inhomogeneous differential equations.	2	6	4	1,2,4,5
Total for module 3: 16 hours.	6	12	6	
Module 4. Basic concepts and formulas of probability theory. Random variables.				
Topic 14. Random events. Classification of events and their classification. Operations on events. Elements of combinatorics. Classical, axiomatic definition of probability. Statistical, geometric probability. Theorems of addition and multiplication of probabilities of events. Formula of total probability. Bayes' formula.	2	4	2	4,5, 8, 9

Topic 15. Bernoulli's scheme of repeated independent trials. Repeated independent trials, Bernoulli's scheme. Bernoulli's formula. Most probable number of successes. Local, integral Laplace theorem, Poisson's theorem.	2	6	4	4,5, 8, 9
Topic 16. Random variables. The concept of a random variable. Discrete random variables. The law and distribution function of a discrete random variable. Numerical characteristics of random variables and their properties. Basic discrete distributions: binomial, geometric, Poisson distribution. Continuous random variables. Integral and differential distribution function of a continuous random variable. Numerical characteristics. Basic continuous distributions: uniform, exponential, normal.	2	4	2	4,5, 8, 9
Topic 17. Basic concepts and problems of mathematical statistics. General and sample population. Sampling method. Variational series. Statistical distribution, empirical distribution function. Polygon and histogram. Sample characteristics.	2	4	2	4,5, 8, 9
Total for module 4: 28 hours.	**8**	**18**	**10**	
Total for semester 2: 60 hours	**14**	**30**	**16**	
TOTAL: 150 hours.	**30**	**60**	**60**	

4. TEACHING AND LEARNING METHODS

MLOs	Teaching methods (directed study)	Hours	Learning methods (self-directed study)	Hours
- - perform operations on matrices; calculate determinants of the 3rd order; solve systems of n linear algebraic equations; perform actions on vectors; solve basic problems on a line in the plane, a plane and a line in space; find equations and construct a circle, ellipse, hyperbola, parabola using known equations;	*Explanatory and illustrative method: lecture, - the main method of studying new material. Problem, partially search method: solving exercises and tasks in the classroom, collectively; Research method: independent solving of tasks. Using the MOODLE, ZOOM platforms during blended learning.*	14	*Extracurricular work - working with notes, textbooks, manuals, materials from the Internet; performing independent work, etc.*	14
- - find limits of functions; investigate functions for continuity; find derivatives, differentials of functions; apply the concept of a derivative when studying functions and constructing their graphs; find the largest and smallest value of a function on a segment; apply elements of differential calculus when solving economic problems;		20		18
- - apply basic integration methods; calculate definite integrals; find areas of plane figures and volumes of solids of revolution; investigate improper integrals for convergence;		12		12
- solve first-order differential equations: with separable variables, homogeneous, linear; solve second-order differential equations: incomplete, linear with constant coefficients;		18		6

- - solve problems on calculating probability; calculate the probabilities of complex random events using basic probability theorems and limit theorems		26		10

5. ASSESSMENT
5.1. Summative assessment
5.1.1. To assess the expected learning outcomes, the following are provided

№	Summative assessment methods	Points / Weight in the overall assessment	Date of preparation
1.	Modular control№. 1 50	50	8 weeks
2.	Modular control№. 2 50	50	15 weeks
3.	Modular control№. 3 35	35	8 weeks
4.	Modular control№. 4 35	35	15 weeks
5.	Summary (semester) control	30	

6. Distribution of points received by students

7. 6. 1 semester (credit)

Modular control				amount
Module1 – 50 point		Module 2 – 50 point		
T1-4	T5-6	T7-9	T10-13	100
25	25	25	25	

8. 2nd semester (exam)

Modular control				Total per module exam	Final test -	Total
Module 3 – 35 point		Module 4 – 35 point				
T14-15	T16-17	T18-19	T20-21	70	30	100
20	15	20	15			

5.2.3. Evaluation criteria

Component	Unsatisfactory	Satisfactory	Good	Excellent
Modular control	1-2. <30 point	30-37	38-45 point	46-50 point
	3-4. <21 point	21-26	27-31 point	32-35 point
	Most tasks not completed Results of independent work – unsatisfactory Most tasks completed	Results of most independent work – satisfactory More than 3/4 of tasks completed	Results of independent work – assessed as good All(or almost all) tasks completed	Results of independent work – assessed as excellent and good

5.3. Formative assessment:
To assess current progress in learning and understand areas for further improvement,

№	Elements of formative assessment Date	Дата
1.	The level of assimilation of theoretical material is demonstrated by students when performing test tasks at the beginning of studying the topic.	15 min. at the beginning of the lesson
2.	The ability to apply theoretical knowledge to solving problems is demonstrated by students when performing independent, individual calculation tasks during practical classes and independent work.	Testing upon completion of each topic.

5.1 The evaluation scale is generally accepted for the University

Evaluation scale: national and ECTS

The sum of points for all types of educational activities	Evaluation on a national scale *(when counting)*
90 - 100	counted
82-89	
75-81	
69-74	
60-68	
35-59	not credited with the possibility of repeating drafting
0-34	not enrolled with mandatory repeated study of the discipline

Individual tasks

Completion of an individual calculation task.

Module 1: Individual control tasks in linear and vector algebra and analytic geometry.

Module 2: Individual control tasks in the theory of limits, differential and integral calculus of functions of one variable.

Module 3: Individual control tasks in the theory of differential equations.

Module 4: Individual control tasks in the theory of probability.

6. LEARNING RESOURCES

6.1. MAIN SOURCES

6.1.1. Textbooks, manuals

1. Stewart, J., Clegg, D. K., & Watson, S. (2020). Calculus: Early transcendentals (9th ed.). Cengage Learning. https://awesomechem.wordpress.com/2021/10/06/calculus-early-transcendentals-9th-ed-2020-stewart-j/

2. Strang, G. (2023). Introduction to linear algebra (6th ed.). Wellesley-Cambridge Press. https://math.mit.edu/~gs/linearalgebra/ila6/indexila6.html

3. Thomas, G. B., Weir, M. D., & Hass, J. R. (2018). Thomas' calculus (14th ed.). Pearson. https://rodrigopacios.github.io/mrpacios/download/Thomas_Calculus.pdf

4. Ross, S. M. (2018). A first course in probability (10th ed.). Pearson. https://chengzhaoxi.xyz/download/pdf/book/A-First-Course-in-Probability.pdf

5. Grimmett, G. R., & Stirzaker, D. R. (2020). Probability and random processes (4th ed.). Oxford University Press. http://old-eclass.uop.gr/modules/document/file.php/TST244/%5BGeoffrey_R._Grimmett%2C_David_R._Stirzaker%5D_Probabi(BookZZ.org).pdf

6. Blitzstein, J. K., & Hwang, J. (2019). Introduction to probability (2nd ed.). CRC Press. https://uni.dcdev.ro/y2s2/ps/Introduction%20to%20Probability%20by%20Joseph%20K.%20Blitzstein,%20Jessica%20Hwang%20(z-lib.org).pdf