

MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE  
SIMON KUZNETS KHARKIV NATIONAL UNIVERSITY OF ECONOMICS

"APPROVED"

Vice-Rector for Educational and Methodical Work

  
Karina NEMASHKALO

HIGHER MATHEMATICS  
syllabus of the academic discipline

Training direction	<b>05 Social and behavioral sciences</b>
Speciality	<b>051 Economics</b>
Academic degree	<b>first (bachelor)</b>
Academic program	<b>International economics</b>

Status of the academic discipline  
Language of teaching, training and assessment

**Compulsory**  
**English**

Chief of the department of higher mathematics,  
economical and mathematical methods

  
**Lyudmyla MALYARETS**

Kharkiv  
2022

МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ  
ХАРКІВСЬКИЙ НАЦІОНАЛЬНИЙ ЕКОНОМІЧНИЙ УНІВЕРСИТЕТ  
ІМЕНІ СЕМЕНА КУЗНЕЦЯ



**"ЗАТВЕРДЖУЮ"**

Проректор з навчально-методичної роботи

Каріна МЕМАШКАЛЮ

**ВИЩА МАТЕМАТИКА**  
робоча програма навчальної дисципліни

Галузь знань **05 Соціальні та поведінкові науки**  
Спеціальність **051 Економіка**  
Освітній рівень **перший (бакалаврський)**  
Освітня програма **Міжнародна економіка**

Статус дисципліни *обов'язкова*  
Мова викладання, навчання та оцінювання *англійська*

Завідувач кафедри  
вищої математики та  
економіко-математичних методів

**Людмила МАЛЯРЕЦЬ**

Харків  
2022

**APPROVED**

at the meeting of the department of higher mathematics and  
economic mathematical methods  
Protocol № 1 dated 31.08.2022

Compiled by:

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higher mathematics and economic mathematical methods

**Sheet of renewal and re-approval of the academic discipline syllabus**

Academic year	Date of the department meeting – the developer of syllabus of the academic discipline	Protocol number	Signature of chief of the department

## The annotation of the academic discipline

The fundamental base in the mathematical preparation of economists and managers is the academic discipline "Higher Mathematics" which is a compulsory discipline of the natural scientific series and the component of the structural logical scheme which is provided for the educational professional program of bachelors of speciality 051 "Economics".

The basic problems of teaching the academic discipline is giving students knowledge of the basic parts of mathematical analysis and linear algebra; a rising of the level of the fundamental mathematical training of students with intensification of its applied direction, mastering the fundamentals of mathematical analysis and linear algebra and application of this knowledge to the economic investigations for solving economic problems, forming skills in application of elements of mathematical analysis and linear algebra in investigations where higher mathematics is applied as instrument of investigation and solving optimization economic problems for forming models of economic processes and developments, acquiring the necessary theoretical and practical knowledge for solving specific problems, which are set in the process of forming economic and mathematical models, and the obtaining the required mathematical knowledge for the study of other disciplines.

*The main purpose* of teaching is to form future specialists' basic mathematical knowledge for solving theoretical and practical problems in professional activity of a competent specialist in the service sphere, skills in analytical thinking and skills in using mathematical knowledge for formation of real processes and developments, and for solving economic problems.

### The characteristics of the academic discipline:

Academic year	<b>1st</b>
Term	<b>1st</b>
Number of credits	<b>5</b>
Form of the final control	<b>exam</b>

### Structural and logical scheme of studying the academic discipline:

Prerequisites	Post-requisites
School course of mathematics (geometry, algebra and precalculus)	Probability theory and mathematical statistics
	Operations research and optimization methods
	Econometrics
	Statistics
	International economics
	International trade
	Microeconomics
	Macroeconomics
	Finances

### Competences and the results of mastering the academic discipline:

Professional competences (PC)	Learning outcomes (LO)
PC4 (CK4). An ability to explain economic and social processes and phenomena on the basis of theoretical models, analyze and interpret the results. PC11 (CK11). An ability to interpret economic decisions on the basis of understanding the laws of economic systems and processes using modern methodological tools	LO2 (PH2). Reproduce moral, cultural, scientific values, increase the achievements of society in the socio-economic sphere, promote a healthy lifestyle
PC4 (CK4). An ability to explain economic and social processes and phenomena on the basis of	LO3 (PH3). Know and use economic terminology, explain the basic concepts of

theoretical models, analyze and interpret the results.	micro- and macroeconomics
PC7 (CK7). An ability to use computer technology and data processing software to solve economic problems, analyze information and prepare analytical reports.	LO6 (PH6). Use professional arguments to convey information, ideas, problems and ways to solve them to specialists and non-specialists in the field of economic activity.
PC4 (CK4). An ability to explain economic and social processes and phenomena on the basis of theoretical models, analyze and interpret the results. PC6 (CK6). An ability to use economic and mathematical methods and models to solve economic problems. PC7 (CK7). An ability to use computer technology and data processing software to solve economic problems, analyze information and prepare analytical reports. PC18 (CK18). An ability to use the principles, ways and instruments of a regulation of international trade, investment, migration, monetary and financial and credit relations	LO8 (PH8). Use corresponding economic and mathematical methods and models to solve economic problems

\*СК – спеціальні (фахові) компетентності, PH – результати навчання

## The syllabus of the academic discipline The themes of lectures

### Content module 1. Linear algebra and analytical geometry

**Theme 1.** The elements of the theory of matrices and determinants

**Theme 2.** The general theory of the system of linear algebraic equations

**Theme 3.** The elements of vector algebra. Elements of analytical geometry

### Content module 2. The elements of mathematical analysis

**Theme 4.** The limit of a function and continuity. Differential calculus of the function of one variable

**Theme 5.** Analysis of the function of several variables

**Theme 6.** Integral calculus

**Theme 7.** Differential equations

**Theme 8.** Series

*The list of practical and laboratory studies, as well as questions and tasks for an independent work is given in the table "Rating-plan of the discipline".*

## Methods of study and teaching

To intensify the process of teaching the academic discipline "Higher Mathematics" the following educational technologies are applied mini-lectures, work in small groups, brainstorming, computer simulation (games), the Delphi method.

**A computer simulation (game)** is an education method, which is based on the use of a specific computer program in order to get visual modelling of a process. Students can change the parameters and data, decisions and analyze the results of such decisions. The purpose of using this method is the development of systematic thinking of students, their ability to plan, form skills to identify and analyze problems, compare and estimate alternatives, make optimal decisions and work under the condition of

a limited time (*themes*: 1, 3, 4, 5).

**Mini-lectures** provide for the delivery the educational material during a short-length segment of time and they are characterized by a significant content, complexity of logical constructions, forms, proofs and generalizations. They are conducted, as a rule, as a part of a study-investigation. Mini-lectures differ from full-size lectures by a shorter duration. Usually, they last no more than 10 – 15 minutes and they are used in order to give briefly new information for all students. Mini lectures are often used as parts of a whole theme, which it is desirable to teach as a full-size lecture in order to avoid the audience's getting tired. Then the information is given by turn as several particular fragments, between them other forms and methods of study are used (*themes*: 1, 2, 4, 6, 7, 8).

**Work in small groups** gives an opportunity to structure practical studies in the form and content, gives a possibility for each student's partaking in the work on the theme under study, stimulates forming personal qualities and experience of social communication (*themes*: 1 - 9).

**Brainstorming** is a method of solving urgent tasks, its core lies in expressing as many ideas as possible in a short period of time, discussing and selecting them (*themes*: 1, 3, 4, 7, 8).

**The Delphi method** is used for the purpose of reaching a consensus in expert judgements. It gives a possibility for students to express their thoughts to a group of experts, which work individually in different places. To choose a management decision according to this method, the academic group is divided, for example, into five small groups. Four groups work, develop and make a management decision, and the fifth group is the expert team. This group carries out an analysis of the variants of management decisions, which are proposed by the working groups, and assesses these variants. Within the expert group the distribution of its members according to specializations is fulfilled (*themes*: 5, 6).

### **The order of assessment of studying results**

The system of assessment of competences which were formulated for a student during the learning of the academic discipline, takes into consideration the forms of studies which according to the syllabus of the academic discipline provide lectures, practical studies, laboratory works, fulfillment of students' independent work. The assessment of the formed competences of students is carried out on the accumulative 100-point system. Control ways include:

**current control** which is carried out within a term during lectures, practical studies and laboratory works and it is assessed as a sum of accumulative points (the maximum equals 60 points; the minimum which makes it possible for a student to pass an exam, equals 35 points);

**module control** which is carried out in the form of a colloquium with taking into account the current control according to a corresponding thematic module, provides an integral assessment of student's results after learning the material of a logically completed part of the discipline (or a thematic module);

**final/term control**, which is carried out as a terminal exam, according to the schedule of the educational process.

*Current control* on the given academic discipline is carried out in the following forms: homework; defence of laboratory works; a written test; an independent creative work, a colloquium.

The total number of points is 60, which are distributed as lectures (including 2 colloquiums (12 points) and one independent creative task (6 points), practical studies (including 2 written tests (12 points) and homework (14 points)) and laboratory studies (including 8 laboratory works (16 points)).

*Final/term control* is conducted in the form of a term exam. **Term exams** are a form of assessment of students' final mastery of the theoretical and practical material of a particular module of the academic discipline or the academic discipline on the whole, which is conducted as a test.

Assessment of student's knowledge during practical studies and carrying out laboratory works is conducted on the accumulative system according to the following criteria: understanding, the degree of the mastery of the theory and methodology of problems which are considered; the degree of the mastery of the factual material of the academic discipline; familiarizing with the recommended literary sources and modern literature on the questions which are considered; the ability to connect theory and practice in the consideration of particular examples, solving problems, carrying out laboratory works,

carrying out calculations in the process of doing homework and tasks which are considered in class; the logic, structure, style of presenting the material in written works and in oral answers in class, the ability to ground one's position, carry out generalization of the information and draw conclusions.

The general criteria for the assessment of *independent work* of students are profound and deep of knowledge, the level of thinking, skills in systematization knowledge on particular themes, skills in drawing conclusions, attainments and techniques of carrying out practical tasks, the ability to find necessary information, carry out its classification and processing, self-realization in practical and laboratory studies.

The criteria for assessment of independent creative work and independent tests are: the ability to carry out a critical and an independent estimation of the defined problem questions; skills in the explanation of alternative views and availability of a students' own point of view, position on the defined problem question; using the analytical approach; the quality and accuracy of expressing the thought; the logic, structure and explanation of conclusions about a particular problem; independence of carrying out of the work; grammatical correctness of the presentation of the material; using the methods of comparison, generalization of the concepts and facts; the design of the work; the quality of presentation.

*Independent work* is a scheduled educational and scientific work which is carried out on a lecture task under the methodical and scientific guidance of a lecturer, it is a specific form of the educational activity, its main objective is forming independence of a person.

The educational time, which is intended for students' independent work of the day-time form of education, is defined according to the educational plan and makes 68 % (102 hours) out of the total educational time for learning the discipline.

During independent work a student becomes an active participant in the educational process, learns to master consciously theoretical and practical knowledge, orientates easily in the information space, has to take responsibility for the quality of his own professional training.

The necessary element of successful mastery of the material of the academic discipline is the students' independent work with specific literature of the mathematical and economic direction.

**The final control** (the exam) of knowledge and competences of students on the academic discipline is carried out on the base of the term exam. The examination paper includes the syllabus of the discipline and provides for assessment of the knowledge level and a degree of the mastery of corresponding competences of students.

The purpose of the exam is to test student's understanding of the syllabus material on the whole, the logic and relations between its particular parts, the skills in the creative use of the stored knowledge, the ability to formulate one's attitude to a particular problem of the academic discipline and so on. The competent approach to the assessment of the exam implies measuring the level of the student's mastery of the competences provided by the qualifying requirements.

Each examination paper contains 5 practical tasks, including two first-level (diagnostic) tasks, two second level (situational) tasks and one third level (heuristic) task.

The assessment of the exam is carried out according to the temporary provision "About the Order of Assessment of Students' Academic Performance on the Accumulative Point Rating System" of Simon Kuznets Kharkiv National University of Economics.

**A student can't be allowed to take the exam**, if the number of points, obtained during the current and module control according to the thematic module during the term, does not make 35 points. After the examination period the dean of the department gives a notice about sitting the failed exams. In a given period the student adds the required points.

In the case of irreproachable fulfillment of all the examination tasks with the demonstration of deep knowledge of the academic discipline, skills in the practical use of the formed competences which are based on the ability to analyze and solve a wide range of tasks, a high level of completing the written work the student obtains 40 points.

**It should be assessed student's progress**, if a sum of points, obtained as the total result of an assessment by all forms of a control, equals or exceeds 60. Accordingly the minimal possible quantity of points by a current and a module control during a term equals 35 and the minimal possible quantity of points, obtained on an exam, equals 25.

The result of a terminal exam is assessed in points (the maximum is 40 points, the minimum of a quantity, which is passed, equals 25 points) and it is entered into the corresponding column of an examination «Mark sheet».

The final mark of the academic discipline is calculated according to the points obtained during the exam and points obtained during the current control on the accumulative system.

The total result in points during the term is "60 and more points mean passed", "59 and less points mean failed" and it is entered into the "Mark sheet" on the academic discipline.

### Rating-plan of the academic discipline

Theme	Forms and types of study		Forms of assessment	Maximal point
1	2		3	4
Theme 1	<i>Class work</i>			
	Lecture	<b>Lecture 1.</b> The elements of the theory of matrices and determinants		
	Practical study	<b>Practical study 1.</b> The elements of the theory of matrices and determinants		
	Laboratory study	<b>Laboratory work 1.</b> The elements of the theory of matrices and determinants	laboratory work	2
	<i>Independent work</i>			
Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.	homework	2	
Theme 2	<i>Class work</i>			
	Lecture	<b>Lecture 2.</b> The general theory of the system of linear algebraic equations		
	Practical study	<b>Practical study 2.</b> The general theory of the system of linear algebraic equations		
	Laboratory study	<b>Laboratory work 2.</b> The general theory of the system of linear algebraic equations	laboratory work	2
	<i>Independent work</i>			
Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work. Preparation for a written test	homework	2	
Theme 3	<i>Class work</i>			
	Lecture	<b>Lecture 3.</b> The elements of vector algebra. Elements of analytical geometry	colloquium	6
	Practical study	<b>Practical study 3.</b> The elements of vector algebra. Elements of analytical geometry	written test	6
	Laboratory study	<b>Laboratory work 3.</b> The elements of vector algebra. Elements of analytical geometry	laboratory work	2
	<i>Independent work</i>			
Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.	homework	2	



Theme 4	<i>Class work</i>			
	Lecture	<b>Lecture 4.</b> The limit of a function and continuity. Differential calculus of the function of one variable		
	Practical study	<b>Practical study 4.</b> The limit of a function and continuity. Differential calculus of the function of one variable		
	Laboratory study	<b>Laboratory work 4.</b> The limit of a function and continuity. Differential calculus of the function of one variable	laboratory work	2
	<i>Independent work</i>			
	Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.	homework	2
Theme 5	<i>Class work</i>			
	Lecture	<b>Lecture 5.</b> Analysis of the function of several variables		
	Practical study	<b>Practical study 5.</b> Analysis of the function of several variables		
	Laboratory study	<b>Laboratory work 5.</b> Analysis of the function of several variables	laboratory work	2
	<i>Independent work</i>			
	Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.	homework	2
Theme 6	<i>Class work</i>			
	Lecture	<b>Lecture 6.</b> Integral calculus		
	Practical study	<b>Practical study 6.</b> Integral calculus		
	Laboratory study	<b>Laboratory work 6.</b> Integral calculus	laboratory work	2
	<i>Independent work</i>			
	Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.	homework	2
Theme 7	<i>Class work</i>			
	Lecture	<b>Lecture 7.</b> Differential equations	independent creative task	6
	Practical study	<b>Practical study 7.</b> Differential equations	written test	6
	Laboratory study	<b>Laboratory work 7.</b> Differential equations	laboratory work	2
	<i>Independent work</i>			
	Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.	homework	2

<b>Theme 8</b>	<i>Class work</i>			
	Lecture	<b>Lecture 8. Series</b>	colloquium	6
	Practical study	<b>Practical study 8. Series</b>		
	Laboratory study	<b>Laboratory work 8. Series</b>	laboratory work	2
	<i>Independent work</i>			
	Questions and tasks to self-study	Search, choice and looking through literary sources on the theme. Learning the lecture material. Carrying out practical homework and a laboratory work.		
<b>Exam</b>			<b>40</b>	

### Recommended reading

#### Main

1. Вища математика: математичний аналіз, лінійна алгебра, аналітична геометрія [електронний ресурс]: підручник / [авт. кол. : Пономаренко В. С., Малярець Л. М., Афанасьєва Л. М. та ін. ; за ред. В. С. Пономаренка]. – Мультимедійне інтерактивне електрон. вид. комбінованого використ. (412 Мб). – Х.: ХНЕУ ім. С. Кузнеця, 2015. – Назва з тит. екрана. – ISBN 978-966-676-568-3.

2. Вища математика : базовий підручник для вузів / під ред. В. С. Пономаренка. – Харків : Фоліо, 2014. – 669 с.

3. Вища математика. Методичні рекомендації до самостійної роботи за темою «Диференціальні рівняння» для студентів усіх спеціальностей першого (бакалаврського) рівня [Електронний ресурс] / уклад. А. В. Воронін, О. В. Гунько; Харківський національний економічний університет ім. С. Кузнеця. - Електрон. текстові дан. (6,03 МБ). - Харків : ХНЕУ ім. С. Кузнеця, 2018. - 75 с. - Загол. з титул. екрану. Режим доступу <http://repository.hneu.edu.ua/handle/123456789/26217>

4. Вища математика : методичні рекомендації до самостійної роботи з теми "Визначений інтеграл" для студентів усіх спеціальностей / Л. М. Малярець, Л.М. Афанасьєва, К. О. Ковальова - Мультимедійне інтерактивне електронн. вид. комбінованого використання. (100 Мб). - ХНЕУ ім. С. Кузнеця, 2018 - Назва з тит. екрана <http://library.hneu.edu.ua/katalog.php>

5. Вища математика: мультимедійні методичні рекомендації до самостійної роботи з теми «Невизначені інтеграли»/ Л.М. Афанасьєва, А.В. Воронін, О.В. Гунько – Мультимедійне інтерактивне електрон. вид комбінованого використ. (89 Мб), - Харків: ХНЕУ ім.С.Кузнеця, 2019. <http://library.hneu.edu.ua/katalog.php>

6. Вища математика. Методичні рекомендації до самостійної роботи за темою "Ряди" для студентів усіх спеціальностей першого (бакалаврського) рівня [Електронний ресурс] / укл. А. П. Рибалко, К. В. Степанова; Харківський національний економічний університет ім. С. Кузнеця. - Електрон. текстові дан. (2,40 МБ). - Харків : ХНЕУ ім. С. Кузнеця, 2019. – 63 с.

7. Simon C.P., Blume L. Mathematics for Economists (2018) – NY: Viva Books 960 p.

#### Additional

8. Барабаш Г. М. Збірник-довідник з курсу “Вища математика для економістів” / Барабаш Г. М., Кирилич В. М., Пелюшкевич О. В. // Львів: Видавничий центр ЛНУ імені Івана Франка, 2018. – 257 с.

9. Барковський В.В. Вища математика для економістів: навч. посібник / Барковський В.В., Барковська Т.В. – Київ : ЦУЛ, 2019. – 456 с

10. Вища математика [Текст] : конспект лекцій: у 2-х ч. Ч.2 / І. Г. Голубков, В. А. Клименко, Т. І. Жиленко. – Суми : СумДУ, 2018. – 116 с.

11. Волков Ю.І., Войналович Н.М. Вища математика. Лекції, завдання для практичних

занять та самостійної роботи студентів, частина 1: Навчальний посібник. – Кропивницький: ПП «Ексклюзив - Систем», 2019. – 73 с.

12. Лиходєєва Г.В., Пастирева К.Ю. Диференціальні рівняння: працюємо самостійно : навч. посіб. – К.: ЦУЛ, 2018. – 144 с.

13. Математика для економістів: Конспект лекцій [Електронний ресурс] : навчальний посібник / КПІ ім. Ігоря Сікорського ; уклад. І. Д. Фартушний. – Електронні текстові дані (1 файл: 2,91 Мбайт). – Київ : КПІ ім. Ігоря Сікорського, 2019. – 109 с.

14. Мацкул В.М. Вища математика для економістів.: Підручник. – Одеса: ОНЕУ, 2018. – 472 с.

15. Щетініна О.К. Вища та прикладна математика в економічних прикладах та задачах. Практикум, ч.2.: навч. пос./ О.К. Щетініна, С.В. Білоусова, Ю.А. Гладка, Т.В. Ковальчук . - К.: КНТЕУ, 2019 – 310 с.

16. Simon C.P., Blume L. Mathematics for Economists (2018) – NY: Viva Books 960 p.

#### **Internet Information Resources:**

17. Xavier Boix, Joe Olson (2018)

<https://cbmm.mit.edu/sites/default/files/documents/algebra.pdf>

18. Octave Programming Tutorial/Vectors and matrices

[https://en.wikibooks.org/wiki/Octave\\_Programming\\_Tutorial/Vectors\\_and\\_matrices](https://en.wikibooks.org/wiki/Octave_Programming_Tutorial/Vectors_and_matrices)

19. Octave Guidelines

<http://www.philender.com/courses/multivariate/notes/matoctave.html>,

20. Освітньо-професійна програма “Міжнародна економіка” <https://www.hneu.edu.ua/wp-content/uploads/2021/10/Mizhnarodna-ekonomika-OPP-2021-bakalavr.pdf>

#### **Methodical support**

21. Сайт персональних навчальних систем: Higher mathematics / доц. Місюра Є.Ю. <https://pns.hneu.edu.ua/course/view.php?id=7959>