



APPROVED:

Vice-rector for study and methodical work

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Высшая математика /Linear Algebra

Syllabus of the course

Specialty	38.03.02 Management
Specialization	Business management and digital innovations
Level of higher education	Bachelor
Form of training	Full-time
Year of enrolment	2022

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Total number of hours	180	Form of final attestation: Exam: semester I
incl:		
contact work	80	
self-study	64	
practical training	0	
control hours	36	

Hours distribution:

Semester:	1
Type of classes	Hours
Contact hours	38
Practical training	42
Laboratory work	
Total contact hours	80
Self-study	64
Control hours	36
Total academic hours	180
Total credits	5

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1. LEARNING OBJECTIVES

Objective:	To give students the necessary stock of information on a number of sections of higher mathematics (basic definitions, theorems, rules) that are most appropriate for their future professional activities, as well as a mathematical apparatus that helps them to put in mathematical form and solve professional problems.
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2. COURSE PLACE IN THE PROGRAMME STRUCTURE

The discipline B1.O Linear algebra is a part of Block 1.

3. EXPECTED LEARNING OUTCOMES

Code and name of graduate competence	Code and name of the competence achievement indicator	Expected learning outcomes
UK-1 – Able to search, critical analysis and synthesis of information, apply a systematic approach to solve tasks	UK-1.1 – Searches for the necessary information, based on the results of the analysis of the task	<p>To know: basic concepts of linear algebra, analytic geometry and calculus</p> <p>To be able to: use mathematical methods and models to solve applied problems.</p> <p>To possess: the skills of modeling and solving applied problems using the methods of higher mathematics.</p>

4. COURSE STRUCTURE AND CONTENT

Code and name of the topics	Course content	Academic hours			
		Contact work			Self-study
		Lectures	Practices	Workshops	
Topic 1. Method of coordinates, its applications	Cartesian coordinate system, calculation of the length of a segment, division of a segment in a given ratio.	2	4		6
Topic 2. Vectors on the plane and in space	Geometric and algebraic definition of a vector. Actions on vectors.	4	4		6
Topic 3. The equation of a straight line on a plane	Topic 3. Equation of a straight line on a plane Derivation of the equation of a straight line on a plane, its use for solving problems.	4	4		6
Topic 4. The equation of the plane. Equation of a straight line in space	Derivation of the plane equation in space. Derivation of the equation of a straight line in space. Problems on the relative position of a plane and a straight line in space.	4	2		6

Topic 5. Matrices, actions on them.	Matrices, their types. Matrix Actions.	2	2		6
Tema 6. Determinants of square matrices	The concept of the determinant of a square matrix. Properties of determinants, methods of calculating determinants. Inverse matrix. Calculation of the inverse matrix. Solution of matrix equations.	2	4		6
Topic 7. Systems of linear equations	Systems of linear equations, basic definitions. Matrix method for solving systems of linear equations. Cramer's method. Gauss method.	4	4		6
Topic 8. Linear dependence and independence of vector systems	The concept of a linear vector space. Investigation of systems of vectors for linear dependence and independence.	2	2		6
Topic 9. Fundamentals of differential calculus	The concept of a function. Basic elementary functions, their graphs. The concept of the limit of a function. Continuous functions. Function derivative. Investigation of functions using the derivative.	7	8		8
Topic 10. Fundamentals of integral calculus	The concept of antiderivative function and indefinite integral. The concept of a definite integral, its geometric interpretation. Methods for calculating indefinite and definite integrals, their applications.	7	8		8
Control hours:					36
Total hours:		38	42	0	64

5. TEACHING AND LEARNING TOOLS OF THE COURSE

5.1 Recommended literature

Bibliographic description of the publication (author, title, type, place and year of publication, number of pages)	Digital resources
1. Krass, M. S. Mathematics in Economics. Basic course: textbook for bachelors / M. S. Krass. — 2nd ed., rev. and additional - Moscow: Yurayt Publishing House, 2019. - 470 p.	https://urait.ru/viewer/matematika-v-ekonomike-bazovyy-kurs-426158
2. Higher mathematics for economists: a textbook for university students studying economics / N.Sh. Kremer [et al.]; edited by prof. N.Sh. Kremer. - 3rd ed. - M.: UNITY-DANA, 2017. - 479 p.	https://znanium.com/read?id=341261

5.2 List of software (including national production)

- 7-Zip
- LibreOffice
- ОС АЛТ образование 10

5.3 List of reference systems and modern professional databases

№	Name of reference systems and professional databases
1.	Digital library Grebennikon.ru – www.grebennikon.ru
2.	Science Digital Library eLIBRARY – www.elibrary.ru
3.	Science Digital Library КиберЛеника – www.cyberleninka.ru
4.	Database ПОЛПРЕД Справочники – www.polpred.com
5.	Database OECD Books, Papers & Statistics on the platform OECD iLibrary www.oecd-ilibrary.org
6.	Legal reference system КонсультантПлюс (installed resource UNECON or www.consultant.ru)
7.	Legal reference system «ГАРАНТ» (installed resource UNECON or www.garant.ru)
8.	Information and referral system «Кодекс» (installed resource UNECON or www.kodeks.ru)
9.	Digital library system BOOK.ru – www.book.ru
10.	Digital library system ЭБС ЮРАЙТ – www.urait.ru
11.	Digital library system ЗНАНИУМ (ZNANIUM) – www.znanium.com
12.	Digital library UNECON – opac.unecon.ru

6. TECHNICAL FACILITIES

There are special rooms for lectures, seminars, coursework, group and individual consultations, current and interim assessments, as well as rooms for self-study.

The premises are equipped with equipment and teaching aids.

The rooms for students' independent work are equipped with computers with Internet connection and access to the university's electronic learning environment.

Name of classroom	Classroom location
Classroom 2009 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and intermediate attestation), equipped with a multimedia system. Special furniture and equipment: Educational furniture for 122 seats (study table 61 pcs., chairs 122 pcs.), the teacher's workplace, desk m/m, drawer 1 pc, chalk board 1 pc (3 sections), chair 1 pc, drawer 1 pc, chair 1 pc, Chair 2 pcs., Intel i3-2100 2.4 Ghz /4Gb/500Gb/Acer V193 19" - 1 pc, Sound projector Yamaha YSP-3000 - 1 pc, Projector stand with camera decks - 1 pc, Projection screen draper - 1 pc, Multimedia projector Type 2 Panasonic PT-VX610E - 1 pc, Screen Media D1 ceiling bracket - 1 pc. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, B, P
Classroom 2011 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and intermediate attestation), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 118 seats, teacher's workplace, desk - 1 pc, chalk board (3 sections) - 1 pc, marker board - 1 pc, desk - 1 pc, desk - 1 pc, drawer - 1 pc, chair - 3 pcs., Computer Intel i3-2100 2.4 Ghz /4Gb/500Gb/Acer V193 19" - 1 pc, ScreenMedia Champion 244x183cm SCM-4304 - 1 pc, Panasonic PT-VX610E multimedia projector - 1 pc. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, B, P
Classroom 2028 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and	191023, St. Petersburg,

intermediate attestation), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 44 seats, teacher's workplace, chalk board (one section) - 1 pc, chair - 1 pc, table - 1 pc, chair - 3 pcs. Portable multimedia set: HP 250 G6 1WY58EA laptop, LG PF1500G multimedia projector. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	Griboedova canal, 30-32, lit. A, Б, P
Classroom 2045 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and intermediate attestation), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 78 seats, teacher's workplace, chalk board (3 sections) - 1 pc, chair - 1 pc, chairs - 2 pcs. Portable multimedia set: HP 250 G6 1WY58EA laptop, LG PF1500G multimedia projector. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, Б, P
Classroom 2052 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and intermediate attestation), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 88 seats, teacher's workplace, chalk board (3 sections) - 1 pc, desk - 1 pc, table - 2 pcs, chair - 2 pcs, Computer Intel i3-2100 2.4 Ghz/500/4/Acer V193 19" - 1 pc, Multimedia projector Type 2 Panasonic PT-VX610E - 1 pc, ScreenMedia Champion 244x183cm SCM-4304 motorized screen - 1 pc, MW Cinerollo 200*200cm manual spring loaded screen - 1 pc, Multimedia projector Type 2 Panasonic PT-VX610E - 1 pc. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, Б, P
Classroom 2060 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and intermediate attestation), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 82 seats, a teacher's workplace, chalk board (3 sections) - 1 pc., chair - 1 pc., table - 1 pc., chair - 2 pcs., Computer Intel i3-2100 2.4 Ghz/500/4/Acer V193 19" - 1 pc., Multimedia projector Panasonic PT-VX610E - 1 pc., Screen with electric drive ScreenMedia Champion 203x153cm (SCM-4303) - 1 pc. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, Б, P
Classroom 2061 Training classroom (for lecture- and seminar-type classes, coursework, group and individual consultations, current control and intermediate attestation), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 80 seats, teacher's workplace, table - 1 pc, chalk board (3 sections) - 1 pc, pulpit - 1 pc, chairs - 2 pcs. Portable multimedia set: HP 250 G6 1WY58EA laptop, LG PF1500G multimedia projector. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, Б, P
Classroom 2023 Computer room (for practical classes, course design (coursework) using computer technology), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 48 seats, teacher's workplace (computer desk - 1 pc.), wheeled marker board - 1 pc, 3 sectional marker board - 1 pc, desk - 1 pc, iso chair - 7 pcs, chair -1 pc, blinds - 3 pcs., Computer i5-8400/8GB/500GB_SSD/Viewsonic VA2410-mh -34 pcs, Switchboard Cisco Catalyst 2960-48PST-L (including SmartNet Service Contract CON-SNT-2964STL) - 1 pc, Wi-Fi Access Point Type1 UBIQUITI UAP-AC-PRO - 1 pc, NEC M350 X projector - 1 pc, Local Area Network Switch (48 ports) Cisco WS-C2960+48PST-L - 1 pc, ProCurve Switch 2626 - 1 pc, Intel pentium x2 g3250 computer /500gb / philips 21.5' monitor - 1 pc, Ubiquiti IP video camera - 1 pc, Wireless access point/UNI FI	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, Б, P

AP PRO/Ubiquiti - 1 pc. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	
Classroom 2034 Computer room (for practical classes, course design (coursework) using computer technology), equipped with a multimedia system. Specialized furniture and equipment: Educational furniture for 25 seats, teacher's workplace (table 1pc., chair 1pc.), marker board 1pc, Rack hanger 2pcs, chairs 3pcs.Computer I5-7400/8Gb/1Tb/DELL S2218H - 21pcs, Network switch Cisco WS-C2960-48TT-L (Catalyst2960) 48-ports 10/100Mbps+2p - 1 pc, Switchboard Cisco Catalyst 2960 24 WS-C2960-24PC-L - 1 pc. Sets of display equipment and visual aids: multimedia applications for lecture courses and practical sessions, interactive teaching and visual aids.	191023, St. Petersburg, Griboedova canal, 30-32, lit. A, B, P

7. METHODOLOGICAL GUIDELINES FOR STUDENTS

The following documents should be made available to the trainee before the start of the course:

- training and methodological documentation;
- local normative acts regulating the main issues of the organisation and implementation of educational activities, including those regulating the procedure for current monitoring and interim assessment of students;
- the schedule of consultations of the teaching staff.

The level and depth of mastering the discipline is determined by the active and systematic work of students in lectures, seminars, independent work, including in terms of identifying the most significant and relevant problems for further study. A special condition for qualitative mastering of the discipline is an effective organisation of work, which allows distributing the academic workload evenly in accordance with the schedule of the educational process.

When preparing for classes, students have the opportunity to attend consultations with the staff of UNECON according to the timetable set out in the schedule of consultations.

The students' in- and out-of-classroom work should aim to form:

- the fundamentals of the learner's world view and scientific understanding;
- basic knowledge relevant to the training area and the declared professional field, forming the target and professional basis for training;
- professional competences oriented towards the needs of the labour market;
- an individual trajectory by mastering a unique set of professional competences that complement the learner's competence model, through a focus on specific professional specialised areas of knowledge defined by labour market representatives;
- meta-skills for learners, such as teamwork and leadership, data analysis, digital skills, project design and implementation, intercultural interaction.

8. SPECIFICATIONS FOR TEACHING DISABLED PERSONS

Students with disabilities, if necessary, are taught on the basis of an adapted work programme using special teaching methods and didactic materials that take into account the particularities of their psychophysical development, individual capacities and health status.

In order for disabled persons and persons with disabilities to master the curriculum, the University shall ensure that:

- for the visually impaired and visually impaired: availability of information on the timetable in accessible places and adapted forms for learners who are blind or visually impaired; presence of an assistant to assist the learner as needed; production of alternative formats of teaching materials (large print or audio files);
- for the hearing-impaired and hearing-impaired: adequate sound reproduction of information;
- for persons with disabilities and persons with mobility impairments: the possibility of unimpeded access for students to classrooms, restrooms and other areas of the department, as well as their stay in these areas.

Learners with disabilities and persons with disabilities are provided with printed and/or electronic educational resources in forms adapted to their disabilities. The education of students with disabilities may be organised with other students or in separate groups or organisations.

ASSESSMENT RESOURCES

1.1 Control tasks and assignments for interim attestation

1. Method of coordinates, its applications.
2. Vectors on the plane and in space. Operations on vectors.
3. Equation of a straight line on a plane. Angle between lines.
4. Equation of a plane in space.
5. The equation of a straight line in space.
6. Matrices, actions on them.
7. The concept of matrix determinant. Properties of determinants.
8. Inverse matrix. Necessary and sufficient condition for its existence.
9. The formula for calculating the inverse matrix.
10. Solution of matrix equations.
11. Systems of linear equations. Basic concepts.
12. Inverse matrix method for solving a system of linear equations.
13. Cramer's method.
14. Gauss method.
15. Linearly dependent and independent systems of vectors.
16. Linear vector space, its basis.
17. Functions. Basic elementary functions, their graphs.
18. Function limit, its properties.
19. Continuity of function. Properties of functions continuous on a segment.
20. Derivative functions, their calculation.
21. Differentiable functions.
22. Basic theorems of differential calculus.
23. Monotonicity of functions. extremum points.
24. Convexity of functions. Inflection points.
25. Asymptotes of the graph of functions.
26. Study of functions and construction of their graphs.
27. Antiderivative functions, indefinite integral, their properties.
28. Methods for calculating indefinite integrals.
29. Definite integral, its geometric interpretation, calculation methods.
30. Functions of several variables.
31. Partial derivatives.
32. Extrema of functions of several variables.

Typical tasks:

1. Vectors are given $\vec{a} = (3; -5; 2)$, $\vec{b} = (1; -1; 1)$. Find the square of the length of the vector $2\vec{a} - \vec{b}$.

2. Solve the system of equations by Cramer's method
$$\begin{cases} 3x_1 + x_2 - 4x_3 = -5 \\ x_1 + 2x_2 - x_3 = -1 \\ -x_1 + 3x_2 + x_3 = 1 \end{cases}.$$
3. Find the coordinates of the point of intersection of the line $\frac{x+1}{2} = \frac{y-2}{1} = \frac{z+1}{4}$ and the plane $x - y + 5z - 1 = 0$.
4. Find the limit $\lim_{x \rightarrow \infty} \frac{x^2 - 3x^3 - 6x^6 - 2}{(3x^3 - 4)(2 - x^2)(2x + 3)}.$
5. Calculate the derivative of the function at the point $x = -1$: $y = \frac{x+2}{4x^5 - 1}.$

1.2 Topics for written task

Is not provided by the work programme of the discipline.

1.3 Interim checkpoints

Number	Type	Method of conduct	Topic number
1	Test paper	in written form	1 - 8
2	Test paper	in written form	9-10
3	Current control	with the help of technical means and information systems	1 -10

1.4 Other assessment objects

Is not provided by the work programme of the discipline.

1.5 Self-study

Name of self-study	Topic number
Doing homework	1-10
Preparation for lectures and practical classes	1-10
Exam Preparation	1-10

1.6 Grading scale

Scales of assessment and procedures for assessing learning outcomes of the discipline are regulated by the Regulations on the current control of progress and interim attestation of students in higher education programmes and the Regulations on the scoring and rating system.

A grading and rating system is used to assess the learning outcomes of the discipline:

The final control of the discipline is an examination (or a differentiated test), the final grade being formed in accordance with the scale given in the table below:

Points	Grade
≤ 54	fail
55-69	satisfactory
70-84	good
≥ 85	excellent

Grading scale

2 (points to 54)	Demonstrates a lack of understanding of the problem. Many of the requirements of the assignment are not met. An initial perception of the material is demonstrated. The work is incomplete and/or plagiarized.
3 (points 55-69)	Demonstrates a partial understanding of the problem. Most of the requirements of the task have been met. Mastery of the elements of the assigned material. The material is mostly clear and coherent.
4 (points 70-84)	Demonstrates considerable understanding of the issue by the discipline. All requirements of the assignment are fulfilled. The content of the completed tasks is disclosed and examined from different perspectives.
5 (points 85-100)	Demonstrates full understanding of the problem. All requirements of the assignment are fulfilled. Demonstrates proficiency in the discipline. The completed assignments are holistic, complete, structured, present different points of view and demonstrate creativity.