



APPROVED

Vice-rector for educational activities

Veronika.G. Shubaeva

«24» *shubaeva* 2023.

## *Высшая математика / Linear algebra*

### Syllabus of the course

Specialization	38.03.02 Management
Specialization	Business management and digital innovations
Level of higher education	Bachelor
Form of training	Full-time
Year of enrolment	2023
Authored by:	
PhD, Desnitskaya Valentina Nikolaevna	

Total number of hours	252	<b>Form of final attestation</b>  Exam: Semester 1
incl:		
contact work	80	
self-study	136	
practical training	0	
control hours	36	

#### Hours distribution:

Semester:	1
Type of activity	Hours
Contact hours	38
Practical training	42
Laboratory work	
<b>Total contact hours</b>	<b>80</b>
Self-study	136
Control hours	36
<b>Total academic hours</b>	<b>252</b>
<b>Total credits</b>	<b>7</b>

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## 1. OBJECTIVES OF MASTERING THE DISCIPLINE

<b>Target:</b>	Provide students with the necessary stock of information on a number of sections of higher mathematics (basic definitions, theorems, rules) that are most relevant to their future professional activities, as well as a mathematical apparatus that helps them formulate and solve professional problems in mathematical form.
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## 2. PLACE OF THE DISCIPLINE IN THE STRUCTURE OF THE EDUCATIONAL PROGRAM

Discipline B1.O Linear algebra is a compulsory part of Block 1.

## 3. PLANNED LEARNING OUTCOMES IN THE DISCIPLINE

Code and name of graduate competence	Code and name of the competency achievement indicator	Planned learning outcomes for the discipline
UC-1 - Capable of searching, critically analyzing and synthesizing information, applying a systematic approach to solving assigned tasks	UC-1.1 - Searches for the necessary information based on the results of the analysis of the task	<p>Know: basic concepts of linear algebra, analytical geometry and mathematical analysis.</p> <p>Be able to: use mathematical methods and models to solve applied problems.</p> <p>Possess: skills in modeling and solving applied problems using methods of higher mathematics.</p>

## 4. STRUCTURE AND CONTENT OF THE DISCIPLINE

Number and name of topics and/or sections/topics	Contents of the discipline	Academic hours			
		Contact work			Self-study
		Lectures	Practice	Workshops	
Section I. Analytical Geometry.					
Topic 1. The coordinate method, its applications.	Cartesian coordinate system, calculating the length of a segment, dividing a segment in a given ratio.	2	4		12
Topic 2. Vectors on the plane and in space.	Geometric and algebraic definition of vector. Operations on vectors.	4	4		12
Topic 3. Equation of a straight line	Derivation of the equation of a straight line on a plane, its use for solving problems.	2	4		12

on a plane.					
Topic 4. Equation of a plane. Equation of a straight line in space.	Derivation of the equation of a plane 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		10
<b>Section II. Linear Algebra.</b>					
Topic 5. Matrices, actions on them.	Matrices, their types. Operations on matrices.	2	2		10
Topic 6. Determinants of square matrices.	The concept of the determinant of a square matrix. Properties of determinants, methods for calculating determinants. Inverse matrix. Calculating the inverse matrix. Solving matrix equations.	2	4		10
Topic 7. Systems of linear equations.	Systems of linear equations, basic definitions. Matrix method for solving systems of linear equations. Cramer's method. Gauss's method.	4	4		10
Topic 8. Linear dependence and independence of vector systems.	The concept of a linear vector space. Research of vector systems for linear dependence and independence.	2	2		12
<b>Section III. Mathematical analysis.</b>					
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. Derivative of a function. Research of functions using the derivative.	9	8		24
Topic 10. Fundamentals of integral calculus.	The concept of a primitive function and an indefinite integral. The concept of a definite integral, its geometric interpretation. Methods for calculating indefinite and definite integrals, their applications.	7	8		24
<b>Control:</b>					<b>36</b>
<b>Total for the discipline:</b>		<b>38</b>	<b>42</b>	<b>0</b>	<b>136</b>

## 5. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE

### 5.1 Recommended literature

Bibliographic description of the publication (author, title, type, place and year of publication, number of pages)	Electronic resources
1. Desnitskaya, Valentina Nikolaevna. Fundamentals of Mathematical Analysis: a tutorial / V.N.Desnitskaya, V.G.Dmitriev, S.V.Petras; Ministry of Education and Science of the Russian Federation, St. Petersburg State University of Economics, Dept. of Higher Mathematics. St. Petersburg: Publishing house of SPbGEU, 2021. 1 file (2.23 MB).	<a href="https://opac.unecon.ru/elibrar ... D0%BB%D0%B8%D0%B7%D0%B0_21.pdf">https://opac.unecon.ru/elibrar ... D0%BB%D0%B8%D0%B7%D0%B0_21.pdf</a>

2. Itenberg, Vladimir Semenovich. Fundamentals of Linear Algebra: a tutorial / V.S.Itenberg, S.E.Ignatova; Ministry of Education and Science of the Russian Federation, St. Petersburg State University of Economics, Department of Higher Economics. St. Petersburg: Publishing House of St. Petersburg State University of Economics, 2017.	<a href="https://opac.unecon.ru/elibrar ...B3%D0%B5%D0%B1%D1%80%D1%8B.pdf">https://opac.unecon.ru/elibrar ...B3%D0%B5%D0%B1%D1%80%D1%8B.pdf</a>
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## 5.2 List of licensed and freely distributed software, including domestically produced

- 7-Zip
- OS Alt education 10
- LibreOffice

## 5.3 List of information reference systems (IRS) and modern professional databases (MPDB)

No.	Name of SPBD/ISS
1.	Electronic library Grebennikon.ru – <a href="http://www.grebennikon.ru">www.grebennikon.ru</a>
2.	Scientific electronic library eLIBRARY – <a href="http://www.elibrary.ru">www.elibrary.ru</a>
3.	Scientific electronic library CyberLeninka – <a href="http://www.cyberleninka.ru">www.cyberleninka.ru</a>
4.	Database POLPRED Directories – <a href="http://www.polpred.com">www.polpred.com</a>
5.	OECD Books, Papers & Statistics database on the OECD iLibrary platform <a href="http://www.oecd-ilibrary.org">www.oecd-ilibrary.org</a>
6.	Legal reference system ConsultantPlus (installed resource SPbSUE or <a href="http://www.consultant.ru">www.consultant.ru</a> )
7.	Reference legal system "GARANT" (installed resource of SPbGEU or <a href="http://www.garant.ru">www.garant.ru</a> )
8.	Information and reference system "Code" (installed resource SPbSUE or <a href="http://www.kodeks.ru">www.kodeks.ru</a> )
9.	Electronic library system BOOK.ru - <a href="http://www.book.ru">www.book.ru</a>
10.	Electronic library system EBS URAYT – <a href="http://www.urait.ru">www.urait.ru</a>
11.	Electronic library system ZNANIUM (ZNANIUM) – <a href="http://www.znanium.com">www.znanium.com</a>
12.	Electronic library of SPbGEU – <a href="http://opac.unecon.ru">opac.unecon.ru</a>

## 6. LOGISTIC AND TECHNICAL SUPPORT OF DISCIPLINE

To implement this discipline, there are special rooms for conducting lecture-type classes, seminar-type classes, course design (completion of coursework), group and individual consultations, ongoing monitoring and midterm assessment, as well as rooms for independent work.

The premises are equipped with equipment and technical teaching aids.

The rooms for independent work of students are equipped with computer equipment with the ability to connect to the Internet and provide access to the electronic information and educational environment of the university.

Name of classrooms, list	Address (location) of classrooms
Room 0005 Computer class (for practical classes, course design (coursework) using computer technology). Equipped with a multimedia complex. Specialized furniture and equipment: Classroom furniture for 25 seats, teacher's workplace, table - 1 pc., whiteboard on wheels - 1 pc., hanger stand - 2 pcs., blinds - 2 pcs., Computer Intel i5 4460 / 1Tb / 8Gb / Samsung s23e200 - 10 pcs., Computer Intel i5 7400 / 1Tb / 8Gb / Philips 243V5Q 23 ' - 12 pcs., Multimedia projector Type 1 Optoma x 400 - 1 pc., ScreenMedia Champion 244x183cm (SCM-4304) electric screen - 1 pc., HP 250 G6 1WY58EA laptop - 3 pcs. Sets of demonstration equipment and teaching aids: multimedia applications for lecture courses and practical classes, interactive teaching aids.	191023, St. Petersburg, st. Kanal Griboyedov, 30/32, letters "A", "B", "R"
Audience 2023 Computer class (for conducting practical classes, course design (completing coursework) using computer technology). Equipped with a multimedia complex. Specialized furniture and equipment: Classroom furniture for 48 seats, teacher's workplace (computer desk - 1 pc.), whiteboard on wheels - 1 pc., 3-section whiteboard - 1 pc., lectern - 1 pc., table - 1 pc., art chair - 7 pcs., chair - 1 pc., blinds - 3 pcs., Computer i5-8400/8GB/500GB_SSD/Viewsonic VA2410-mh - 34 pcs., Cisco Catalyst 2960-48PST-L switch (including SmartNet CON-SNT-2964STL service contract) - 1 pc., Wireless access point Wi-Fi Type 1 UBIQUITI UAP-AC-PRO - 1 pc., Projector NEC M350 X - 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 AP PRO/Ubiquiti - 1 pc. Demonstration equipment and teaching aids sets: multimedia applications for lecture courses and practical classes, interactive teaching aids.	191023, St. Petersburg, st. Kanal Griboyedov, 30/32, letters "A", "B", "R"
Room 3012 Classroom (for lectures and seminars, course design (coursework), group and individual consultations, ongoing monitoring and midterm assessment) equipped with a multimedia complex. Specialized furniture and equipment: Classroom furniture for 74 seats, teacher's workstation, chalk board (3-section) - 1 pc., lectern - 1 pc., chair - 2 pcs. Portable multimedia kit: HP 250 G6 1WY58EA Notebook, LG PF1500G Multimedia Projector. Sets of demonstration equipment and teaching aids: multimedia applications for lecture courses and practical classes, interactive teaching aids.	191023, St. Petersburg, st. Kanal Griboyedov, 30/32, letters "A", "B", "R"
Audience 3020 Classroom (for lectures and seminars, course design (coursework), group and individual consultations, ongoing monitoring and midterm assessment) equipped with a multimedia complex. Specialized furniture and equipment: Classroom furniture for 25 seats, teacher's workstation, chalkboard - 1 pc., lectern - 1 pc., table - 3 pcs., desk - 1 pc., table - 1 pc., chair - 9 pcs., built-in cabinets - 5 pcs., glass display case - 1 pc., Intel i3-2100 2.4 Ghz/500/4/Acer V193 19" computer - 1 pc., Optoma EX-632 multimedia projector - 1 pc., Wi-Fi wireless access point Type 1 UBIQUITI UAP-AC-PRO - 1 pc., Switch ProCurve Switch 2626 - 1 pc., Local Area	191023, St. Petersburg, st. Kanal Griboyedov, 30/32, letters "A", "B", "R"

Network Switch (24 ports) Cisco WS-C2960+24PC-L - 1 pc., Cisco Module - 1 pc. Demonstration equipment and teaching aids sets: multimedia applications for lecture courses and practical classes, interactive teaching aids.	
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## **7. METHODOLOGICAL INSTRUCTIONS FOR STUDENTS TO MASTER THE DISCIPLINE**

When starting to study the discipline, the student must familiarize themselves with the following documents:

- educational and methodological documentation;
- local regulations governing the main issues of organizing and implementing educational activities, including those regulating the procedure for conducting ongoing monitoring of academic performance and midterm assessment of students;
- schedule of consultations for faculty members.

The level and depth of mastering the discipline are determined by the active and systematic work of students in lectures, seminar-type classes, and independent work, including in terms of identifying the most significant and relevant problems for further study. A special condition for high-quality mastering of the discipline is the effective organization of work, which allows for the even distribution of the academic load in accordance with the schedule of the educational process.

In preparation for classes, students are given the opportunity to attend consultations with the faculty of SPbGEU according to the schedule established in the consultation schedule.

The students' in-class and out-of-class work should be aimed at developing:

- fundamental foundations of students' worldview and natural science knowledge;
- basic knowledge corresponding to the direction of training and the declared professional field, forming a target and professional basis for training personnel;
- professional competencies aimed at meeting the needs of the labor market;
- individual trajectory through the acquisition of a unique set of professional competencies that complement the student's competency model, due to the focus on specific professional specialized areas of knowledge determined by representatives of the labor market;
- meta-skills of students, such as: teamwork and leadership, data analysis, digital skills, project development and implementation, intercultural interaction.

## **8. FEATURES OF MASTERING THE DISCIPLINE FOR DISABLED PEOPLE AND PERSONS WITH LIMITED HEALTH CAPABILITIES**

The training of students with disabilities, if necessary, is carried out on the basis of an adapted work program using special teaching methods and didactic materials compiled taking into account the characteristics of the psychophysical development, individual capabilities and health status of such students (student).

In order to master the curriculum of the discipline by disabled people and people with limited health capabilities, the University provides:

- for disabled people and people with limited health capabilities due to vision: posting reference information about the schedule of classes in places accessible to students who are blind or visually impaired, and in an adapted form; the presence of an assistant providing the student with the necessary assistance; issuing alternative formats of methodological materials (large font or audio files);
- for disabled people and people with limited hearing: reproduction of information using appropriate sound means;
- for disabled people and people with limited health capabilities who have musculoskeletal disorders: the possibility of unimpeded access of students to classrooms, toilets and other premises of the department, as well as staying in the said premises.

Students with disabilities and individuals with special educational needs are provided with printed and/or electronic educational resources in forms adapted to their health limitations. Education of students with special educational needs can be organized both together with other students and in separate groups or in separate organizations.



# ASSESSMENT TOOLS FUND

## 1.1 Test questions and assignments for the midterm assessment

- 1 The coordinate method and its applications.
- 2 Vectors on the plane and in space. Operations on vectors.
- 3 Equation of a line on a plane. Angle between lines.
- 4 Equation of a plane in space.
- 5 Equation of a straight line in space.
- 6 Matrices, actions on them.
- 7 The concept of a matrix determinant. Properties of determinants.
- 8 Inverse matrix. Necessary and sufficient condition for its existence.
- 9 Formula for calculating the inverse matrix.
- 10 Solving 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 Limit of a function, its properties.
- 19 Continuity of a function. Properties of functions continuous on a segment.
- 20 Derivatives of functions, their calculation.
- 21 Differentiable functions.
- 22 Fundamental theorems of differential calculus.
- 23 Monotonicity of functions. Extreme points.
- 24 Convexity of functions. Points of inflection.
- 25 Asymptotes of the graph of functions.
- 26 Study of functions and construction of their graphs.
- 27 Antiderivative of a function, 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.

## 1.2 Topics of written works

The work program does not provide for this discipline.

## 1.3 Checkpoints

Checkpoint number	Checkpoint type	Method of implementation	Topic numbers
1	Test	in writing	1--8
2	Test	in writing	9-10
3	Current control	with the help of technical means and information systems	1-10

## 1.4 Other objects of assessment

The work program does not provide for this discipline.

## 1.5 Independent work of the student

<b>Titles of independent work</b>	<b>Topic numbers</b>
Doing homework	1-10
Preparation for lectures and practical classes	1-10
Preparing for the exam	1-10

## 1.6 Result assessment scale

The assessment scales and procedures for assessing learning outcomes in a discipline are regulated by the Regulation on the current monitoring of academic performance and midterm assessment of students in higher education programs and the Regulation on the point-rating system.

To assess the development of learning outcomes in a discipline, a point-rating system of student performance is used:

The form of final assessment for the discipline is an exam (or differentiated test), the final grade is formed in accordance with the scale given in the table below:

<b>Points</b>	<b>Grade</b>
$\leq 54$	unsatisfactory
55-69	satisfactorily
70-84	Fine
$\geq 85$	Great

### Result assessment scale

2 (score up to 54)	Demonstrates a lack of understanding of the problem. Many of the requirements for the task are not met. Primary perception of the material is demonstrated. The work is unfinished and/or it is plagiarism.
3 (score 55-69)	Demonstrates partial understanding of the problem. Most of the requirements for the task are met. Mastery of the elements of the given material. The completed material is generally understandable and holistic.
4 (score 70-84)	Demonstrates significant understanding of the problem in the assigned discipline. All requirements for the assignment have been met. The content of the completed tasks is disclosed and examined from different points of view.
5 (score 85-100)	Demonstrates a complete understanding of the problem. All requirements for the task are met. Demonstrated confident mastery of the discipline material. Completed tasks are holistic, completed in full, structured, present different points of view, demonstrated a creative approach.