

**SYLLABUS**  
**Fall semester 2023-2024 academic year**  
**Educational program "6B06102-Information Systems"**

ID and name of course	Independent work of the student (IWS)	Number of credits			General number of credits	Independent work of the student under the guidance of a teacher (IWST)
		Lectures (L)	Practical classes (PC)	Lab. classes (LC)		
101215 Mathematics-2 (Algebra and Discrete mathematics)	17	3	3	0	6	17

**ACADEMIC INFORMATION ABOUT THE COURSE**

Learning Format	Cycle, component	Lecture types	Types of practical classes	Form and platform final control
Offline	base	Problematic, analytical	Problematic, problem solving	Oral
<b>Lecturer - (s)</b>	Sautbekova Merey, senior-lecturer			
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<b>Assistant - (s)</b>	-			
<b>e-mail :</b>	-			
<b>Phone :</b>	-			

**ACADEMIC COURSE PRESENTATION**

Purpose of the course	Expected Learning Outcomes (LO) * Describe what is the result of studying the course the student will be able to:	Indicators of LO achievement (ID) As a result of studying the discipline, the student will be able to:
	LO 1. Explain the essence of the basic concepts and theorems of algebra and discrete mathematics based on proof tools.	ID 1 Understand the basic definitions and theorems of algebra and discrete mathematics.
		ID 2 Apply definitions and theorems to solve problems.
	LO 2. Solve basic matrix algebra problems.	ID 3 Apply operations on matrices.
		ID 4 Investigate the linear dependence of a system of vectors.
		ID 5 Find the rank of a matrix.
	LO 3. Solve typical problems of set theory and binary relations using basic definitions and formulas of discrete mathematics.	ID 6 Find solutions to systems of linear equations.
		ID 7 Find inverse matrices. Solve matrix equations.
		ID 8 Determine the parity of permutations. Calculate determinants.
	LO 4. Solve typical problems of set theory and binary relations using basic definitions and formulas of discrete mathematics.	ID 9 Apply various methods of proving set identities.
		ID 10 Test binary relations for specific properties.
	LO 5. Master the basic tools of number theory.	ID 11 Find general solutions to recurrent equations.
		ID 12 Find the generating function of a sequence and be able to carry out the reverse transition.

		<p><b>ID 13</b> Apply the method of mathematical induction. Explore the properties of Fibonacci numbers.</p> <p><b>ID 14</b> Investigate the properties of multiplicative functions and find general solutions to Diophantine equations.</p>
	<p><b>LO 6.</b> Based on the elements of algebraic logic, construct SKNF, SDNF and Zhegalkin polynomials of functions of algebraic logic.</p>	<p><b>ID 15</b> Be able to construct truth tables.</p> <p><b>ID 16</b> Build SCNF and SDNF functions.</p> <p><b>ID 17</b> Find Zhegalkin polynomials.</p> <p><b>ID 18</b> Check functions for self-duality.</p> <p><b>ID 19</b> Check functions for linearity and monotonicity.</p>
<b>Prerequisites</b>	School algebra course	
<b>Postrequisites</b>	Linear algebra, Basics of algebraic structures	
<b>Learning Resources</b>	<p><b>Literature:</b> main, additional.</p> <ol style="list-style-type: none"> <li>1. Linear Algebra, A.S. Solodovnikov and G.A. Toropova, Mir, Moscow, 1990.</li> <li>2. A. Kostrikin, Yu. Manin, Linear Algebra and Geometry, Volume 1, 1997.</li> <li>3. Проскуряков И.В. Сборник задач по линейной алгебре. – М.: Лань, 2010.</li> </ol> <p><b>Additional:</b></p> <ol style="list-style-type: none"> <li>4. Фадеев Д.К., Соминский И.С. Сборник задач по высшей алгебре. – М.: Наука, 1982.</li> <li>5. Сборник задач по алгебре. Под редакцией А.И. Кострикина. – М.: Физматгиз, 2002. Изд. 3е, испр. и доп.</li> <li>6. Икрамов Х.Д., Задачник по линейной алгебре. – М.: Наука, 1975.</li> <li>7. Скорняков Л.А. Элементы алгебры. – М.: Наука, 1978.</li> <li>8. Мальцев А.И., Основы линейной алгебры. – М.: Наука, 1970.</li> <li>9. Хорн Р., Джонсон И., Матричный анализ. – М.: Наука, 1989.</li> <li>10. Ван дер Варден Б.Л. Алгебра. – М.: Наука, 1976.</li> </ol>	

<b>Academic course policy</b>	<p>The academic policy of the course is determined by <u>the Academic Policy and the Policy of Academic Integrity of Al-Farabi Kazakh National University</u> .</p> <p>Documents are available on the main page of IS Univer .</p> <p><b>Integration of science and education.</b> The research work of students, undergraduates and doctoral students is a deepening of the educational process. It is organized directly at the departments, laboratories, scientific and design departments of the university, in student scientific and technical associations. Independent work of students at all levels of education is aimed at developing research skills and competencies based on obtaining new knowledge using modern research and information technologies. A research university teacher integrates the results of scientific activities into the topics of lectures and seminars (practical) classes, laboratory classes and into the tasks of the IWST, IWS, which are reflected in the syllabus and are responsible for the relevance of the topics of training sessions and assignments.</p> <p><b>Attendance.</b> The deadline for each task is indicated in the calendar (schedule) for the implementation of the content of the course. Failure to meet deadlines results in loss of points.</p> <p><b>Academic honesty.</b> Practical/laboratory classes, IWS develop the student's independence, critical thinking, and creativity. Plagiarism, forgery, the use of cheat sheets, cheating at all stages of completing tasks are unacceptable.</p> <p>Compliance with academic honesty during the period of theoretical training and at exams, in addition to the main policies, is regulated by <u>the "Rules for the final control" , "Instructions for the final control of the autumn / spring semester of the current academic year" , "Regulations on checking students' text documents for borrowings"</u>.</p> <p>Documents are available on the main page of IS Univer .</p> <p><b>Basic principles of inclusive education.</b> The educational environment of the university is conceived as a safe place where there is always support and equal attitude from the teacher to all students and students to each other, regardless of gender, race / ethnicity, religious beliefs, socio-economic status, physical health of the student, etc. All people need the support and friendship of peers and fellow students. For all students, progress is more about what they can do than what they can't. Diversity enhances all aspects of life. All students, especially those with disabilities, can receive counseling assistance by phone / e- mail <a href="mailto:mercy.sautbekova@gmail.com">mercy.sautbekova@gmail.com</a> or via video link Zoom.</p> <p><b>Integration MOOC (massive open online course).</b> In the case of integrating MOOC into the course, all students need to register for MOOC. The deadlines for passing MOOC modules must be strictly observed in accordance with the course study schedule.</p>
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	<b>ATTENTION!</b> The deadline for each task is indicated in the calendar (schedule) for the implementation of the content of the course, as well as in the MOOC. Failure to meet deadlines results in loss of points.

<b>INFORMATION ABOUT TEACHING, LEARNING AND ASSESSMENT</b>										
<b>Score-rating letter system of assessment of accounting for educational achievements</b>				<b>Assessment Methods</b>						
Grade	Digital equivalent points	points, % content	Assessment according to the traditional system	<p><b>Criteria-based assessment</b> is the process of correlating actual learning outcomes with expected learning outcomes based on clearly defined criteria. Based on formative and summative assessment.</p> <p><b>Formative assessment</b> is a type of assessment that is carried out in the course of daily learning activities. It is the current measure of progress. Provides an operational relationship between the student and the teacher. It allows you to determine the capabilities of the student, identify difficulties, help achieve the best results, timely correct the educational process for the teacher. The performance of tasks, the activity of work in the classroom during lectures, seminars, practical exercises (discussions, quizzes, debates, round tables, laboratory work, etc.) are evaluated. Acquired knowledge and competencies are assessed.</p> <p><b>Summative assessment</b> - type of assessment, which is carried out upon completion of the study of the section in accordance with the program of the course. Conducted 3-4 times per semester when performing IWS. This is the assessment of mastering the expected learning outcomes in relation to the descriptors. Allows you to determine and fix the level of mastering the course for a certain period. Learning outcomes are evaluated.</p> <table border="1" style="width: 100%; margin-top: 10px;"> <thead> <tr> <th style="text-align: left;">Formative and summative assessment</th> <th style="text-align: left;">Points</th> </tr> </thead> <tbody> <tr> <td>Work in practical classes</td> <td style="text-align: center;">18</td> </tr> <tr> <td>Independent work</td> <td style="text-align: center;">42</td> </tr> </tbody> </table>	Formative and summative assessment	Points	Work in practical classes	18	Independent work	42
Formative and summative assessment	Points									
Work in practical classes	18									
Independent work	42									
A	4.0 _	95-100	Great							
A-	3.67	90-94								
B+	3.33	85-89			Fine					
B	3.0	80-84	Satisfactorily							
B-	2.67	75-79								
C+	2.33	70-74								
C	2.0	65-69								
C-	1.67	60-64								

D+	1.33	55-59	Unsatisfactory	Final control (exam)	40
D	1.0	50-54		TOTAL	100

**Calendar (schedule) for the implementation of the content of the course. Methods of teaching and learning.**

A week	Topic name ID Number	Max. of hours ball	LO			
<b>MODULE 1. Matrix algebra.</b>						
1	L 1. Ring of matrices. Operations on matrices.		LO1	ID1	2	2
	PC 1. Operations on matrices.		LO3	ID1	2	5
2	L 2. Rearrangements. Determinants.		LO1	ID1 ID2	2	2
	PC 2. Calculation of determinants of different orders.		LO3	ID7	2	5
3	L 3. Rank and base of the vector system. Replacement theorem.		LO1	ID1	2	2
	PC 3. Study of the linear dependence of a system of vectors through determinants. Determining the parity of permutations.		LO3	ID2 ID3	2	5
4	L 4. Gauss's method of reducing a matrix to a stepwise form. Matrix rank.		LO1	ID1 ID2	2	
	PC 4. Finding the rank of a matrix.		LO4	ID4	2	5
	IWST 1. Taking a quiz on the topic: Operations on matrices. Determinants.		LO3	ID5 ID6 ID7	1	30
5	L 5. Inverse matrices. Gauss-Jordan method for finding the inverse matrix.		LO1	ID1 ID2	2	2
	PC 5. Finding inverse matrices. Solving matrix equations.		LO3		2	5
6	L 6. Methods for solving systems of linear algebraic equations. KroneckerCapelli theorem.		LO1	ID1 ID2	2	2
	PC 6. Solving systems of linear algebraic equations using the Gauss and Cramer method.		LO3	ID6	2	5
	IWST 2. Consultation.					
<b>MODULE 2. Sets and Relations</b>						
7	L 7. Sets and operations on them. Identities of set algebra. Finite and infinite sets.		LO1	ID1 ID2	2	
	PC 7. Prove some identities of set algebra. Apply operations on sets.		LO3	ID8	2	
	IWST 3. Taking a test on the topic: Permutations. Linear dependence. Matrix rank. Inverse matrices. SLAE.		LO3	ID5 ID6	1	30
8	L 8. Relationship. Power of sets. Finite and infinite sets. Relationships of order. Equivalence relation. Partition theorem.		LO1	ID1 ID2	2	2
	PC 8. Apply operations on binary relations. Examine relationships for equivalence.		LO3	ID9	2	5
<b>MODULE 3. Elements of Number theory.</b>						
9	L 9. Dirichlet's principle. Principles of counting. Inclusion-exclusion formula. Placements and combinations.		LO1	ID1 ID2	2	2
	PC 9. Apply counting principles. Apply the inclusion-exclusion formula.		LO4	ID10 ID11	2	5
10	L 10. Number of injections, surjections and bijections on finite sets. Method of mathematical induction. Fibonacci numbers. Recurrent relations. Generating functions and their properties.		LO1	ID1 ID2	2	2
	PC 10. Apply placements and combinations to solve problems. Apply the method of mathematical induction. Explore the properties of Fibonacci numbers.		LO4 LO5	ID12 ID13	2	5

	IWST 5. Consultation on the implementation of IWS 3		ID10 ID13 ID14		
11	L 11. Simple properties of divisibility. Integers modulo comparable. Chinese remainder theorem.	LO1	ID1	2	
	PC 11. Find a general solution to recurrent equations. Find generating functions. Solve systems of equations with comparisons.	LO5	ID14 ID15	2	
	IWST 6. Taking a quiz on the topics: "Principles of Accounting. Inclusion/exclusion formula. Mathematical induction". "Multiplicative functions. Fibonacci numbers. Recurrent relations."	LO5	ID14 ID15	1	30
12	L12. Multiplicative functions. Euler's and Fermat's theorems.	LO1	ID1	2	2
	PC 12. Explore the properties of multiplicative functions. Continued fractions. Solving equations in integers.	LO5	ID16	2	5
<b>MODULE 4. Logic Algebra</b>					
13	L 13. Logic algebra functions. Basic equivalences. SKNF and SDNF.	LO1	ID1 ID2	2	2
	PC 13. Construct truth tables. Check whether the function preserves 0 and 1. Find SCNF and SDNF.	LO6	ID16 ID17	2	5
	IWST 6. Consultation on the implementation of IWST 4.				
14	L 14. Zhegalkin polynomials. Closed classes. Examples. Duality. Self-dual functions.	LO1	ID1 ID2	2	
	PC 14. Finding the Zhegalkin polynomial in different ways. Check a function for self-duality.	LO6	ID18 ID19	2	5
	IWST 7. Finding the Zhegalkin polynomial in different ways. Check a function for self-duality.	LO6	ID16 ID17 ID18	1	30
15	L 15. The class of monotone functions and its closedness. Post's theorem.	LO1	ID1 ID2	2	
	PC 15. Check the function for linearity and monotonicity. Functions in different bases.	LO6	ID17 ID18	2	
	<b>Midterm control 2</b>				<b>60</b>
	<b>Final control (exam)</b>				<b>40</b>
	<b>TOTAL for course</b>				<b>100</b>

**SUMMATIVE ASSESSMENT RUBRIC  
CRITERIA FOR ASSESSMENT OF STUDY RESULTS**

**1-5 oral tasks of "IWS" (25% of 100% of OB)**

Criterion	"Very good" 20-25 %	«Good» 15-20%	«Satisfactory» 10-15%	«Unsatisfactory» 0-10%
<b>Knowledge and understanding of course theory and concepts</b>	A comprehensive explanation of the question, with detailed evidence for each conclusion and statement, logically and coherently	An answer in which the problem/task is not fully disclosed, contains abbreviated arguments of the main points, and	The proposed task is an answer that does not contain a complete solution, superficially proves the main points, allows for compositional imbalances in the narrative, and violates the logic and sequence of	Failure to properly cover the given task, incorrect reasoning/solution, factual and verbal errors, predicting the wrong conclusion.

	structured and supported by examples from the topics in the developed class.	allows to break the logic and sequence of the narrative of the material. The answer contains stylistic errors and misuse of terms.	the material narrative. Failure to demonstrate theoretical ideas with examples from developed class notes.	
<b>Application of selected methodology and technology to real practical tasks</b>	Completing the task in full, giving a detailed, reasoned answer to the question, and then solving the practical problems of the course.	Half-fulfillment of the task, incomplete, sometimes unsubstantiated answer to the question posed by the incomplete solution of the practical problems of the course; illiterate use of scientific language norms in the course.	The material is presented in fragments, the logical sequence is broken, factual and semantic errors are made, the theoretical knowledge of the course is used superficially.	An irrational method of solving the task or an insufficiently thought-out response plan; inability to solve problems, perform general tasks; allow errors and omissions exceeding the norm.
<b>Evaluation and analysis of the application of the chosen methodology to the proposed practical task, justification of the obtained result</b>	Consistent, logical and correct justification of scientific principles and applied methodology and technology, compliance with norms of literacy, scientific language, 1-2 inaccuracies that do not affect the general correct conclusion (visualization of the presentation) in the presentation of the material are allowed. justification results using graphical data).	3-4 inaccuracies in the use of conceptual material, minor errors in generalization and conclusion are allowed, which do not affect the overall good level of the task performance.	Conclusions about the application of established scientific rules are unclear and unreliable, there are stylistic and grammatical errors, as well as inaccuracies in processing the results of a practical decision.	The assignment was completed with gross errors, incomplete answers to questions, poor use of conceptual material and reasoning.
<b>Write, APA style</b>	The way you write/produce shows clarity, precision and accuracy. Strictly adheres to APA style.	The output shows clarity, precision and accuracy, with some errors in the output. Mainly follows APA style.	There are some basic errors in the input/output path and the clarity needs to be improved. There are pitfalls in following APA style.	The writing is unclear, the content/output is difficult to follow. There are many pitfalls in following APA style.

Dean \_\_\_\_\_

Head of department \_\_\_\_\_

Lecturer \_\_\_\_\_



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Sautbekova M.S.