**SYLLABUS**

**Fall semester 2023-2024 academic year**

**Educational program “6B06102-Information Systems”**

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| **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  |
| **Lecturer - (s)**  | Sautbekova Merey, senior-lecturer  |
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| **Assistant - (s)**  | -  |
| **e-mail :**  | -  |
| **Phone :**  | -  |
| **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.  |
| **LO 3.** Solve typical problems of set theory and binary relations using basic definitions and formulas of discrete mathematics.  | **ID 5** Find the rank of a matrix.  |
| **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 1**0 Test binary relations for specific properties.  |
| **LO 5.** Master the basic tools of number theory.  | **ID 1**1 Find general solutions to recurrent equations.  |
| **ID 1**2 Find the generating function of a sequence and be able to carry out the reverse transition.  |
|  |  | **ID 1**3 Apply the method of mathematical induction. Explore the properties of Fibonacci numbers.  **ID 1**4 Investigate the properties of multiplicative functions and find general solutions to Diophantine equations.  |
|   | **LO 6.** Based on the elements of algebraic logic, construct SKNF, SDNF and Zhegalkin polynomials of functions of algebraic logic.  | **ID 1**5 Be able to construct truth tables. **ID 16** Build SCNF and SDNF functions. **ID 17** Find Zhegalkin polynomials. **ID 18** Check functions for self-duality. **ID 19** Check functions for linearity and monotonicity.  |
| **Prerequisites**  | School algebra course  |
| **Postrequisites**  | Linear algebra, Basics of algebraic structures  |
| **Learning Resources**  | **Literature:** main, additional. 1. Кострикин А.И. Введение в алгебру, т.1. Основы алгебры,т.2 Линейная алгебра, т.3 Основные алгебраические структуры. – М.: МЦНМО, 2020.
2. Курош А.Г. Курс высшей алгебры. – Лань, 2011.
3. Проскуряков И.В. Сборник задач по линейной алгебре. – М.: Лань, 2010.
4. Фадеев Д.К., Соминский И.С. Сборник задач по высшей алгебре. – М.: Наука, 1982.
5. Сборник задач по алгебре. Под редакцией А.И. Кострикина. – М.: Физматгиз, 2002. Изд. 3е, испр. и доп.
6. Икрамов Х.Д., Задачник по линейной алгебре. – М.: Наука, 1975.
7. Скорняков Л.А. Элементы алгебры. – М.: Наука, 1978.
8. Мальцев А.И., Основы линейной алгебры. – М.: Наука, 1970.
9. Хорн Р., Джонсон И., Матричный анализ. – М.: Наука, 1989.
10. Ван дер Варден Б.Л. Алгебра. – М.: Наука, 1976.
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| **Academic course policy**  | The academic policy of the course is determined by the Academic Policy and the Policy of Academic Integrity of Al-Farabi Kazakh National University . Documents are available on the main page of IS Univer . **Integration of science and education.** 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 andassignments.**Attendance.** 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.**Аcademic honesty.** 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.Compliance with academic honesty during the period of theoretical training and at exams, in addition to the main policies, is regulated by 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". Documents are available on the main page of IS Univer . **Basic principles of inclusive education.** 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 fariza.rakymzhankyzy@gmail.com or via video link in MS Teams**Integration MOOC (massive open online course).** 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.  |

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|  | **ATTENTION!** 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.  |
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| **INFORMATION ABOUT TEACHING, LEARNING AND ASSESSMENT**  |
| **Score-rating letter system of assessment of accounting for educational achievements**  | **Assessment Methods**  |
| **Grade**  | **Digital equivalent points**  | **points,** **% content**  | **Assessment according to the traditional system**  | **Criteria-based assessment** is the process of correlating actual learning outcomes with expected learning outcomes based on clearly defined criteria. Based on formative and summative assessment. **Formative assessment 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. **Summative assessment** -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.  |
| A | 4.0 \_ | 95-100 | Great |
| A- | 3.67 | 90-94 |
| B+ | 3.33 | 85-89 | Fine |
| B | 3.0 | 80-84 | **Formative and summative assessment**  | **Points**  |
| B- | 2.67 | 75-79 |  |
| C+ | 2.33 | 70-74 | Work in practical classes  | 18  |
| C | 2.0 | 65-69 | Satisfactorily | Independent work  | 42  |
| 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** |
|  |  | **MODULE 1. Matrix algebra.**  |
| **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.  |   |   |   |  |
|  |  | **MODULE 2. Sets and Relations**  |
| **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**  |
|  |  | **MODULE 3. Elements of Number theory.**  |  |  |  |
| **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. Inclusionexclusion 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**  |
|  |  | **MODULE 4. Logic Algebra**  |  |  |  |
| **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**  |  |
|  |  | **Midterm control 2**  |  |  | **60**  |
|  |  | **Final control (exam)**  |  |  | **40**  |
|  |  | **TOTAL for course**  |  |  | **100**  |

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