SYLLABUS

Fall semester 2023-2024 academic year

Educational program "6B06107 - Data Science"

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)		
Mathematical Logic 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)	-			
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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 meaning of the basic concepts and theorems of discrete mathematics and mathematical logic based on the means of proof.	**ID 1.1** Understand the basic definitions and theorems of discrete mathematics and mathematical logic.
		ID 1.2 Ability to use definitions and theorems in calculations
	LO 2. Using the basic definitions and formulas of discrete mathematics, generating model problems of set theory and binary relations	**ID 2.1** Consider different ways of proving set equilibria
		ID 2.2 Examination of special properties of binary relations
		ID 2.3 Understand and apply the relationship between binary relations and partitioning of sets
	LO 3. Compilation of combinatorics sample problems	**ID 3.1** Ability to use addition and multiplication rules

		ID 3.2 Using the input-output formula
		ID 3.3 Use layout and typing in solving the math.problem
	LO 4. Ability to use the basic tools of number theory	**ID 4.1** 1 Finding the general solution of the recurrence equation
		ID 4.2 Find the generating function of the chain and implement the reverse transition.
		ID 4.3 Ability to use the method of mathematical induction.
		ID 4.4 Study the properties of Fibonacci numbers
		ID 4.5 Investigate the properties of multiplicative functions and find a general solution to the Diophantine equation.
		ID 4.6 Test binary relations for specific properties.
	LO 5. To be able to apply operations to graphs based on the basis of graph theory, to find metric characteristics of graphs and to be able to use graph theory to solve some applied problems effectively.	**ID 5.1** Find the intersection, union and composition of graphs
		ID 5.2 Finding matrices corresponding to graphs
		ID 5.3 Finding metric properties of graphs
		ID 5.4 Checking graphs for isomorphism
		ID 5.5 Checking graphs for Eulerianness. Coloring graphs.
	LO 6. Based on the elements of algebraic logic, construct SKNF, SDNF and Zhegalkin polynomials of functions of algebraic logic.	**ID 6.1** Be able to construct truth tables. **ID 6.2** Build SCNF and SDNF functions. **ID 6.3** Find Zhegalkin polynomials.
Prerequisites	Fundamentals of Algebra, Linear Algebra	

Postrequisites	Mathematical logic
Learning Resources	**Literature:** main, additional. 1. Kostrikin A., Manin Yu., Linear Algebra and Geometry, Gordon and Breach Science Publishers, 1986. 2. Sets, Functions and Logic – an introduction to abstract mathematics, 3rd edition, Keith Devlin, 2004 3. Introduction to mathematical logic, 4th edition, Elliott Mendelson, 1992. 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. E-sources: 7. https://byjus.com/maths/mathematical-logic/ 8. https://www.tutorialspoint.com/discrete_mathematics/discrete_mathematics_propositional_logic.htm

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 and assignments. **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. **Academic 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 merey.sautbekova@gmail.com or via video link Zoom. **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.

	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.

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
A	4.0 _	95-100	Great
A-	3.67	90-94	

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

	3.33	85-89	Fine
	3.0	80-84	
	2.67	75-79	
	2.33	70-74	
	2.0	65-69	Satisfactorily
	1.67	60-64	
	1.33	55-59	Unsatisfactory
	1.0	50-54	

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.

Formative and summative assessment	**Points**
Work in practical classes	18
Independent work	42
Final control (exam)	40
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. Sets. Relations and functions.				
1	L 1. Sets and basic operations on them. Power of the set. Finite and infinite sets.	**LO1**	**ID1**	**2**	**2**
	PC 1. Proving equilibria in set theory. Applying operations to sets.	**LO3**	**ID1**	2	5
2	L 2. Relations. Actions applied to relations. Special binary relations. Ordinal relations. Equivalence relation. Separation theorem.	**LO1**	**ID1 ID2**	2	2
	PC 2. Applying operations to binary relations. Study of equivalence relations.	**LO3**	**ID7**	2	5
3	L 3. Counting rules. Dirichlet's rule. Input and output formula. Substitutions. Layouts and dials.	**LO1**	**ID1**	**2**	**2**
	SW1. Ability to use addition and multiplication rules. Using the input-output formula.	**LO3**	**ID2 ID3**	2	5
	IWST 1. Acceptance of control work on the topic "Application of operations to sets and relations".	**LO3**	**ID1 ID2**	**1**	30

	MODULE 2. Elements of Number theory.				
4	L 4. Dirichlet's principle. Principles of counting. Inclusion-exclusion formula. Placements and combinations.	**LO1**	**ID1 ID2**	**2**	**2**
	PC 4. Apply counting principles. Apply the inclusion-exclusion formula.	**LO4**	**ID10 ID11**	**2**	**5**
5	L 5. 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 5. 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**		
6	L 6. Simple properties of divisibility. Integers modulo comparable. Chinese remainder theorem.	**LO1**	**ID1**	**2**	
	PC 6. 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**
7	L7. Multiplicative functions. Euler's and Fermat's theorems.	**LO1**	**ID1**	**2**	**2**
	PC 7. Explore the properties of multiplicative functions. Continued fractions. Solving equations in integers.	**LO5**	**ID16**	**2**	**5**
	Module 3 Basics of graph theory.				
8	L.8 Basic concepts of graph theory. Metric characteristics of graphs.	**LO1**	**ID1 ID2**	1	
	PC 8. Chain parts. Solving equations in whole numbers.	**LO4**	**ID10 ID11**	2	4
9	L.9 Degrees of graphs' roofs. Operations on graphs.	**LO1**	**ID1 ID2**	1	
	PC 9. Study of metric characteristics of graphs.	**LO4 LO5**	**ID12 ID13**	2	4
10	L. 10 Internal graphs. Cycles. Bound graphs. Trees.	**LO1**	**ID 1 ID2**	1	
	PC 10. Proof of isomorphism of graphs. Applying operations to graphs.	**LO4**	**ID10 ID11**	2	4
	IWST 5. Consultation on the implementation of IWST	**LO1**	**ID1 ID2**		

11	L.11 Matrices corresponding to graphs.	LO4 LO5	ID12 ID13	1	24
	PC 11. Acceptance of control work on the topic "Research of graphs".	LO1	ID1 ID2	1	
12	L.12 Planar graphs. Coloring graphs. Eulerian graphs.	LO1	ID1	2	2
	PC 12. Checking graphs for connectedness, planarity, Eulerianness. Coloring graphs.	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. Basic equivalences. SKNF and SDNF. ns.	LO1	ID1 ID2	2	
	PC 14. finding the SKNF and SDNF.	LO6	ID18 ID19	2	5
		LO6	ID16 ID17 ID18	1	30
15	L 15 Zhegalkin polynomials. Closed classes. Examples. Duality. Self-dual functions	LO1	ID1 ID2	2	
	IWST 7. Finding the Zhegalkin polynomial in different ways. Check a function for self-duality.	LO6	ID17 ID18	2	
	Midterm control 2				60
	Final control (exam)				40
	TOTAL for course				100

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%

Knowledge and understanding of course theory and concepts	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.	
Application of selected methodology and technology to real practical tasks	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.
Evaluation and analysis of the application of the chosen methodology to the proposed practical task, justification of the obtained result	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	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.

	allowed. justification results using graphical data).			
Write, **APA style**	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.

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Head of department _____ **Imanberdiev K.B.**

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