Identification	**Subject**	MATH 312**,** Introduction to Discrete Mathematics, 6 ECTS
	Department	Mathematics
	Program	Undergraduate
	Term	Spring, 2024
	Instructor	Osmanov Vusal
	E-mail:	Saracli@mail.ru, vusal.osmanov@khazar.org
	Phone:	(+99470) 333 33 48
	Classroom/hours	Wednesday- 08:30;10:10;Wednesday- 08:30;10:10
Prerequisites	The prerequisite is MATH 105	
Language	English	
Compulsory/ Elective	Required	
Required textbooks and course materials	***Corse Textbooks:*** 1. Kenneth H. Rosen, *Discrete Mathematics and Its Applications*, 7th edition, McGraw-Hill, New-York, 2012. ***Supplementary book:*** 1. Kenneth H. Rosen. *Handbook of Discrete and Combinatorial Mathematics*, CRC Press, Boca Raton, FL, 2000.	
Course outline	This is an introductory course in discrete mathematics. Discrete mathematics is the part of mathematics devoted to the study of the discrete objects. Here discrete means consisting of distinct or unconnected elements. Discrete mathematics is used whenever objects are counted, when relationships between finite sets are studied, and when processes involving a finite number of steps are analyzed. The goal of this course is to introduce students to ideas and techniques from discrete mathematics that are widely used in science and engineering. This course teaches the students techniques in how to think logically and mathematically and apply these techniques in solving problems. The course of Discrete Mathematics is an essential at School of Engineering and Applied Sciences of Khazar University. This course is offered to undergraduates and introduces students to the formulation, methodology, and techniques for sets, functions, as well as algorithms and mathematical reasoning. Key topics involving - propositions, negation, conjunction and disjunction of propositions, the concepts of tautology, contradiction and contingency, definition of dual function, duality principle, self dual functions, the concept of dual formula, expansion of Boolean functions in terms of variables, the canonical disjunctive and conjunctive normal forms, definition of the functionally completeness of the set of Boolean functions, representation of functions by Zhegalkin polynomials, definition of closure, definition of graphs, vertices and edges of graphs, the finite graph, the concept of path, connected graphs, isolated vertices, geometric realization of graphs, the concept of isomorfic graphs, adjacent vertices,incident vertices, trees, coding, decoding, alphabetical and uniform coding, test for unique decipherability of coding,derivative of Boolean functions and formal languages and computability are covered in this course. ***Topics covered include:*** • Compound propositions. Logical operations on the propsitions. Precedence of logical operators. • Definitions of tautology, contradiction and contingency. De Morgan’s laws. Some important logical equivalences.	

	• Boolean variable. Boolean expressions. The Boolean sum. The Boolean product. Most important identities in Boolean algebra. Absorption law. The abstract definition of a Boolean algebra. • Definition of dual function. Duality principle. Self dual functions. The concept of dual formula. • Expansion of Boolean functions in terms of variables. The canonical disjunctive and conjunctive normal forms. • Definition of the functionally completeness of the set of Boolean functions. Theorem on the completeness of sets. Examples on the completeness of Boolean sets. Representation of functions by Zhegalkin polynomials. • Definition of closure. The classes T_0 and T_1. The class of self-dual functions. The precedence relation. Definition of mototoncity. Set of monotonic functions. The calass of all linear functions. Necessity and sufficiency conditions of functionally completeness. • Definition of graphs. Vertices and edges of graphs. The finite graph. The concept of path. The definitions of cycle and loop. Connected graphs. Isolated vertices. Geometric realization of graphs. The concept of isomorfic graphs. Subdivision of a graph. Definition of homeomorfic graphs. Subgraph. Theorem on constructing a graph on the plane. • Adjacent vertices. Incident vertices. Isolated vertex of graph. Pendant vertex of graph. The Handshaking theorem. Definition of directed graph. Undirected graphs. Complete graphs. Cycles. Wheels. n - Cubes. • Representation a graph with adjacency lists. An adjacency list for a simple graph. An adjacency list for a directed graph. Adjacency matrices. Incidence matrices. • Definition of network. Vertices and ports of network. Finite network. Infinite network. Countable network. Geometric realization of the original network. Concept of isomorphic network. • Concept of tree. Forests. Rooted tree. Subtree. Definition of m -ary tree. Binary tree. Geometric realization of trees. • Coding. Decoding. Alphabetical and uniform coding. Test for unique decipherability of coding. Unique decipherability recognition algorithm. • Derivative of Boolean functions
Course objectives	The concept of Logically proposition; Boolean functions, Boolean variable and Boolean expressions; Most important identities in Boolean algebra; Expansion of Boolean functions in terms of variables; Definitions of the functionally completeness and closure; The conepts of graps and trees; Coding and decoding; Alphabetical and uniform coding; Test for unique decipherability of coding; Unique decipherability recognition algorithm; the derivative of Boolean functions;
Learning outcomes	By the end of the course the students should be able: Executing logical operations on the Boolean propositions; Constructing truth tables for Boolean functions; Expansion of Boolean functions in terms of variables; Construction canonical disjunctive and conjunctive normal forms; Computing the approximate values of square and cube root functions; Representation of functions by Zhegalkin polynomials; Proving the completeness and closure of classes; Construction of adjacent and incident matrices of graphs; Representation a graph with adjacency lists; Unique decipherability recognition algorithm for decoding; To find the derivative of Boolean functions;

<table>
<tr><td rowspan="5">Teaching methods</td><td colspan="2">Lecture</td><td>x</td></tr>
<tr><td colspan="2">Group discussion</td><td>x</td></tr>
<tr><td colspan="2">Experiential exercise</td><td>x</td></tr>
<tr><td colspan="2">Course paper</td><td>x</td></tr>
<tr><td colspan="2">Others</td><td></td></tr>
<tr><td rowspan="8">Evaluation</td><td>Methods</td><td>Date/deadlines</td><td>Percentage (%)</td></tr>
<tr><td>Midterm Exam</td><td></td><td>30</td></tr>
<tr><td>Class Participation</td><td></td><td>5</td></tr>
<tr><td>Quizzes</td><td></td><td>20 (2 quizzes)</td></tr>
<tr><td>Activity</td><td></td><td>5</td></tr>
<tr><td>Final Exam</td><td></td><td>40</td></tr>
<tr><td>Total</td><td></td><td>100</td></tr>
<tr><td>Policy</td><td colspan="3">Preparation for class

The structure of this course makes your individual study and preparation outside the class extremely important. The lecture material will focus on the major points introduced in the text. Reading the assigned chapters and having some familiarity with them before class will greatly assist your understanding of the lecture. After the lecture, you should study your notes and work relevant problems and cases from the end of the chapter and sample exam questions.
Throughout the semester we will also have a large number of review sessions. These review sessions will take place during the regularly scheduled class periods.

Quizzes and examinations
Quizzes may be given unannounced throughout the term. There will be no make-up quizzes.

Withdrawal (pass/fail)

This course strictly follows grading policy of the School of Science and Engineering. Thus, a student is normally expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course the following term or year.

Cheating/plagiarism

Cheating or other plagiarism during the Quizzes, Mid-term and Final Examinations will lead to paper cancellation. In this case, the student will automatically get zero (0), without any considerations.

Professional behavior guidelines

The students shall behave in the way to create favorable academic and professional environment during the class hours. Unauthorized discussions and unethical behavior are strictly prohibited.

Ethic

Use of any electronic devices is prohibited in the classroom. All devices should be turned off before entering class. This is a university policy and violators will be reprimanded accordingly!</td></tr>
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	Students should not arrive in late to class!		
Tentative Schedule			
Week	**Date/Day (tentative)**	**Topics**	**Textbook/ Assignments**
1	13.02.24 13.02.24	Compound propositions. Negation of propositions. Definition of conjunction. The concept of disjunction. Definition of exclusive Or. The conditional statement. The biconditional statement. Truth table of propsitios. Precedence of Logical Operators.	Ch. 1, Sec. 1.1 (Kenneth H. Rosen)
2	20.02.24 20.02.24	The concept of tautology. Definition of contradiction. Contingency. Logically equivalent propositions. De Morgan's laws. Some important logical equivalences.	Ch. 1, Sec. 1.2 (Kenneth H. Rosen)
3	27.02.24 27.02.24	The complement of an element. Boolean variable. Boolean expressions. The Boolean sum. The Boolean product. Most important identities in Boolean algebra. Absorption law. The abstract definition of a Boolean algebra.	Ch. 11, Sec. 11.1 (Kenneth H. Rosen)
4	05.03.24 05.03.24	Definition of dual function. Duality principle. Self dual functions. The concept of dual formula.	Part I Ch. 1 Sec. 1.3 (S.V.Yablonsky)
5	12.03.24 12.03.24	Expansion of Boolean functions in terms of variables. The canonical disjunctive and conjunctive normal forms.Zhegalkin Plynomials. Derivative of the boolean Functions and Taylor Expansion of the Boolean functions.	Part I Ch. 1 Sec. 1.4 (S.V.Yablonsky) **Quiz 1**
6	19.03.24 19.03.24	Definition of the functionally completeness of the set of Boolean functions. Theorem on the completeness of sets. Examples on the completeness of Boolean sets. Representation of functions by Zhegalkin polynomials. Definition of closure. Examples on the closed classes.	Part I Ch. 1 Sec. 1.5 (S.V.Yablonsky)
7	26.03.23 26.03.23	Definition of the functionally completeness of the set of Boolean functions. Theorem on the completeness of sets. Examples on the completeness of Boolean sets. Representation of functions by Zhegalkin polynomials. Definition of closure. Examples on the closed classes.	Part I Ch. 1 Sec. 1.5 (S.V.Yablonsky)
8	02.04.24 02.04.24	The class of T_0. Definition of the class of T_1. The class of self-dual functions. The precedence relation. Definition of mototoncity. Set of monotonic functions. The calass of all linear functions. Necessity and sufficiency conditions of functionally completeness.	Part I Ch. 1 Sec. 1.6 (S.V.Yablonsky)
9	09.04.24 09.04.24	Definition of graphs. Vertices and edges of graphs. The finite graph. The concept of path. The definitions of cycle and loop. Connected graphs. Isolated vertices. Gemetric realization of graphs. The concept of isomorfic graphs. Subdivision of a graph. Definition of homeomorfic graphs. Subgraph. Theorem on constructing a graph on the plane.	Part III Ch. 1 Sec. 1.1 (S.V.Yablonsky)
10	16.04.24 16.04.24	**M i d t e r m E x a m** Adjacent vertices. Incident vertices. Isolated vertex of graph. Pendant vertex of graph. The Handshaking theorem.	Ch. 9 Sec. 9.2 (Kenneth H. Rosen)

		Definition of directed graph. Undirected graphs. Complete graphs. Cycles. Wheels. n - Cubes.	
11	23.04.24 23.04.24	Representation a graph with adjacency lists. An adjacency list for a simple graph. An adjacency list for a directed graph. Adjacency matrices. Incidence matrices.	Ch. 9 Sec. 9.3 (Kenneth H. Rosen)
12	30.04.24 30.04.24	Definition of network. Vertices and ports of network. Finite network. Infinite network. Countable network. Geometric realization of the original network. Concept of isomorphic network.	Part III Ch. 2 Sec. 2.1 (S.V.Yablonsky) **Quiz 2**
13	07.05.24 07.05.24	Concept of tree. Forests. Rooted tree. Subtree. Definition of m -ary tree. Binary tree. Geometric realization of trees.	Ch. 10 Sec. 10.1, 10.2 (Kenneth H. Rosen)
14	12.05.24 12.05.24	Coding. Decoding. Alphabetical and uniform coding. Set-theoretic characterization for message sources. Statistical description of message sources. Logical description of message sources. Encoding. Alphabet coding. Elementary codes. Uniform encoding. Correction of a message code at the output.	Part IV Sec. 0.1 (S.V.Yablonsky)
15	19.05.24 19.05.24	Predicates and Quantifiers. Nested Quantifiers. Rules of Inference. Introductions to Proofs. Proof metods and Strategy.	
	TBA	**F i n a l E x a m**	

This syllabus is a guide for the course and any modifications to it will be announced in advance.