KAZAKH-BRITISH TECHNICAL UNIVERSITY
RESEARCH AND EDUCATIONAL CENTER OF MATHEMATICS AND CYBERNETICS

Approved by

Head of the Center of Mathematics and Cybernetics
_____A.A. Issakhov

«____» _____ 2021

Syllabus
Discrete Mathematics and Mathematical Logic
MAT 1215

Semester: Fall 2021
2021/2022 Academic Year
3 credits (2/0/1)

Instructor: Assylbek Abdiashimovich Issakhov, professor

Personal Information about the Instructor	Time and place of classes		Contact information	
	Lessons	Office Hours	Tel.:	e-mail
Ph.D., Professor	According to the schedule	TBA	+77076108099	a.isakhov@kbtu.kz
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COURSE DURATION: 3 credits, 15 weeks, 45 class hours
COURSE PRE-REQUISITES: Good knowledge of school mathematics is enough.

COURSE DESCRIPTION

Course objectives

Discrete Structures is a transfer-oriented course designed to meet the requirements of Computer and Information Science degree programs. Furthermore, this course is designed to meet the following program objectives. Upon successful completion of this course, students will be able to:

- Demonstrate critical thinking, analytical reasoning, and problem-solving skills
- Apply appropriate mathematical concepts and operations to interpret data and to solve problems
- Identify a problem and analyze it in terms of its significant parts and the information needed to solve it.
- Formulate and evaluate possible solutions to problems, and select and defend the chosen solutions.

Course outcomes

At the end of the course, students are expected to:

- create compound statements, expressed in mathematical symbols or in English, to determine the truth or falseness of compound statements and to use the rules of inference to prove a conclusion statement from hypothesis statements by applying the rules of propositional and predicate calculus logic;
- prove mathematical statements involving numbers by applying various proof methods, which are based on the rules of inference from logic;
- prove the validity of sequences and series and the correctness of repeated processes by applying mathematical induction;
- define and identify the terms, rules, and properties of set theory and use these as tools to support problem solving and reasoning in applications of logic, functions, number theory, sequences, counting, trees and graphs, and finite state machines;
- solve recursive problems by applying knowledge of recursive sequences;

- create graphs and trees to represent and help prove or disprove statements, to make decisions or select from alternative choices, to calculate probabilities, to document derivation steps, or to solve problems; and
- construct and analyze finite state automata (another name for machines), formal languages, and regular expressions.

Knowledge: during the study of this course, students must obtain knowledge about how to: explain with examples the basic terminology of functions, relations, and sets; perform the operations associated with sets, functions, and relations; convert logical statements from informal language to propositional and predicate logic expressions; apply formal methods of symbolic propositional and predicate logic, such as calculating validity of formulae and computing normal forms; Identify the proof technique used in a given proof; determine which type of proof is best for a given problem; explain the parallels between ideas of mathematical and/or structural induction to recursion and recursively defined structures; explain the relationship between weak and strong induction and give examples of the appropriate use of each; state the well-ordering principle and its relationship to mathematical induction; apply counting arguments, including sum and product rules, inclusion-exclusion principle and arithmetic/geometric progressions; apply the pigeonhole principle in the context of a formal proof; be familiar with elementary concepts of Languages and Automata theory and understand their role in Computer Science.

Skills: As a result of studying this course, students must be able to

- apply formal logic proofs and/or informal, but rigorous, logical reasoning to real problems, such as predicting the behavior of software or solving problems such as puzzles;
- Demonstrate comprehension of discrete structures and their relevance within the context of computer science, in the areas of data structures and algorithms, in particular;
- Apply discrete structures into other computing problems such as formal specification, verification, databases, artificial intelligence, and cryptography;
- Demonstrate mathematical skills, analytical and critical thinking abilities;
- Communicate clearly and effectively using the technical language of the field correctly.

Literature

Required

1. Kenneth Rosen: "Discrete Mathematics and Its Applications", 7th edition, 2012, McGraw-Hill. Press, 2009.
2. Seymour Lipschutz, Marc Lipson: Discrete Mathematics. (Shaum's Outline), 4th edition, 2009, McGraw-Hill.

Supplementary

1. Discrete Mathematics, 2nd Edition by Biggs, Oxford University Press, 2013, Paperback, 9780198713692.

COURSE CALENDAR

Week	Class work				SIW (student's individual work)
	Topic	Lectures	Seminars	Chapters for reading	
1	Sets, Relations, and Functions.	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 4, demonstrate your knowledge during the quiz)
2	Sets, Relations, and Functions (continuation). Proofs and Induction.	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 4, demonstrate your knowledge during the quiz)

3	Introduction to Number Theory.	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 4, demonstrate your knowledge during the quiz)
4	Introduction to Number Theory (continuation).	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 7, demonstrate your knowledge during the quiz)
5	Counting. Elements of Combinatorics.	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 7, demonstrate your knowledge during the quiz)
6	Logic and Propositional Calculus.	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 7, demonstrate your knowledge during the quiz)
7	Logic and Propositional Calculus (continuation).	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 11, demonstrate your knowledge during the quiz)
8	Boolean Algebra.	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 11, demonstrate your knowledge during the quiz)
9	Boolean Algebra (continuation).	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 11, demonstrate your knowledge during the quiz)
10	Advanced Counting Techniques.	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 11, demonstrate your knowledge during the quiz)
11	Elements of Graph Theory.	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 14, demonstrate your knowledge during the quiz)
12	Elements of Graph Theory (continuation).	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 14, demonstrate your knowledge during the quiz)
13	Binary Trees.	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 14, demonstrate your knowledge during the quiz)
14	Languages, Automata, Grammars.	2	1	according to the lecture notes	Recommended homeworks at the end of each part of the lectures (Deadline – Week 14, demonstrate your knowledge during the quiz)
15	Languages, Automata, Grammars (continuation).	2	1	according to the lecture notes	

COURSE ASSESSMENT PARAMETERS

Attendance and activity on lectures	15%
Home works and SIW	0%
Control works and midterm	40%
Seminar lessons	10%
Final exam	40%
Total	**100%**

No	Assessment criteria	Weeks																Total
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15		
1.	Attendance and activity on lectures	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1		15.0
2.	Home works and SIW																	
3.	Control works and midterm				10			10				10			10			40.0
4.	Seminar lessons	1	1	1		1	1		1	1	1		1	1				10.0
6.	Final examination																40	40.0
	Total															60	40	100.0

Lectures are conducted in the form of explaining the theory given in the course that is why students supplied with handouts uploaded into the intranet. Activity and attendance on lessons is mandatory. Mandatory requirement is preparation for each lesson.

Grading policy:

Intermediate attestations (on 8th and 15th week) join topics of all lectures, laboratories, homework, quiz and materials for reading discussed to the time of attestation. Maximum number of points within attendance, activity, homework, quiz and laboratories for each attestation is 30 points.

Final exam joins and generalizes all course materials, is conducted in the complex form with questions and problems. Final exam duration is 120 min. Maximum number of points is 40. At the end of the semester you receive overall total grade (summarized index of your work during semester) according to conventional KBTU grade scale.

ACADEMIC POLICY

Students are required:

- to be respectful to the teacher and other students;
- to switch off mobile phones during classes;
- DO NOT cheat. Plagiarized papers shall be graded with zero points!
- to come to classes prepared and actively participate in classroom work; to meet the deadlines;
- to enter the room before the teacher starts the lesson;
- to attend all classes. No make-up tests or quiz are allowed unless there is a valid reason for missing it;
- to follow KBTU academic policy regarding **W, AW, I, F** grades.
- When students are absent for 20% of the lessons or more (without Spravka), then their grade is F.
- When students have a score of 29 or less for attestation 1 added to attestation 2, then their grade is F.
- When students have a score of 19 or less (less than 50%) for their final exam, then their grade is F.
- When students do not come for their final exam, then their grade is F.

Students are encouraged to

- consult the teacher on any issues related to the course;
- make up within a week's time for the works undone for a valid reason without any grade deductions;