«Approved»
by the Dean
_____Syzdykova Z.A.
«___» of_____2024

Syllabus
Academic Year 2024-2025

1. General Information	
Course title	Discrete Mathematics
Degree cycle (level)/ major	Information technologies
Year, term	Year 1, term: 2
Number of credits	5
Language of delivery:	English
Prerequisites	Calculus 1, Linear Algebra
Postrequisites	Theory of Probability and Statistics,Algorithms and Data structures, Advanced programming
Lecturer(s)	Shynar Abutalipova, The Candidate of Physical and Mathematical Sciences, assistant professor, sh.abutalipova@astanait.edu.kz Astana IT University, Expo, C1 block, 3rd floor, office C1.1.336).
2. Goals, Objectives and Learning Outcomes of the Course	
1. Course Description	The course includes: logics, set theory, functions, and fundamental principles of counting, number theory, inclusion-exclusion principle, recurrence relations, graph theory.
2. Course Goal(s)	Course goal is to familiarize students with an initial base in mathematics such as sets, basic of combinatorics and graph theory. The main goal is tobe able to apply above-mentioned tools to problems in postrequisites courses.
3. Course Objectives:	Course objectives include: • To demonstrate knowledge of mathematical knowledge; • To understand basic mathematical principles (proving, counting,understanding discrete objects); • To solve counting problems using different enumeration methods; • To apply basic techniques involving discrete objects such as sets,functions, graphs and mathematical expressions in discrete mathematics; • To develop mathematical abilities in writing programs by computers.
4. Skills & Competences	• Basic school mathematical knowledge; • Ability to construct examples and counterexamples

5. Course Learning Outcomes:	By the end of this course students will be able to: • Know basic mathematical concepts; • Learn main proof techniques of mathematics; • Be familiar with important discrete objects; • Understand counting principles of combinatorics; • Be able to transform discrete problems into simple forms; • Describe programing questions in terms of graphs and trees.
6. Methods of Assessment	• Homework • Quiz • Final exam
7. Reading List	Assigned reading materials and presentations should be read prior to class. Class lectures and discussions will proceed with supplemental and advanced topics, which could be difficult to understand unless students have read the assigned material. Readings are listed in the schedule section. All necessary updates and / or changes to the course will be reflected in the Learning Management System (moodle.astanait.edu.kz). Basic Literature: 1. E. Goodaire and M. Parmenter Discrete Mathematics with Graph Theory(third edition); 2. Kenneth H. Rosen. Discrete Mathematics and Its Applications (seventhedition); Supplementary literature: 1. Ralph P. Grimaldi. Discrete and Combinatorial Mathematics (fifthedition); 2. А.С. Джумадильдаев, Элементы дискретной математики, Алматы,2004; 3. Д. Андерсон Дискретная математика и комбинаторика. 2004;
1. Resources	Online journals, article, papers, books and internet resources as well as online emulators and online software for simulation.
2. **Course policy**	**Course and University policies include:** **Attendance:** Attendance is not allocated any grading points in the marking scheme, but is compulsory to pass the course. Normally students are required to achieve course attendance of minimum 70% to get admitted to the examination rubric. In case a student misses 30% or more class sessions without a valid excuse the instructor has the right to mark him as "not graded". In such case a student is not admitted to the exam and automatically fails the course. In cases, when a student misses class session due to valid reasons (is excused by the instructor or the dean's office) he or she has to confirm the absence reason using a valid document in accordance with the academic policy of AITU. It should be NOTED that in cases when a student is excused for 30% of the scheduled class sessions or more he or she has to study material

provided under the course on their own. Course instructor might provide additional opportunities to submit missed graded pieces of work during office hours or conduct alternative assessment exercises using method of his or her choosing.

Preparation for Class: Class participation is a very important part of the learning process in this course. Although not explicitly grade, students will be evaluated on the QUALITY of their contributions and insights. Quality comments possess one or more of the following properties:
- Offers a different and unique, but relevant, perspective;
- Contributes to moving the discussion and analysis forward;
- Builds on other comments.

Class work: The duration of each lecture and practical lesson is 50 minutes for offline class, and 40 minutes for online class. Students are expected to complete all readings and assignments ahead of time, attend class regularly and participate in class discussions. In case of systemic student's misconduct, the student can be dispensed from the classes.

Being late on class: When students come to class late, it can disrupt the flow of a lecture or discussion, distract other students, impede learning, and generally erode class morale. Moreover, if left unchecked, lateness can become chronic and spread throughout the class. Therefore, the being late to the class is not welcome and can have restriction activities by the course instructor.

Attestation I and II: Students, who score less than 25% for Attestation period I or Attestation period II (RK1/RK2) automatically fail the course.

Home work / Assignments: The assignments are designed to acquaint students with the theoretical knowledge and practical skills required for the course. The textbook readings will be supplemented with materials collected from recent professional articles and journals. In case of using someone's work (papers, articles, any publications), all works must be properly cited. Failure to cite work will be resulted as a cheating from the students and may be a subject of additional disciplinary measures.

Late submissions: Most assignments will be discussed in class on the due date. It is expected that all work will be submitted on time. All gradings are based using a percentage grading scale.

In the case of some extraordinary event, students should notify the course instructor and request an extension of the deadline for submission. If approved, a new date will be given to the student depending upon the circumstances by the instructor.

Final exam / Final project:
The online final exam for the course "Discrete Mathematics" includes eight theoretical and practical tasks for 90 minutes. Students will be given tasks in LMS and must give their answers. At the completion

of the exam, all works must be submitted in the Learning Management System (moodle.astanait.edu.kz). No late submissions are allowed in the exam.

The offline final exam for the course "Discrete Mathematics" includes twenty theoretical and practical multiple-choice tasks or eight theoretical and practical writing exam tasks for 80 minutes.

Laptops and mobile devices can only be used for classroom purposes when directed by the course instructor. Misuse of laptops or handheld devices will be considered a breach of discipline and appropriate action will be initiated by the instructor.

Online lessons can be used in case if there won't be a chance to make offline traditional lessons. It must not discourage the interest and enthusiasm of students. The main software to run the online lessons is Microsoft Teams for video calls and live webinars, and Moodle (moodle.astanait.edu.kz) as a Learning Management System. Also, some alternatives such as Telegram, Zoom, or other messenger may be involved as an additional workaround.

Cheating and plagiarism are defined in the Academic conduct policies of the university and include:
1. Submitting work that is not your own papers, assignments, or exams;
2. Copying ideas, words, or graphics from a published or unpublished source without appropriate citation;
3. Submitting or using falsified data;
4. Submitting the same work for credit in two courses without prior consent of both instructors.
Any student who is found cheating or plagiarizing on any work for this course will receive 0 (zero) for that work and further actions will also be taken regarding academic conduct policies of the university.

Academic Conduct Policies of the university: The full texts of all the academic conduct code will be posted to the students using Learning Management System (moodle.astanait.edu.kz).

Contacting the Course instructor: The easiest and most reliable way to get in touch with the course instructor is by email. Students must feel free to send email if you have a question related to the course. Instructor responds as soon as they can but not always instantaneously. Besides that, students are also welcomed to arrange a one-to-one meeting with the instructor by their office during office hours to discuss the class using both offline and online.

3. Course Content

#	Abbreviation	Meaning
1	ISIS	Instructor-supervised independent work

2	SIS	Students' independent work
3	IP	Individual project
4	PA	Practical assignment
5	LW	Laboratory work
6	MCQ	Multiple choice quiz

3.1 Lecture, Practical/Seminar/Laboratory Session Plans

Week No	Course Topic	Lectures (H/W)	Practice sessions (H/W)	Lab. sessions (H/W)	ISIS (H/W)	SIS (H/W)
1	**Logic.** Propositional Logic. Logical operators. Truth table. Propositional Equivalences. Disjunctive normal forms.	3	2	-	1	9
2	**Sets and Relations.** Set operations. Venn diagrams. Binary Relations: reflexive, symmetric, anti-symmetric and transitive relations. Equivalence relations.	3	2	-	1	9
3	**Functions.** One-to-one, onto and bijective functions. The inverse functions. The composition of functions. Cardinality of sets.	3	2	-	1	9
4	**The Integers.** Divisibility and Modular Primes. Arithmetic Euclidean algorithm and GCD. Solving congruence relations. Chinese remainder theorem.	3	2	-	1	9
5	**Induction and Recursion.** Mathematical Induction. Recursively defined sequences. Solving recurrence relations.	3	2	-	1	9
6	**Principles of Counting.** The principle of Inclusion-Exclusion. The sum and product rules. The Pigeonhole principle.	3	2	-	1	9
7	**Permutations and Combinations.** Permutations and Combinations. Combination with repetitions. Binomial Theorem.	3	2	-	1	9
8	**Graphs.** Definitions and basic properties. Isomorphism	3	2	-	1	9
9	**Paths and Circuits.** Eulerian circuits. Hamiltonian cycles. Adjacency Matrix.	3	2	-	1	9
10	**Planar Graphs and Colourings.** Planar graphs. Colouring graphs.	3	2	-	1	9
	Total hours: 150	30	20	0	10	90

3.2 List of Assignments for Student Independent Study

№	Assignments (topics) for Independent study	Hours	Recommended literature and other sources (links)	Form of submission
1	2	3	4	5
1	Techniques of proofs	9	[1], Chapter 0	Exercises
2	Partial Order	9	[1], Chapter 2	Exercises
3	One-to-one Correspondence and the Cardinality of a Set.	9	[1], Chapter 3	Exercises
4	Applications of Congruence	9	[1], Chapter 4	Exercises
5	Solving recurrence relations; Generating Functions	9	[1], Chapter 5	Exercises
6	Elementary Probability	9	[1], Chapter 7	Exercises
7	Algorithms	9	[1], Chapter 8	Exercises
8	Applications of Paths and Circuits	9	[1], Chapter 11	Exercises
9	Trees	9	[1], Chapter 12	Exercises
10	The Max Flow-Min Cut Theorem	9	[1], Chapter 14	Exercises

4. Student Performance Evaluation System for the Course

Period	Assignments	Number of points	Total
1st attestation	Assignments**:	40	100
	1 Homework	10	
	2 Homework	10	
	3 Quiz	20	
	Mid Term	60	
2nd attestation	Assignments**:	40	100
	1 Homework	10	
	2 Homework	10	
	3 Quiz	20	
	End Term	60	
Final exam	Written Exam/Quiz/		100
Total	0,3 * 1st Att + 0,3 * 2nd Att + 0,4*Final		100

** *The number of assignments can be different. It depends from the course program and designed by course syllabus.*

Achievement level as per course curriculum shall be assessed according to the evaluation chart adopted by the academic credit system.

Letter Grade	Numerical equivalent	Percentage	Grade according to the traditional system
A	4,0	95-100	Excellent
A-	3,67	90-94	
B+	3,33	85-89	Good
B	3,0	80-84	
B-	2,67	75-79	
C+	2,33	70-74	
C	2,0	65-69	Satisfactory
C-	1,67	60-64	
D+	1,33	55-59	
D	1,0	50-54	
FX	0	25-49	Fail
F	0	0-24	

Based on the specific grade for each assignment, and the final grade, following criteria must be satisfied:

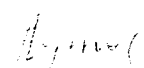| Grade	Criteria to be satisfied
90-100	- Work would be worthy of further dissemination under appropriate conditions - Mastery of advanced methods and techniques at a level beyond that explicitly taught - Ability to synthesize and employ in an original way idea from across the subject - Outstanding command of critical analysis and judgment
80-89	- Excellent range and depth of attainment of intended outcomes - Mastery of a wide range of methods and techniques - Evidence of study and originality of what has been taught - Able to display a command of critical analysis and judgement
70-79	- Attained all the intended learning outcomes for a unit - Able to use well a range of methods and techniques to come to conclusions - Able to employ critical analysis and judgement
60-69	- Some limitations in attainment of learning objectives, but has managed to grasp most of them - Able to use most of the methods and techniques taught - Evidence of study and comprehension of what has been taught but grasp insecure - Some grasp of the issues and concepts underlying the techniques and material taught, but weak and incomplete
50-59	- Attainment of only a minority of the learning outcomes - Able to demonstrate a clear but limited use of some of the basic methods and techniques taught - Weak and incomplete grasp of what has been taught - Deficient understanding of the issues and concepts underlying the techniques and material taught

25-49	- Attainment of nearly all the intended learning outcomes deficient - Lack of ability to use at all or the right methods and techniques taught - Inadequately and incoherently presented - Wholly deficient grasp of what has been taught - Lack of understanding of the issues and concepts underlying the techniques and material taught
0-24	No significant assessable material, absent or assessment missing a must pass component

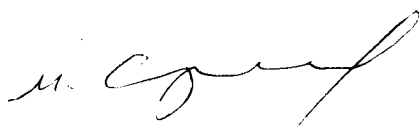## 5. Methodological Guidelines

Assessment is administered continuously throughout the course. The students are rated against their performance in continuous rating administered throughout the semester (60%) and summative rating done during the examination session (40%), total 100%. Continuous rating is students' on-going performance in class and independent work. Class work is assessed for attendance, laboratory works' defense and in- class assessments.

- **ISiS (Instructor Supervised Student Independent Study)** -comprises presentation to be done by students independently and checked by instructor.
- **Mid-term and End-term** is a review of the topics covered and assessment of each student's knowledge. The form of the midterm and end term exams is complex.
- **Final assessment** is a combination of both individual (team) project (report) and oral presentation (slides) to evaluate the students' academic performance and professional skills. At the completion of this course each student has to submit an online project version conforming to the project outline, as well as to prepare and present a slide presentation that follows the presentation outline. Project iterations would be required to submit as well. Students should submit the written Report of Final project and slide-Presentation 3 days before the Final exam day.

6. Lecturer (lecturers) approvals Full name Job title Date Sign

Full name	Job title	Date	Sign
Shynar Abutalipova	Assistant professor	05 / 12 / 2024	

Director   Sergaziyev M.Zh.