DISCRETE MATHEMATICS

COURSE SYLLABUS

Code and name of specialty	122 «Computer Science»	**Institute / faculty**	Faculty of Computer Science and Software Engineering
Program name	«Computer Science and Intelligent Systems»	**Department**	Software Engineering and Management Information Technologies
Type of program	**Educational and Professional**	**Language of instruction**	Ukrainian, English

LECTURER

Full name, *e-mail*	**Kateryna Yahup, *Kateryna.Yahup@khpi.edu.ua***

Doctor of Technical Sciences, Professor, published more than 90 scientific papers, basic courses " Software Architecture Basics", "Discrete Mathematics".

GENERAL DESCRIPTION OF THE COURSE

Summary	The course “Discrete Mathematics” is a course in the cycle of professional compulsory training of the specialty 122 – "Computer Science”. It is taught in the third semester in the amount of 150 hours (5 ECTS credits), in particular: lectures – 32 hours, laboratory classes – 32 hours, independent work – 86 hours. There are no individual tasks. The study of the discipline ends with the semester test.
Course objectives	To acquaint students with the basics of combinatorics, automata theory, graph theory and their applications to the problems of mathematical cybernetics; to instill in students the skills of free handling of basic discrete objects and the correct use of concepts and symbols of discrete mathematics to express quantitative and qualitative relations of the real world.
Types of classes and control	Lectures, laboratory classes. Continuous assessment – laboratory works, intermediate modular assessment. Final assessment – semester test.
Term	3

Student workload (credits) / Type of course	3 / Mandatory (elective)	**Lectures (hours)**	32	**Laboratory classes (hours)**	32	**Self-study (hours)**	86

Program competences	GC 1. Ability to abstract thinking, analysis and synthesis. GC 2. Ability to apply knowledge in practical situations. GC 3. Ability to understand the subject area and professional activity.GC6. Здатність вчитися і оволодівати сучасними знаннями. GC 6. Ability to search, process and summarize information from various sources. GC 7. Ability to develop and manage projects. PC1. Ability to mathematically formulate and study continuous and discrete mathematical models, justify the choice of methods and approaches for solving

	theoretical and applied problems in the field of computer science, analysis and interpretation. PC3. Ability to think logically, build logical conclusions, use formal languages and models of algorithmic calculations, design, develop and analyze algorithms, evaluate their efficiency and complexity, solvability and unsolvability of algorithmic problems for adequate modelling of subject areas and creation of software and information systems.

Learning outcomes	Teaching and learning methods	Forms of assessment (continuous assessment CAS, final assessment FAS)
PLO 1. Know linear and vector algebra, differential and integral calculus, theory of functions of many variables, series theory, differential equations for functions of one and many variables, operational calculus, probability theory and mathematical statistics to the extent necessary for the development and use of information systems, technologies and infocommunications, services and infrastructure of the organization. PLO 2. Apply knowledge of basic and natural sciences, systems analysis and modeling technologies, standard algorithms and discrete analysis in solving problems of design and use of information systems and technologies.	Interactive lectures with presentations, discussions, laboratory classes, teamwork, case method, student feedback method, problem-based learning	Written individual assignments for laboratory works (CAS), assessment of knowledge in laboratory classes (CAS), express surveys (CAS), online tests (CAS), final/semester control in the form of a semester test, according to the schedule of the educational process (FAS)

ASSESSMENT AND GRADING

Ranges of points corresponding to grades	core (points) for all types of learning activities	ECTS grading scale	The national grading scale
	90-100	A	excellent
	82-89	B	good
	74-81	C	
	64-73	D	satisfactory
	60-63	E	
	35-59	FX	Unsatisfactory (with the exam retake option)
	0-34	F	Unsatisfactory (with mandatory repetition of the course)

Allocation of grade points

100% Final assessment as a result of Final exam (30%) and Continuous assessment (70%).
30% Final exam
70% Continuous assessment:
Module №1 (10%)
Module №2 (20%)
Laboratory works (40%)
Laboratory work №1 (2%)
Laboratory work №2 (2%)
Laboratory work №3 (4%)
Laboratory work №4 (6%)
Laboratory work №5 (6%)
Laboratory work №6 (4%)

					Laboratory work №7 (6%) Laboratory work №8 (6%) Laboratory work №9 (4%)

Course policy	Students must attend all classes according to the study schedule and adhere to the norms of academic ethics. To study the course, students need to have their personal computer and (or) use computers of the computer center at the department. Students must work with compulsory and recommended reading, including Internet resources. Students must complete and submit all laboratory works during the semester in which the course is taught, before the examination session. The final assessment is not carried out without the personal presence of students.

COURSE STRUCTURE AND CONTENT

Topic 1	Sets and operations on them. Correspondences between sets	**Laboratory work 1**	Sets and operations on them. Correspondences between sets	**Self-study**	Sets and operations on them. Correspondences between sets
Topic 2	Set, function, mapping, operation. Ways of the representation	**Laboratory work 2**	Set, function, mapping, operation. Ways of the representation		Set, function, mapping, operation. Ways of the representation
Topic 3	Relationships and their properties.	**Laboratory work 3**	Relationships and their properties.		Relationships and their properties.
Topic 4	The concept of discrete algebra. Algebra basics.	**Laboratory work 4**	The concept of discrete algebra. Algebra basics.		The concept of discrete algebra. Algebra basics.
Topic 5	Permutations, combinations, placement	**Laboratory work 5**	Permutations, combinations, placement		Permutations, combinations, placement
Topic 6	The principle of inclusion and exclusion.	**Laboratory work 6**	The principle of inclusion and exclusion.		The principle of inclusion and exclusion.
Topic 7	Polynomial and binomial formulas	**Laboratory work 7**	Polynomial and binomial formulas		Polynomial and binomial formulas
Topic 8	Boolean functions. Implementation of functions by formulas. Equivalence of formulas. The principle of duality.	**Laboratory work 8**	Boolean functions. Implementation of functions by formulas. Equivalence of formulas. The principle of duality.		Boolean functions. Implementation of functions by formulas. Equivalence of formulas. The principle of duality.
Topic 9	Normal forms, irredundant, minimal and reduced DNF.	**Laboratory work 9**	Normal forms, irredundant, minimal and reduced DNF.		Normal forms, irredundant, minimal and reduced DNF.
Topic 10	Methods of obtaining reduced and minimum DNF.	**Laboratory work 10**	Methods of obtaining reduced and minimum DNF.		Methods of obtaining reduced and minimum DNF.
Topic 11	Complete systems of Boolean functions. Zhegalkin Polynom.	**Laboratory work 11**	Complete systems of Boolean functions. Zhegalkin Polynom.		Complete systems of Boolean functions. Zhegalkin Polynom.

Topic 12	Closed classes. Completeness theorem.	**Laboratory work 12**	Closed classes. Completeness theorem.		Closed classes. Completeness theorem.
Topic -13	The concept of the graph. adjacency, incidence, degree of vertices.	**Laboratory work 13**	The concept of the graph. adjacency, incidence, degree of vertices.		The concept of the graph. adjacency, incidence, degree of vertices.
Topic 14	Routes, chains, cycles. Isomorphism of graphs. Ways to set graphs.	**Laboratory work 14**	Routes, chains, cycles. Isomorphism of graphs. Ways to set graphs.		Routes, chains, cycles. Isomorphism of graphs. Ways to set graphs.
Topic 15	Complete and bipartite graphs. Operations on graphs. Connection capabilities. Diameter, radius, center of the graph.	**Laboratory work 15**	Complete and bipartite graphs. Operations on graphs. Connection capabilities. Diameter, radius, center of the graph.		Complete and bipartite graphs. Operations on graphs. Connection capabilities. Diameter, radius, center of the graph.
Topic 16	Trees. Planar graphs. Euler's Hamilton graphs. Coloring graphs.	**Laboratory work 16**	Trees. Planar graphs. Euler's Hamilton graphs. Coloring graphs.		Trees. Planar graphs. Euler's Hamilton graphs. Coloring graphs.

RECOMMENDED READING

Compulsory

1. Douglas B. (2020) West. Combinatorial Mathematics. – Cambridge University Press
2. Oscar Levin (2021) Discrete Mathematics: An Open Introduction, – University of Northern Colorado Greeley.
3. Jon Pierre Fortney. (2021) Discrete Mathematics for Computer Science An Example-Based Introduction. Chapman and Hall/CRC
4. Sriraman Sridharan, R. Balakrishnan. (2019) Discrete Mathematics Graph Algorithms, Algebraic Structures, Coding Theory, and Cryptography. Chapman and Hall/CRC.
5. Ryan T. (2021) White , Archana Tikayat Ray. Practical Discrete Mathematics. Packt
6. James A. Anderson , Jerome Lewis, O. (2003) Dale Saylor . Discrete Mathematics With Combinatorics. Prentice Hall; Subsequent edition.
7. David Guichard. (2021) An Introduction to Combinatorics and Graph Theory
8. Susanna Epp. (2019) Discrete Mathematics with Applications. Cengage Learning, Inc.

Recommended

1. Fan Chung, Ron Graham, Frederick Hoffman, Ronald C. Mullin, Leslie Hogben, Douglas B. West. 50 years of Combinatorics, Graph Theory, and Computing. (2019) Chapman and Hall/CRC.
2. Michel Rigo. (2016) Advanced Graph Theory and Combinatorics. Wiley-ISTE.
3. Thomas Koshy.(2017) Fibonacci and Lucas Numbers with Application.Wiley-ISTE.
4. Robin Wilson.(2016) Combinatorics: A Very Short Introduction. Oxford University Press.
5. Sarah-Marie Belcastro.(2020) Discrete Mathematics with Ducks. Chapman and Hall/CRC.
6. М. А. Новотарський. (2020) Дискретна математика Київ : КПІ ім. Ігоря Сікорського
7. В. М. Коцовський (2020) Основи дискретної математики Ужгород:
8. Коноваленко О.Є., Ткачук М.А., Грабовський А.В. (2016) Дискретна математика: Харків : НТУ «ХПІ».
9. Кублій Л. І. (2020) Комп'ютерна дискретна математика Київ: КПІ ім. Ігоря Сікорського
10. Нікольський Ю.В., Пасічник В.В., Щербина Ю.М. (2016) Дискретна математика: Підручник. Вид. 4-е. Львів: Магнолія.

Academic integrity

Graduate students are expected to adhere to the Code of Ethics of Academic Relations and Integrity" of NTU "KhPI".

The content of this syllabus is consistent with the course program.