Subject code	Credits
INFN1006	4

Course title in Lithuanian

DISKREČIOSIOS STRUKTŪROS IR MATEMATINĖ LOGIKA

Course title in English

DISCRETE STRUCTURES AND MATHEMATICAL LOGICS

Short course annotation in Lithuanian (up to 500 characters)

Kursas skirtas supažindinti studentus su pagrindinėmis diskretinės matematikos, kombinatorikos, matematinės logikos sąvokomis ir išmokyti praktinių žinių taikymo įgūdžių. Baigę kursą studentai gebės formalizuoti tekstus teiginių ir predikatų logikos priemonėmis; patikrinti ir pagrįsti samprotavimų pagrįstumą; paskaičiuoti sudėtingų loginių išraiškų teisingumą; teiginių ir predikatų logikos priemonėmis intelektikos uždavinių žinių pateikimui konstruoti Žinių bazes; Žinių bazėse atlikti loginio išvedimo procedūras; pritaikyti pagrindinius kombinatorikos algoritmus, sprendžiant užduočių sudėtingumo tyrimo uždavinius. Kursą sudaro paskaitos ir praktiniai darbai.

Short course annotation in English (up to 500 characters)

The course introduces the students with the basic concepts in discrete mathematics, abstract algebra, mathematical logics (especially to logical knowledge representation and inference) and combinatorics; abilities to apply these concepts in information structures analysis are formed; students gain knowledge in formal logical descriptions, literacy in logical symbolization, learn to recognize incorrect logical structures, get acquainted with principles of logical induction and logical deduction. Course serves as prerequisite for courses of artificial intelligence and logical programming. The course structure consists of lectures and practical works.

Prerequisites for entering the course

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Course aim

Provide knowledge of the basic concepts of discrete structures and mathematical logic and develop practical skills in application of these concepts to solve real world problems.

Content

No	Content (topics)
1.	**Knowledge representation.** Models of knowledge representation, knowledge bases, extensional and intensional knowledge, examples.
2.	**Discrete nature of knowledge**. Semantic elements of knowledge, judgments, reasoning, their semantical structure, ambiguity of natural language.
3.	**Fundamentals of intuitive set theory**. The concept of a set, its properties, symbols for sets, sets of numbers, operations over sets, Venn diagrams, laws of set algebra, paradoxes.
4.	**Relations and functions**. Cartesian product, relations, properties of relations, functions, properties of functions (surjection, injection, bijection), examples.
5.	**Algebraic structures**. Structures with one operation, structures with two operations, Boolean algebra.
6.	**Combinatorics**. Formulation of problems in combinatorics, combinatorics problems with regular structure, combinatorics problems with irregular structure, combinatorial trees, generating functions in combinatorics, combinatorial algorithms.
7.	**Functions in logic**. Features as functions, operators (functions of objects), propositional functions.
8.	**Propositional logic**. **(syntax):** Complex propositions, truth tables, main tautologies, tautologies in reasoning, proof in mathematics; **(semantics):** analysis of logical possibilities, logical relations among complex propositions, formalization of complex propositions, normal forms.
9.	**Knowledge representation in propositional logic**. Methods of deductive reasoning, transformation of knowledge base to CNF, examples.
10.	**Inference in propositional logic**. Resolution rule, proof by contradiction, algorithms of inference, examples.
11.	**First-order logic**. Concept of predicate, quantifiers, laws of first-order logic, categorical propositions, reasoning in first-order logic, syllogisms, relations in reasoning, using properties of relations in reasoning.
12.	**Knowledge representation in first-order logic**. Knowledge base of the first-order logic, syntax of formulas, interpretation, Skolemization, transformation of knowledge base to canonical form, examples.
13.	**Inference in the first-order logic**. Herbrand's universe, Herbrand's base, unification, algorithms of inference, examples.

Distribution of workload for students (contact and independent work hours)

Lectures	**45 hours**
Practical work	**15 hours**
Individual students work	**50 hours**
Total:	**110 hours**

Structure of cumulative score and value of its constituent parts

Final written exam (50%), mid-term written exam (25%), and a test (25%).

Recommended reference materials

No.	Publication year	Authors of publication and title	Publishing house	Number of copies in		
				University library	*Self-study rooms*	*Other libraries*
Basic materials						
1.	2001	K.Plukas, E.Mačikėnas, B.Jarašiūnienė, I.Mikuckienė. Taikomoji diskrečioji matematika.	Technologija, Kaunas.	12	4	
2.	2005	A. Krylovas. Diskrečioji matematika. Mokomoji knyga.	Vilnius: Technika.	4	2	
3.	2004	Plečkaitis R. Logikos pagrindai.	Tyto alba	4	4	
Supplementary materials						
1.	2003	Russell S, P. Norvig. Artificiale Intelligence. A Modern Approach.	Prentice Hall, Upper Saddle River.	1		
2.	2007	Raškinis G. Intelektika.	VDU, Kaunas	10		

Course programme designed by

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