Subject code	Credits
INFN1006	4

Title

DISKREĻIOSIOS STRUKTÌROS IR MATEMATINĀ LOGIKA

Title in English

DISCRETE STRUCTURES AND MATHEMATICAL LOGIC

Subject goal and annotation

The course presents introduction to 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 being formed; students learn basics of formal logical descriptions, literacy in logical symbolization, learn to recognize incorrect logical structures, will get acquainted with principles of logical induction and logical deduction. Course serves as prerequisite for courses of artificial intelligence and logical programming. Form of study: lectures and problem solving practical.

Prerequisites

Relationship between the learning outcomes of the Programme and learning outcomes of the subject

Learning outcomes of the Programme	Learning outcomes of the subject	Criteria for measuring the achievement of learning outcomes
1. Knowledge and understanding of basic mathematics, physics and nature, and its applicability in engineering.	Knowledge and understanding of basic concepts and operations in discrete mathematics and logic.	Student demonstrates knowledge and understanding by solving problem orientated exercises.
3. Knowledge of basic and advanced computer science and its application.	Ability to perform procedures of logical inference in Knowledge Bases.	Apply resolution algorithm when solving problems of logical inference.
7. Formalization and specification of real-world problems, and ability to describe them at an abstract level 8. Perform interdisciplinary research and development in Internet systems area, apply results in practical applications.	Ability to formalize meaning of texts by means of propositional and predicate logic. Check and prove correctness of reasoning.	Student demonstrates the ability formalize meaning of texts using symbols of set algebra, propositional and predicate logic.
15. Clear and convincing presentation of problems and solutions to experts and non-experts using ground knowledge, reasoning, relevant presentation tools and methods..	Construct Knowledge Bases for representation of applied information by means of propositional and first order logic.	Student demonstrates the ability to construct Knowledge Bases by means of logical methods of knowledge representation.

Subject content

	Lecture topics and contents	Hours
1.	**Knowledge representation:** Models of knowledge representation, knowledge bases, extensional and intensional knowledge, examples.	3
2.	**Discrete nature of knowledge:**Semantic elements of knowledge, judgments, reasoning, their semantical structure, ambiguity of natural language.	3
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.	3
4.	**Relations and functions:** Cartesian product, relations, properties of relations, functions, properties of functions (surjection, injection, bijection), examples.	3
5.	**Algebraic structures:** Structures with one operation, structures with two operations, Boolean algebra.	3

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.	3
7.	**Functions in logic:** Features as functions, operators (functions of objects), propositional functions.	2
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.	5
9.	**Knowledge representation in propositional logic:** Methods of deductive reasoning, transformation of knowledge base to CNF, examples.	2
10.	**Inference in propositional logic:** Resolution rule, proof by contradiction, algorithms of inference, examples.	4
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.	6
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.	4
13.	**Inference in the first-order logic:** Herbrandś universe, Herbrandś base, unification, algorithms of inference, examples.	4
	Total	**45**

Seminar contents

	Lecture topics and contents	**Hours**
1.	**Algebraic structures and Combinatorics**	3
2.	**Fundamentals of intuitive set theory, relations and functions**	3
3.	**Propositional logic**	3
4.	**Inference in propositional logic**	3
5.	**First-order logic**	3
	Total	**15**

Evaluation of study results

Final written exam (50%), mid-term written exam (25%), tests (25%).

Distribution of subject study hours

Lectures	45
Seminar	15
Individual studies (including studies in groups, preparation for the mid-term and final exams)	44
Total	**104**

Recommended literature

No	**Authors of publication and title**	**Number of copies available**		
		in the Library of VMU	*in specialized publication collections at VMU*	*in other libraries*
Main literature				
1.	Plukas, E.Maļikānas, B.Jaraģiļienā, I.Mikuckienā. (2001) *Taikomoji diskrečioji matematika.* Technologija, Kaunas.	5		
2.	A. Krylovas. (2005) *Diskrečioji matematika. Mokomoji knyga*. Vilnius: Technika, 144 p.	5		
3	. S. Russell, P. Norvig. (2003). *Artificiale Intelligence. A Modern Approach*. Prentice Hall, Upper Saddle River.	3		
4	Copi, I. M., Cohen C. (1990) *Introduction to logic.* New York/London: Macmillan.	3		
Additional literature				
1.	. Pleļkaitis R (2004). *Logikos pagrindai*. Tyto alba.	9		

2.	G. Rąžkinis. *Intelektika*. VDU, Kaunas 2007.	15
3	A. Rąžkinis, G. Karoblis *Logikos užduočių pratybos*. . VDU, Kaunas 2007.	15

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