(faculty stamp)

KARTA PRZEDMIOTU

1. Course title: DISCRETE MATHEMATIC AND MATHEMATICAL LOGIC	**2. Course code:** **DMaML**
3. Validity of course description: 2018/2019	
4. Level of studies: BA, BSc programme	
5. Mode of studies: INTRAMURAL STUDIES	
6. Field of study: INFORMATICS	
7. Profile of the studies: comprehensive	
8. Specialty: ALL	
9. Semester: III	
10. Faculty teaching the course: Faculty of Automatic Control, Electronics and Computer Science	
11. Course instructor: Marek Sikora, PhD., D.Sc.	
12. Course classification: common courses	
13. Course status: obligatory	
14. Language of instruction: English	
15. Pre-requisite qualifications: Mathematical skills on the secondary school level and the course of Mathematical Analysis and Linear Algebra.	
16. Course objectives: The goal of education is to achieve the following skills: efficient handling of the discrete mathematic and mathematical logic apparatus and tools; issues formulating and descripting in terms of mathematics and its results interpretation. The other goal is to show connections between different branches of mathematics and computer science.	
17. Description of learning outcomes:	

Nr	Learning outcomes description	Method of assessment	Teaching methods	Learning outcomes reference code
1.	Student knows definitions and properties of basic notions of set theory (including rough set theory), relations and mathematical logic (including zeroth- and first-order logic)	Exam	Lecture	K1A_W02
2.	Student knows methods and algorithms of automatic deductive reasoning in classical logic.	Exam	Lecture	K1A_W02 K1A_W09
3.	Student knows definitions and properties of basic notions, theorems and methods of linear recurrence equations solving.	Exam	Lecture	K1A_W02
4.	Student knows basic notions and methods of simple combinatoric objects counting.	Exam	Lecture	K1A_U08 K1A_U12

5.	Student can check binary relations properties, point distinguished elements, check logical formulas satisfiability and provide a formal proofs of logical theorems.	Final test	Lecture	K1A_U08 K1A_U11
6.	Student can solve linear recurrence equations with generating functions and characteristic equations.	Final test	Table classes	K1A_U08
7.	Student can define a simple expert with the usage of skeleton system.	Laboratory tasks	Laboratory	K1A_U06 K1A_U08 K1A_K02 K1A_U12
8.	Student can applicate rough set theory algorithms library for the purpose of decision tables analysis and decision algorithms development.	Laboratory tasks	Laboratory	K1A_U06 K1A_U08 K1A_K02 K1A_U12

18. Teaching modes and hours

Lecture	Classes	Laboratory	Project	BA/MA Seminar
30	15	15	-	-

Lectures and table classes are leaded in a traditional way. During the lectures definitions and theorems (with proofs) are presented; all notions are presented with examples. Students can observe the reasoning process, ask questions, participate and cooperate in equations derivations or problems resolving. During the table classes students solve (independently or with a little help from the teacher) selected examples. Laboratories are assumed to be the place of practical skills evolvement.

Lectures:

1. Introduction to set theory (sets – operations, properties, Venn-Euler diagrams, Boole algebra, Infinite operations, Cartesian product and ordered n-tuples).
2. Relations (types, properties, equivalence relation, tolerance relation, ordering relations, function, set image and inverse image, lexicographical order).
3. Zeroth-order logic (syntax, semantics, tautology, axiomatics, formal systems – proof system: assumpitonal, semantic tables, resolution, SAT problems, indirect proofs).
4. First-order logic (syntax, semantics, formulas satisfiability and truth, axiomatics, formal systems, decidability).
5. Automated theorem proving (clauses, Horn clauses, normal forms: CNF, DNF, resolution, DPLL algorithm, ascending and descending reasoning).
6. Rough sets (basic definitions, decision logic, attributes reduction, reducts induction algorithms, decision algorithm).
7. Basic information about decision rules expert systems.
8. Introduction to inductive reasoning problems.
9. Mathematical induction (natural numbers, mathematical induction principle for natural numbers, prefix and complete induction principle, application of induction principle in theorem proofs).
10. Counting (sets equipotence, law of union, simple counting schemes, permutation distribution for cycles, Newton binomial theorem, integer functions counting, ordered spacing, induction-exclusion principle, Sterling and Bell numbers, set division into specified subset power, Dirichlet's box principle, multisets).
11. Recurrence and combinatorics cont. (linear recurrence equations – a general form, solving with characteristic equations), generating functions, exponential generating functions, generating functions of several sequences, combination with constraints, generating functions of two variables).

Table classes:

During the table classes the lectures content is strengthened and illustrated.

Laboratories:

1. Programming in logic – Prolog programming language and programming developlment environment (e.g. Amzi Prolog), implementing sample programs; prolog as a library – binding with object programming languages.
2. Rough sets – RSESlib library or RRoughSet package – development and application possibilities.
3. Applications of skeleton system experts usage.
4. Applications of RapidMiner environment to inductive reasoning.

19. Examination: yes

20. Primary sources:

1. Ross K. A., Wright C.R.B.: Matematyka Dyskretna. Wydawnictwo Naukowe PWN, Warszawa 2000.
2. Lipski W.: Kombinatoryka dla programistów. WNT, Warszawa 2004 (wydanie III).
3. Ben-Ari M.: Logika matematyczna w Informatyce. WNT, Warszawa 2005.
4. Grzegorczyk A.: Zarys logiki matematycznej. BM 20, PWN, Warszawa.
5. Clocksion W.F., Mellish C.S.: Prolog programowanie. Helion, Gliwice 2004.

21. Secondary sources:

1. Rasiowa H.: Wstęp do matematyki współczesnej. Państwowe Wydawnictwo Naukowe, Warszawa 1984.
2. Kowalski R.: Logika w rozwiązywaniu zadań, WNT, Warszawa 1989.
3. Palka Z., Ruciński A.: Wykłady z kombinatoryki. WNT, Warszawa 2004.
4. Pawlak Z.: Rough Sets: Theoretical Aspects of Reasoning about Data, Kluwer Academic Publishers, .
5. Mattson H.F.: Discrete Mathematics with Applications, John Wiley & Sons.

22. Total workload required to achieve learning outcomes

Lp.	Teaching mode	Contact hours / Student workload hours
1.	Lecture	30/30
2.	Classes	15/10
3.	Laboratory	15/10
4.	Project	/
5.	BA/MA Seminar	/
6.	Other	5 /5
	Total number of hours:	65/55

23. Total hours:	120
24. Number of ECTS credits:	4
25. Number of ECTS credits allocated for contact hours:	1
26. Number of ECTS credits allocated for in-practice hours (laboratory classes, projects):	3

27. Comments: -

Approved:

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(date, Instructor's signature) (*date, the Director of the Faculty Unit signature)*

[1] 1 ECTS credit – 25-30 student workload hours