Study programmes: Bachelor studies – Mathematics

Course name: M105 - Discrete structures 1

Lecturers: Žarko Mijajlović, Milan Božić, Aleksandar Jovanović, Zoran Petrović, Dragana Todorić, Aleksandar Lipkovski

Status: Compulsory

ECTS: 6

Attendance prerequisites: no prerequisite

Course aims: Acquisition of general knowledge of discrete mathematics.

Course outcome: Upon completion of the course, the students have basic knowledge from discrete mathematics. The students understand the following concepts: set, relation, function, countability, mathematical induction, divisibility, congruence, proposition, tautology, term, formula, formal systems. The students know fundamental theorems of set theory, elementary number theory and mathematical logic. They are able to solve problems in these fields, and to attend more advanced courses in mathematics and computer science which the acquired concepts and techniques should be applied.

Course content:
Elementary set Theory: Notion of a set and basic set operations; powerset. Cartesian products of sets; relations. Equivalence relations and examples. Orderings and examples. Functions; images and inverse images. One-to-one (injections) and onto functions (surjections), one-to-one correspondences (bijections). Characteristic functions and set identities. Countable sets (countability of integers and rationals); uncountable sets (uncountability of the reals). Cantor–Bernstein theorem. The axiom of choice and its equivalents.
Elementary number theory: The set of natural numbers; the Peano axioms; mathematical induction. Divisibility; prime numbers. Fundamental theorem of arithmetics; Chinese remainder theorem, Wilson's theorem; Diophantine equations; recursion.
Propositional logic: Propositions and truth values; propositional connectives; propositional formulas. Boolean algebras, finite Boolean algebras; disjunctive normal form (DNF) and conjunctive normal form (CNF). Complete sets of connectives. Truth assignments; tautologies; verifying tautologies; tautologies versus set identities.
First-order logic: First order language; terms and formulas; free and bound variables. Structures and variable assignments; value of a term, truth value of a formula. Valid first-order formulas; some methods for checking first-order validity (method of semantic tableaux; Skolemization), applications.
Formal systems: Simple examples of formal systems. Formal systems for propositional logic. Completeness and compactness theorems for propositional logic; applications. Formal systems for predicate logic. Completeness and compactness theorems for predicate logic (without proof); applications. Method of analytic tableaux.

Literature:
1. Ž. Mijajlović, Algebra, Milgor, Beograd, 1998;
2. Ž. Mijajlović, Z. Petrović, Matematička logika, elementi teorije skupova, Beograd, 2012;
3. J. A. Anderson, J. A. Anderson, Discrete Mathematics with Combinatorics, Prentice Hall, 2003.

Number of hours: 5	**Lectures: 3**	**Tutorials: 2**	**Laboratory: -**	**Research: -**

Teaching and learning methods: Lectures/ Tutorials

Assessment (maximal 100 points)

Course assignments	points	Final exam	points
Lectures	-	Written exam	-
Exercises / Tutorials	-	Oral exam	-
Colloquia	40	Written-oral exam	60
Essay / Project	-		