Academic subject: Mathematical Logic			
Degree Class: LM-40 – Matematica		**Degree Course:** Mathematics	**Academic Year:** 2017/2018
		Kind of class: optional	**Year:** 2 / **Period:** 1
			ECTS: 7 divided into **ECTS lessons:** 7 **ECTS exe/lab/tutor:**
Time management, hours, in–class study hours, out–of–class study hours lesson: 60 exe/lab/tutor: in–class study: 60 out–of–class study: 115			
Language: Italian	**Compulsory Attendance:** no		
Subject Teacher: Luigi Borzacchini	**Tel:** 0805442654 **e–mail:** luigiborzacchini47@gmail.com	**Office:** Department of Mathematics Room 5 , Floor II	**Office days and hours:** monday 9-10, tuesday 12-13, wednesday 12-13
Prerequisites: Mathematical knowledge which usually is acquired during the first year of a degree of the L-35 class: basic arithmetic, algebra, geometry			
Educational objectives: introduction to mathematical logic, including limitative theorems and the theory of algorithms, with elements of history of logic			
Expected learning outcomes (according to Dublin Descriptors)	**Knowledge and understanding:** logic of propositions and predicates, axiomatization of mathematics, theory of algorithms **Applying knowledge and understanding:** logical coding of (even mathematical) natural language propositions, demonstrations by natural deduction, semantic tableaux, resolution. **Making judgements:** autonomous comprehension and employment skills of logic-set theoretical-algorithmic language **Communication:** in the logic-set theoretical-algorithmic language **Lifelong learning skills:** advanced issues of mathematical logic, foundations of mathematics and theory of algorithms		
Course program. 1.Introduction. Logic, language and mathematics. Aristotelian and mathematical logic. (Iconic/syntactic) representation and formal thinking: the signs. Syntax and semantics. Demonstration (Rules and axioms) and truth. Representation as language and as computation. Representation and Interpretation. Language and metalanguage. 2. Preliminaries. Theory of formal languages and algorithms: Alphabets and Expressions. Chomskij Hierarchy: grammars and machines (membership and parsing). Decidability e complexity. Infinite and Cantor theory: denumerability, non-denumerability of real numbers, transfinite hierarchy. 3. Propositions Logic. Propositions, Connectives and Truth tables. Normal forms. Venn diagrams. Hilbert calculus and natural deduction. Deduction theorem. Interpretations. Logic and set-theoretical language. Intension and Extension. Correctness, completeness, compactness, consistence, decidability. 4. Predicates logic. Formulas, Variables, Predicates and Quantifiers. Hilbert calculus and natural deduction. Interpretations and models: Tarski semantics. Axiomatized Theories. Herbrand universe. Gödel completeness theorem. Löwenheim theorem. Compactness theorem.			

5. Decision problem. General theorem prover. Semantic tableaux method. Resolution. Gentzen calculus. Skolem-Herbrand theorem.

6. Logic and philosophy of mathematics. Paradoxes. Philosophy of mathematics in the 20th century: Frege-Hilbert debate. The problem of foundation: logicism, formalism, intuitionism. Axiomatized Theories.

7. Recursive functions. Equality. Predicates logic with Equality. Equations calculus. Recursivity (primitive, total, partial). Recursive functions and Turing-machines. Recursive and Recursively denumerable sets: membership and generation.

8. Limitative theorems. Hilbert program and the genesis of computer science. Halting problem (Turing). Semidecidability of predicates logic (Church).

9. Axiomatization of arithmetic. Successor theory and Peano arithmetic. An outline of second order predicates logic. Arithmetization of syntax and representability. Gödel Incompleteness theorems. Undecidability of the truth problem (Tarski).

10. Axiomatization of set theory (Zermelo-Fraenkel). Choice axiom and the continuum hypothesis. Paradoxes. Questions about foundations: continuity, transfinite hierarchy, independence and consistence of the Choice axiom and continuum hypothesis (Gödel e Cohen).

Teaching methods: lectures

Auxiliary teaching: in the web: in www.dm.uniba.it/Members/borzacchini tutorials and power point slides 2, 4, 5 in the folder <matematica discreta-introduzione alla logica matematica>. In the folder <Logica Matematica> the notes, the power point slides 1', 3', 6', and those in the <complementi di logica matematica>. Historical issues can be found in the folder <storia e fondamenti della matematica>

Assessment methods: oral exam

Bibliography: G. Lolli. Introduzione alla logica formale. Il Mulino