# *The Hebrew University of Jerusalem*

## *Syllabus*

# *MATHEMATICAL LOGIC (1) - 80423*

*Last update 10-10-2024*

*HU Credits: 4*

*Degree/Cycle: 1st degree (Bachelor)*

*Responsible Department: Mathematics*

*Academic year: 0*

*Semester: 1st Semester*

*Teaching Languages: Hebrew*

*Campus: E. Safra*

*Course/Module Coordinator: Prof. Itay Kaplan*

*Coordinator Email: yair.hayut@math.huji.ac.il*

*Coordinator Office Hours: by appointment*

*Teaching Staff:*

*Prof. Itay Kaplan,*
*Mr. George Peterzil*

*Course/Module description:*

*We will study basic concepts in mathematical logic. We will cover propositional calculus and predicate calculus (first order logic).*
*We will prove all the basic theorems (soundness, completeness, and compactness, both for propositional logic and for predicate logic).*
*We will describe a deduction system and prove its properties.*
*We will talk about some basic topics in model theory - complete theories, isomorphisms.*
*In the remaining time we will describe some connections between those topics and other areas of mathematics.*

*Course/Module aims:*

*The main goal of the course is to distinguish between syntax and semantics, and to study their connections.*

*Learning outcomes - On successful completion of this module, students should be able to:*

*The students will*
*1) distinguish between semantic and syntactic objects and recognize their connections,*
*2) define precisely the basic notions that we will introduce in class (proposition, formula, structure, connectives, quantifiers and others),*
*3) be able to prove theorems from class: properness, completeness, compactness.*
*4) be able to write a precise deduction using the deduction system presented in class.*
*5) know how to use "induction on the structure of the formula/sentence"*

*Attendance requirements(%):*

*0*

*Teaching arrangement and method of instruction: Lecture + exercise*

*Course/Module Content:*

*Propositional calculus. Logical connectives. Truth tables.*
*Tautologies.*
*Complete set of connectives.*

*The compactness theorem for propositional logic.*
*The languages of predicate calculus (first order logic). Quantifiers.*
*Terms and formulas.*
*Free and bound variables.*
*Structures.*
*Satisfaction of formulas in structures.*
*The theory of a set of structures.*
*Models of a set of formulas.*
*Deductions.*
*The soundness theorem.*
*Godel's completeness theorem.*
*The compactness theorem.*

*In the remaining time, we will touch on different subjects such as model theory and games.*
*We may learn more/other subjects.*

*Required Reading:*
*none*

*Additional Reading Material:*
*H. Enderton, A Mathematical Introduction to Logic*

*Grading Scheme:*
*Written / Oral / Practical Exam 85 %*
*Submission assignments during the semester: Exercises / Essays / Audits / Reports / Forum / Simulation / others 15 %*

*Additional information:*
*Lecture recordings will be available after each class.*