

Logic lecture

2026 Fall

Lecturer: Zalán Molnár

Code of the course: BBN-FIL18-301.01, BMA-FILD-301.1, BMA-LOTD17-102, BMI-LOTD17-102E

Aim of the course: This course provides an intensive introduction to mathematical logic, complemented by a dedicated exercise class. It covers the fundamental concepts and techniques that are essential for further study in logic, particularly within the Logic and Philosophy of Science master's program.

Although there are no formal prerequisites, students are expected to have a certain level of maturity in abstract and mathematical thinking, as well as a strong commitment to the subject.

Content of the course: In the lecture we focus on the two most important formal logical frameworks.

- **Class 1-4.** Basics of Propositional logic: syntax and semantics, proof theory, compactness, completeness. Applications in combinatorics, graph theory (de Bruijn-Erdős theorem, König's Lemma)
- **Class 5-13.** Basics of First-order logic: syntax and semantics, basic model and proof theory, Ehrenfeucht-Fraissé Games, categoricity, theory of dense linear orderings. Completeness and Compactness theorems, Löweheim-Skolem theorems. Application of compactness: glimpse to definability theory, hyperreal numbers, non-standard models of arithmetic. Decidable and undecidable theories, theory of random graphs, Gödel's first incompleteness theorem. Limits of first-order logic and glimpse to second-order logic.

The lectures are accompanied by an *exercise class*, in which students practice applying the concepts and techniques introduced in the lectures. Participation in the exercise classes is strongly recommended, as they provide an opportunity to deepen understanding of the material and clarify any questions that may arise during the lectures.

Grading criteria: (oral) exam based on the Lecture Notes and Lecture.

References

- [1] Herbert B. Enderton. *A Mathematical Introduction to Logic*. Academic Press. 2001.
- [2] Sets, Logic, Computation: An Open Introduction to Metalogic
- [3] Lecture Notes
- [4] László Csirmaz, Zalán Gyenis *Mathematical logic. Exercises and solutions*. Springer. 2022.