



Course Guide

PHIL10133: *Logic, Computability and Incompleteness* 2020/21

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1. Course Aims and Objective

2. Intended Learning Outcomes

Upon successful completion of the course, students will be able to demonstrate:

- i) Familiarity with the general philosophical/mathematical project of Hilbert's program and how this is impacted by the technical results explored in the course.
- ii) Thorough understanding of some key limitative results in logic and computability, including the halting problem, the undecidability of first-order logic, and the incompleteness of first-order arithmetic.
- iii) Ability to employ abstract, analytical and problem solving skills.
- iv) Ability to formulate clear and precise pieces of mathematical reasoning.

Also, students will demonstrate the following transferable skills:

- i) Evaluating abstract theoretical claims.
- ii) Grasping and analysing complex metatheoretical concepts.
- iii) Deploy rigorous formal methods.

3. Seminar Times and Locations

To be determined

4. Seminar Content (core readings)

Week 1: Cardinality, Enumerability, Diagonalization

Week 2: Turing Machines and Computability

Week 3: Recursive Functions

Week 4: First-Order Logic Revisited

Week 5: First-Order Logic Continued

Week 6: Uncomputability and Undecidability

Week 7: Completeness, Compactness and Löwenheim-Skolem

Week 8: Formal Arithmetic

Week 9: Diagonal Lemma, Gödel and Tarski Theorems

Week 10: Provability Predicates and Löb's Theorem

Week 11: TBA

5. PPLS Undergraduate Student Handbook

The PPLS Undergraduate Student Handbook has more information on Student Support

and academic guidance; late coursework and plagiarism; illness and disability adjustments, and useful sources of advice.

The Handbook can be found here:

http://www.ppls.ed.ac.uk/students/undergraduate/documents/PPLS_Student_Handbook-Master_Copy.pdf

6. Readings

The weekly course readings are provided on the Learn website. Please refer to the Readings folder.

The primary text will be Boolos & Jeffrey's *Computability and Logic*. We will use the 'canonical' 3rd edition.

- **Topic 1:** Cardinality, Enumerability, Diagonalization
B&J ch 1,2.
- **Topic 2:** Turing Machines and Computability
B&J ch 3,6.
- **Topic 3:** Recursive Functions
B&J ch 7,8
- **Topic 4, 5:** First-Order Logic Revisited
B&J ch 9.
- **Topic 6:** Uncomputability and Undecidability
B&J ch 5,10.
- **Topic 7:** Completeness, Compactness and Löwenheim-Skolem
B&J ch 11,12,13.
- **Topic 8:** Formal Arithmetic
B&J ch 14.
- **Topic 9:** Diagonal Lemma, Gödel and Tarski Theorems
B&J ch 15
- **Topic 10:** Provability Predicates and Löb's Theorem
B&J ch 16.

7. Assessment Information

Midterm Assignment (30%) Final Take Home Test (70%)

Please note - Regulation 14 Assessment deadlines: Student responsibilities

It is a student's responsibility to ascertain and meet his or her assessment deadlines, including examination times and locations.