Course Guide

PHIL10133: Logic, Computability and Incompleteness 2021/22

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Department of Philosophy
School of Philosophy, Psychology and Language Sciences
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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](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.