Course Guide

PHIL10133: *Logic, Computability and Incompleteness* 2019/20

Course Organiser: Dr Paul Schweizer (paul@inf.ed.ac.uk)
Office Location: Dugald Stewart Building room 5.13
Office Hours: Tuesday 3-4pm and by Appointment

Course Secretary: Ann-Marie Cowe (philinfo@ed.ac.uk)

Contents

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

Thursdays 2.10pm – 4pm, Dugald Stewart Building, room 1.20

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: Uncomputability and Undecidability
Week 6: Completeness, Compactness and Löwenheim-Skolem
Week 7: Formal Arithmetic
Week 8: Diagonal Lemma, Gödel and Tarski Theorems
Week 9: Provability Predicates and Löb's Theorem
Week 10: Computational Complexity
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**: First-Order Logic Revisited
  B&J ch 9.
- **Topic 5**: Uncomputability and Undecidability
  B&J ch 5,10.
- **Topic 6**: Completeness, Compactness and Löwenheim-Skolem
  B&J ch 11,12,13.
- **Topic 7**: Formal Arithmetic
  B&J ch 14.
- **Topic 8**: Diagonal Lemma, Gödel and Tarski Theorems
  B&J ch 15
- **Topic 9**: Provability Predicates and Löb's Theorem
  B&J ch 16.
- **Topic 10**: Computational Complexity: will be provided on Learn

7. Assessment Information

Final two hour examination in the December diet (100%)

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.

8. Feedback

Two compulsory formative exercise sets will be assigned during the semester, and feedback on the submitted exercise sets will be provided.

9. Useful Information

Attendance by ALL students at University classes, seminars and tutorials etc
The University expects all students to attend all their University classes, lectures and tutorials etc, whether or not these are described as “compulsory” by the School. This includes participating fully in the requirements of all courses, including submitting assignments, contributing to tutorials and workshops or laboratories, attending meetings with Personal Tutors and sitting examinations.

Your attendance will be monitored by the School, so that staff can help you to manage your progress through the courses. We will do this so we can be quickly alerted to any additional pastoral or academic support needs any student might require, and so that the School can provide advice, guidance or support in a timely and useful manner.