PH210-15 Logic II: Metatheory

24/25

Department
Philosophy
Level
Undergraduate Level 2
Module leader
Walter Dean
Credit value
15
Module duration
10 weeks
Assessment
100% exam
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This module will develop the metatheory of propositional and first-order logic. Our primary goal will be to show that a proof system similar to that presented in Logic I is sound (i.e. proves only logically true sentences) and complete (proves all logically true sentences). In order to better understand how we prove things about (as opposed to within) a proof system, we will first study the syntax, semantics, and proof theory of propositional logic. We will then consider Tarski's definitions of satisfaction and truth in a model and proceed to develop the Henkin completeness proof for first-order logic. Other topics covered along the way will include countable versus uncountable sets, the compactness theorem, and the expressive limitations of first-order logic. PH210 is recommended as a prerequisite for PH340 (Logic III: Incompleteness and Undecidability), PH341 (Modal Logic), and PH345 (Computability Theory).

Module aims

To expose students to the basic metalogical notions of soundness and completeness. A natural deduction system for propositional and first order logic will be introduced and proven to be sound and complete. Along the way, basic mathematical tools needed for proving these results will be developed. These include elementary set theory and inductive proofs and definitions.

Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

- Week 1: Introduction, set theory, inductive definitions
- Week 2: Syntax and semantics of propositional logic
- Week 3: Natural deduction
- Week 4: Soundness and completeness of propositional logic
- Week 5: Syntax and semantics of first-order logic
- Week 7: Semantic notions, theories and models
- Week 8: Natural deduction and soundness for first-order logic
- Week 9: Completeness for first-order logic
- Week 10: The compactness theorem and applications

Learning outcomes

By the end of the module, students should be able to:

- Demonstrate knowledge of the Soundness and Completeness Theorems for propositional and first-order logic and related technical results and definitions (subject knowledge and understanding)
- Understand the significance these concepts and results have for logic and mathematics (cognitive skills)
- Use and define concepts with precision, both within formal and discursive contexts (key skills)
- Write precise mathematical proofs (subject specific skills)

Indicative reading list

Our primary text will be a version of the Open Logic text customised for PH210.

The same material is also covered in a number of other sources including:

Logic and Structure, 5th edition by Dirk van Dalen, Springer Verlag, 2008.

Much of the material we will be covering is also presented at a more elementary level in chapters 15–19 of the textbook for PH136 (Logic I):

Language, Proof, and Logic by Jon Barwise and John Etchemendy, CSLI Publications, 2002.

Students desiring additional background on problem solving techniques are also encouraged to obtain:

How to Prove It by Daniel J. Velleman, Cambridge University Press, 2006.

Subject specific skills

Demonstrate knowledge of the Soundness and Completeness Theorems for propositional and first-order logic and related technical results and definitions
Understand the significance these concepts and results have for logic and mathematics
Use and define concepts with precision, within both formal and discursive contexts

Transferable skills

Understand definitions and proof techniques from metalogic applicable in other domains—e.g. such as mathematical and structural induction, basic set theoretic operations and constructions The ability to comprehend and construct precise mathematical proofs

Study

Study time

Type	Required
Lectures	9 sessions of 3 hours (18%)
Seminars	9 sessions of 1 hour (6%)
Private study	114 hours (76%)
Total	150 hours

Private study description

No private study requirements defined for this module.

Costs

No further costs have been identified for this module.

Assessment

You must pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

Assessment group B9

	Weighting	Study time
In-person Examination 2 hour exam	100%	

- Answerbook Pink (12 page)

Feedback on assessment

Discussion and feedback on exercises during seminar.

[Past exam papers for PH210](#)

Availability

Courses

This module is Core for:

- UMAA-GV17 Undergraduate Mathematics and Philosophy
  - Year 2 of GV17 Mathematics and Philosophy
  - Year 2 of GV17 Mathematics and Philosophy
  - Year 2 of GV17 Mathematics and Philosophy
- UMAA-GV18 Undergraduate Mathematics and Philosophy with Intercalated Year
  - Year 2 of GV18 Mathematics and Philosophy with Intercalated Year
  - Year 2 of GV18 Mathematics and Philosophy with Intercalated Year
- Year 2 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Core optional for:

- UMAA-G103 Undergraduate Mathematics (MMath)
  - Year 2 of G100 Mathematics
  - Year 2 of G103 Mathematics (MMath)
  - Year 2 of G103 Mathematics (MMath)
  - Year 2 of G103 Mathematics (MMath)
  - Year 2 of G103 Mathematics (MMath)

This module is Optional for:

- UPHA-VL78 BA in Philosophy with Psychology
  - Year 2 of VL78 Philosophy with Psychology
  - Year 3 of VL78 Philosophy with Psychology
- Year 4 of UPHA-VL79 BA in Philosophy with Psychology (with Intercalated year)
- UHIA-V1V5 Undergraduate History and Philosophy
  - Year 2 of V1V5 History and Philosophy
  - Year 3 of V1V5 History and Philosophy
- Year 4 of UHIA-V1V6 Undergraduate History and Philosophy (with Year Abroad)
- UPHA-V700 Undergraduate Philosophy
  - Year 2 of V700 Philosophy
  - Year 2 of V700 Philosophy
  - Year 3 of V700 Philosophy
  - Year 3 of V700 Philosophy

- Year 4 of UPHA-V701 Undergraduate Philosophy (wiith Intercalated year)
- Year 4 of UPHA-V702 Undergraduate Philosophy (with Work Placement)
- UIPA-V5L8 Undergraduate Philosophy and Global Sustainable Development
  - Year 2 of V5L8 Philosophy and Global Sustainable Development
  - Year 2 of V5L8 Philosophy and Global Sustainable Development
  - Year 3 of V5L8 Philosophy and Global Sustainable Development
  - Year 3 of V5L8 Philosophy and Global Sustainable Development
- Year 4 of UIPA-V5L9 Undergraduate Philosophy and Global Sustainable Development (with Intercalated Year)
- UPHA-VQ72 Undergraduate Philosophy and Literature
  - Year 2 of VQ72 Philosophy and Literature
  - Year 3 of VQ72 Philosophy and Literature
- Year 4 of UPHA-VQ74 Undergraduate Philosophy and Literature (with Work Placement)
- Year 4 of UPHA-VQ73 Undergraduate Philosophy and Literature with Intercalated Year
- Year 4 of UPHA-VL80 Undergraduate Philosophy with Psychology (with Work Placement)
- UPHA-VQ52 Undergraduate Philosophy, Literature and Classics
  - Year 2 of VQ52 Philosophy, Literature and Classics
  - Year 3 of VQ52 Philosophy, Literature and Classics
- Year 4 of UPHA-VQ53 Undergraduate Philosophy, Literature and Classics (with Work Placement)
- UPHA-V7ML Undergraduate Philosophy, Politics and Economics
  - Year 2 of V7MR Philosophy, Politics and Economics (Bipartite with Economics Major)
  - Year 2 of V7MP Philosophy, Politics and Economics (Bipartite)
  - Year 2 of V7MP Philosophy, Politics and Economics (Bipartite)
  - Year 2 of V7ML Philosophy, Politics and Economics (Tripartite)
  - Year 2 of V7ML Philosophy, Politics and Economics (Tripartite)
  - Year 2 of V7ML Philosophy, Politics and Economics (Tripartite)
  - Year 3 of V7MR Philosophy, Politics and Economics (Bipartite with Economics Major)
  - Year 3 of V7MP Philosophy, Politics and Economics (Bipartite)
  - Year 3 of V7MP Philosophy, Politics and Economics (Bipartite)
  - Year 3 of V7ML Philosophy, Politics and Economics (Tripartite)
  - Year 3 of V7ML Philosophy, Politics and Economics (Tripartite)
  - Year 3 of V7ML Philosophy, Politics and Economics (Tripartite)
- UPHA-V7MM Undergraduate Philosophy, Politics and Economics (with Intercalated year)
  - Year 4 of V7MS Philosophy, Politics and Economics (Bipartite with Economics Major) (with Intercalated Year)
  - Year 4 of V7MS Philosophy, Politics and Economics (Bipartite with Economics Major) (with Intercalated Year)
  - Year 4 of V7MQ Philosophy, Politics and Economics (Bipartite) with Intercalated Year
  - Year 4 of V7MM Philosophy, Politics and Economics (Tripartite) (with Intercalated year)
  - Year 4 of V7MH Philosophy, Politics and Economics - Economics/Philosophy Bipartite (Economics Major) (with Intercalated year)
  - Year 4 of V7MF Philosophy, Politics and Economics - Economics/Politics Bipartite (Economics Major) (with Intercalated year)
  - Year 4 of V7MI Philosophy, Politics and Economics - Philosophy/Economics Bipartite (Philosophy Major) (with Intercalated year)

- ◦ Year 4 of V7MJ Philosophy, Politics and Economics - Philosophy/Politics Bipartite (with Intercalated year)
  - ◦ Year 4 of V7MG Philosophy, Politics and Economics - Politics/Economics Bipartite (Politics Major) (with Intercalated year)
- UPHA-V7MW Undergraduate Politics, Philosophy and Law
  - ◦ Year 2 of V7MW Politics, Philosophy and Law
  - ◦ Year 2 of V7MW Politics, Philosophy and Law
  - ◦ Year 3 of V7MW Politics, Philosophy and Law
  - ◦ Year 3 of V7MW Politics, Philosophy and Law