

USC Philosophy

PHIL 452: Modal Logic

Fall 2016—Tue, Thu—12:30 - 1:50pm

Location: [THH](#) 213

Instructor: Gabriel Uzquiano Cruz

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Office: STO 221

Office Hours: Tue, Thu 11:00-12:00pm and by appt.

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Blackboard:

<http://blackboard.usc.edu>

Course Description:

Modal logic emerged in the early part of the twentieth century as a branch of logic concerned with modality. It extends the language of each propositional and predicate logic with modal operators designed to regiment phrases such as ‘it is possible that’ and ‘it is necessary that’. Modal logic has a variety of applications in philosophy, linguistics and computer science. This course will cover basic elements of propositional and quantified modal logic and some of its applications in philosophy, which may include the logic of belief and knowledge, tense logic, and the logic of preference and obligation. The semester will be divided into three main parts, each addressing a different set of topics.

1. *Propositional Modal Logic*

We will cover elements of propositional logic: axiomatic presentations of propositional modal logic; a minimal modal logic K; schemata D, T, B, 4 and 5; S5 and metaphysical modality; possible worlds model theory; Kripke models; soundness and completeness results for a variety of propositional modal logics.

2. *Applications of Modal Logic and Possible Worlds Semantics*

Topics may include the logic of belief and knowledge, tense logic and the logic of preference and obligation. We will look at the distinction between the material, indicative, and counterfactual conditional; Stalnaker’s model theory for the logic of indicative and counterfactual conditionals; and Lewis’ alternative model theory for counterfactual conditionals.

3. *Quantified Modal Logic and Counterpart Theory*

We will cover the distinction between *de re* and *de dicto* modal claims; questions raised by the simplest quantified modal logic; the distinction between constant- and variable-domain possible worlds model theory for quantified modal logic; the question of whether existence is a necessary or contingent matter; whether existence is an eternal or temporary matter; and the contrast between Lewis' counterpart theory and quantified modal logic.

Course Materials

1. Textbook

There is one main textbook for this course:

Sider, T. (2010) *Logic for Philosophy*. Oxford University Press.

2. Additional Resources

Chellas, B. (1980) *Modal Logic*. Cambridge University Press.

Humberstone, L. (2016) *Philosophical Applications of Modal Logic*. College Publications.

van Benthem, J. (2010) *Modal Logic for Open Minds*. CSLI Publications.

Open Logic Project, [The Open Logic Text](#)

Course Requirements

Requirements for Undergraduate Students

1. Assignments

There will be seven problem sets covering the material discussed in lecture. The assignments will make up 60% of the final grade for the course.

2. Final Project

There will be a final project due on Tuesday, December 13 at 1pm. You should submit an extended abstract and bibliography by Tuesday, December 1. There is some flexibility as to the nature of the project. It could simply involve a detailed presentation of some advanced result in modal logic, e.g., a proof of some meta-theoretic result in modal logic or a presentation of some specific application

of modal logic in logic or linguistics. Or it could be a philosophical discussion of some topic related to modal logic. A technical project should not involve more than 5 to 8 pages, whereas a more philosophical paper should approach 10 to 15 pages. The final project will contribute 25% of the final grade for the course.

3. Presentation

You will give a brief presentation your final project during the last week of classes. The presentation may take between 10 and 20 minutes depending on class size, and it will make up 5% of the final grade.

4. Participation

It is of course very important that you attend every lecture and come prepared to be involved in class discussion. Participation will make up 10% of the final grade.

Requirements for Graduate Students

Graduate students will be expected to complete all the above requirements. However, they will be assigned additional problems, and they will choose more advanced final project topics. Their final project should approach 15 to 20 pages.

Grading Breakdown

Course Requirements	% of Grade
Participation	10
Problem Sets	60
Final Project	25
Presentation	5

Course Schedule

In what follows, ‘*L&P*’ abbreviates: *Logic and Philosophy*.

UNIT 1: PROPOSITIONAL MODAL LOGIC

Date	Topics	Assignments
Tuesday, August 23	<i>Introduction</i>	<i>L&P, Chapter 1</i>
Thursday, August 25	<i>Preliminaries: Sets and Proofs</i>	
Tuesday, August 30	<i>Propositional Logic: Syntax and Semantics</i>	<i>L&P, Chapter 2, #2.1 - 2.4</i>
Thursday, September 1	<i>Propositional Logic: Axioms and Completeness</i>	<i>L&P, Chapter 2, #2.6 - 2.9</i>
Tuesday, September 6	<i>Modal Propositional Logic: Introduction</i>	<i>L&P, Chapter 6, #6.1 - 6.2</i> <i>Problem Set #1 due</i>
Thursday, September 8	<i>Modal Propositional Logic: Possible Worlds Semantics</i>	<i>L&P, Chapter 6, #6.3</i>
Tuesday, September 13	<i>Modal Propositional Logic: Axioms and Completeness</i>	<i>L&P, Chapter 6, #6.4</i>
Thursday, September 15	<i>Landscape of Normal Modal Logics I</i>	<i>L&P, Chapter 6, #6.4</i>
Tuesday, September 19	<i>Landscape of Normal Modal Logics II</i>	<i>L&P, Chapter 6, #6.5 - 6.6</i> <i>Problem Set #2 due</i>
Thursday, September 21	<i>Canonical Models and Completeness</i>	
Tuesday, September 27	<i>Completeness Proofs for Canonical Modal Logics</i>	

UNIT 2: APPLICATIONS OF POSSIBLE WORLDS SEMANTICS

Thursday, September 29	<i>Epistemic Logic</i>	<i>L&P, Chapter 7, #7.2</i>
Tuesday, October 4	<i>Modal Epistemic Logic and Fitch's Paradox</i>	<i>Problem Set #3 due</i>
Thursday, October 6	<i>Intuitionistic Logic</i>	<i>L&P, Chapter 3, #3.5, Chapter 7, #7.4</i>
Tuesday, October 11	<i>Quantified Propositional Logic: Prior's Theorem</i>	
Thursday, October 13	<i>Kaplan's Paradox and Possible World Semantics</i>	
Tuesday, October 18	<i>Indicative and Material Conditionals</i>	<i>Problem Set #4 due</i>
Thursday, October 20	<i>Stalnaker on Indicative and Counterfactual Conditionals</i>	<i>L&P, Chapter 8, #8.1 - 8.6</i>
Tuesday, October 25	<i>Lewis on Counterfactual Conditionals</i>	<i>L&P, Chapter 8, #8.7 - 8.10</i>
Thursday, October 27	<i>Problems for Possible Worlds Semantics for Counterfactual Conditionals</i>	

UNIT 3: QUANTIFIED MODAL LOGIC AND COUNTERPART THEORY

Tuesday, November 1	<i>Historical and Philosophical Introduction</i>	<i>L&P, Chapter 9, #9.1 - 9.3</i> <i>Problem Set #5 due</i>
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Thursday, November 3	<i>The Simplest Quantified Modal Logic: Axioms and Fixed Domain Models</i>	<i>L&P, Chapter 9, #9.7</i>
Tuesday, November 8	<i>The Necessity of Identity and Distinctness</i>	<i>L&P, Chapter 9, #9.4 - 9.5</i>
Thursday, November 10	<i>Free Quantified Modal Logic: Axioms and Variable Domain Models</i>	<i>L&P, Chapter 9, #9.5 - 9.6</i>
Tuesday, November 15	<i>The Barcan and Converse Barcan Formula in Variable Domain Models</i>	<i>L&P, Chapter 9, #9.6</i> <i>Problem Set #6 due</i>
Thursday, November 17	<i>The Being Constraint</i>	
Tuesday, November 22	<i>The Logic of Actuality and Quantified Modal Logic</i>	
Thursday, November 24	<i>THANKSGIVING BREAK</i>	
Tuesday, November 29	<i>Counterpart Theory and Quantified Modal Logic</i>	<i>Extended Abstract and Bibliography for Final Project due</i>
Thursday, December 1	<i>Final Project Presentations</i>	<i>Problem Set #7 due</i>
Tuesday, December 13	<i>FINAL PROJECT DUE</i>	1pm

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else’s ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Section

11, [*Behavior Violating University Standards*](#). Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on [scientific misconduct](#).

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the [*Office of Equity and Diversity*](#) or to the [*Department of Public Safety*](#). This is important for the safety whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. [*The Center for Women and Men*](#) provides 24/7 confidential support, and the sexual assault resource center webpage sarc@usc.edu describes reporting options and other resources.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the [*American Language Institute*](#), which sponsors courses and workshops specifically for international graduate students. [*The Office of Disability Services and Programs*](#) provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, [*USC Emergency Information*](#) will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.