

# USC Philosophy

## **PHIL 452: Modal Logic**

Fall 2017—Tue, Thu—12:30 - 1:45 pm

**Location:** [VKC](#) 205

**Instructor:** Gabriel Uzquiano

**Phone:** 213-740-1074

**Office:** STO 221

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

You can book an appointment by following this [link](#).

**E-mail Address:** [uzquiano@usc.edu](mailto:uzquiano@usc.edu)

**Blackboard:** <http://blackboard.usc.edu>

## **Course Description:**

Modal logic extends the language of propositional and predicate logic with modal operators  $\Box$  and  $\Diamond$  designed to capture the logic of certain sentential operators such as ‘it is possible that’ and ‘it is necessary that’. 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 Propositional Modal Logic and Possible Worlds Semantics*

Topics may include the logic of belief and knowledge, tense logic and the logic of conditionals. We will look, in particular, 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. Lecture Notes

Lecture notes will be made available in Blackboard.

### 2. Additional Resources

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

Hughes, G. E. and Cresswell, H. (1996) *A New Introduction to Modal Logic*, Routledge.

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

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* bi-weekly 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 12 at 1pm. You should submit an extended abstract and bibliography by Tuesday, November 28. There is some flexibility as to the nature of the project. It could be 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 philosophy. 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

*What follows is a tentative schedule that is subject to change.*

#### **UNIT 1: PROPOSITIONAL MODAL LOGIC**

Date	Topics	Suggested Readings and Assignments
Tuesday, August 22	<i>Introduction</i>	
Thursday, August 24	<i>Sets, Relations, and Proofs</i>	<i>Open Logic Text, I: Sets, Relations, Functions</i> <i>Open Logic Text VIII: Methods</i>
Tuesday, August 29	<i>Propositional Logic: Syntax and</i>	<i>Logic for Philosophy, Chapter</i>

Thursday, August 31	<i>Semantics</i>  <i>Propositional Logic: Axioms and Proofs</i>	<i>2, sections 2.1 - 2.4</i>  <i>Logic for Philosophy, Chapter 2, sections 2.6 - 2.9</i>  <b><i>Problem Set #1 due</i></b>
Tuesday, September 5	<i>Propositional Logic: Soundness and Completeness</i>	<i>Logic for Philosophy, Chapter 6, sections 6.1 - 6.2</i>
Thursday, September 7	<i>Propositional Logic: The Proof of Completeness</i>	<i>Logic for Philosophy, Chapter 6, section 6.3</i>
Tuesday, September 12	<i>Modal Propositional Logic: Possible Worlds Semantics and the Minimal Modal Propositional Logic</i>	<i>Logic for Philosophy, Chapter 6, section 6.4</i>
Thursday, September 14	<i>Axioms and Proofs in the Minimal Modal Propositional Logic</i>	<i>Logic for Philosophy, Chapter 6, section 6.4</i>  <b><i>Problem Set #2 due</i></b>
Tuesday, September 19	<i>Landscape of Normal Modal Logics I</i>	<i>Logic for Philosophy, Chapter 6, sections 6.5 - 6.6</i>
Thursday, September 21	<i>Landscape of Normal Modal Logics II</i>	
Tuesday, September 26	<i>Canonical Models and Completeness</i>	
Thursday, September 28	<i>Frames</i>	<b><i>Problem Set #3 due</i></b>

***UNIT 2: APPLICATIONS OF PROPOSITIONAL MODAL LOGIC AND POSSIBLE WORLDS  
SEMANTICS***

Tuesday, October 3	<i>Epistemic Logic: Logics of Belief and Knowledge</i>	
Thursday, October 5	<i>The Logic of Provability</i>	
Tuesday, October 10	<i>Modal Epistemic Logic: Fitch's Paradox</i>	
Thursday, October 12	<i>Quantified Propositional Modal Logic: Prior's Theorem and Kaplan's Paradox</i>	<b>Problem Set #4 due</b>
Tuesday, October 17	<i>Indicative and Material Conditionals</i>	
Thursday, October 19	<i>Stalnaker on Indicative and Counterfactual Conditionals</i>	<i>Logic for Philosophy, Chapter 8, sections 8.1 - 8.6</i>
Tuesday, October 24	<i>Lewis on Counterfactual Conditionals</i>	<i>Logic for Philosophy, Chapter 8, sections 8.7 - 8.10</i>
Thursday, October 26	<i>Problems for Possible Worlds Semantics for Counterfactual Conditionals</i>	<b>Problem Set #5 due</b>

### ***UNIT 3: QUANTIFIED MODAL LOGIC AND COUNTERPART THEORY***

Tuesday, October 31	<i>Historical and Philosophical Introduction</i>	<i>Logic for Philosophy, Chapter 9, sections 9.1 - 9.3</i>
Thursday, November 2	<i>The Simplest Quantified Modal Logic: Axioms and Fixed-Domain Models</i>	<i>Logic for Philosophy, Chapter 9, section 9.7</i>
Tuesday, November 7	<i>The Necessity of Identity and Distinctness</i>	<i>Logic for Philosophy, Chapter 9, sections 9.4 - 9.5</i>
Thursday, November 9	<i>Free Quantified Modal Logic: Axioms and Variable Domain Models</i>	<i>Logic for Philosophy, Chapter 9, sections 9.5 - 9.6</i>

		<b><i>Problem Set #6 due</i></b>
Tuesday, November 14	<i>The Barcan and Converse Barcan Formula in Variable Domain Models</i>	<i>Logic for Philosophy, Chapter 9, section 9.6</i>
Thursday, November 16	<i>The Being Constraint</i>	
Tuesday, November 21	<i>The Logic of Actuality and Quantified Modal Logic</i>	
Thursday, November 23	<i>THANKSGIVING BREAK</i>	
Tuesday, November 28	<i>Counterpart Theory and Quantified Modal Logic</i>	<b><i>Extended Abstract and Bibliography for Final Project due</i></b>  <b><i>Problem Set #7 due</i></b>
Thursday, November 30	<i>Final Project Presentations</i>	
Tuesday, December 12	<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 Part B, Section 11, “Behavior Violating University Standards” <https://policy.usc.edu/scampus-part-b/>. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, <http://policy.usc.edu/scientific-misconduct>.

#### Support Systems:

*Student Counseling Services (SCS) - (213) 740-7711 – 24/7 on call*

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

<https://engemannshc.usc.edu/counseling/>

*National Suicide Prevention Lifeline - 1-800-273-8255*

Provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week. <http://www.suicidepreventionlifeline.org>

*Relationship & Sexual Violence Prevention Services (RSVP) - (213) 740-4900 - 24/7 on call*

Free and confidential therapy services, workshops, and training for situations related to gender-based harm. <https://engemannshc.usc.edu/rsvp/>

*Sexual Assault Resource Center*

For more information about how to get help or help a survivor, rights, reporting options, and additional resources, visit the website: <http://sarc.usc.edu/>

*Office of Equity and Diversity (OED)/Title IX compliance – (213) 740-5086*

Works with faculty, staff, visitors, applicants, and students around issues of protected class. <https://equity.usc.edu/>

*Bias Assessment Response and Support*

Incidents of bias, hate crimes and microaggressions need to be reported allowing for appropriate investigation and response. <https://studentaffairs.usc.edu/bias-assessment-response-support/>

*Student Support & Advocacy – (213) 821-4710*

Assists students and families in resolving complex issues adversely affecting their success as a student EX: personal, financial, and academic. <https://studentaffairs.usc.edu/ssa/>

*Diversity at USC – <https://diversity.usc.edu/>*

Tabs for Events, Programs and Training, Task Force (including representatives for each school), Chronology, Participate, Resources for Students.