

PHIL 305: Mathematical Logic
Fall 2019

Instructor: Brian Miller

Email: brianmiller@rice.edu

Office hours: Mondays 3:00-5:00pm in HUM 229

Teaching Assistant: Wai San Ng

Email: wn6@rice.edu

Office hours: Tuesday 3:30-5:30 in Fondren 506

Course Objectives

Students should develop an understanding of formal languages and related concepts, including logical truth, entailment and derivations. They should also develop an understanding of metalinguistic concepts such as soundness, completeness and the method of recursive proof. They should develop an appreciation of both the value and limits of formal languages for analyzing reasoning and natural languages.

Students will demonstrate on examinations the abilities to: evaluate metatheoretical statements and provide proofs or counterexamples, to construct derivations in QD, translate English sentences into QL, to recognize examples of sentences which are difficult to translate, or whose translations are controversial.

Course Materials

There are no required texts to buy – all readings will be provided through Canvas.

Evaluation

- There will be five take-home examinations during the semester. The first exam will count for 16 points and each subsequent exam will count for 21 points.
 - No assistance of any kind is permitted on examinations—no notes, friends, internet, text, etc. If you have questions during an examination, please email both me and the TA.
- The Final is a cumulative **optional** take-home exam and will count for a third of your final grade if you choose to take it. The submission deadline for the optional final exam is the end of our scheduled final exam period (TBA).
 - No assistance of any kind is permitted on the final examination—no notes, friends, internet, text, etc. If you have questions during an examination, please email both me and the TA. You must decide whether to take the final examination before looking it over – once you open the file, you're committed.

- All homework is optional, but it is very strongly recommended that you do appropriate amounts. There will be ten graded. If your average grade on those assignments is greater than your lowest score on one of the first four exams, we will substitute your average homework score for your lowest exam score. (Your last exam score will not be replaced.) Write legibly on all submitted assignments.
 - You may consult notes and the text for graded homework, but all other forms of assistance are forbidden.
- Partial credit will be awarded on homework and exams, but only when the correct answer is given, e.g. when a proof is correct but incomplete. No credit will be given for incorrect answers, even if some of the work leading up to that incorrect answer is correct.
- Homework and take-home exams are to be submitted at the beginning of class on the date specified, unless otherwise noted. Late homework will be docked 10% per day past submission deadline. Late exams will be docked 10% **per hour** past submission deadline.

Grading Scale:

| | | | | | | | | | |
|----|----------|----|----------|----|----------|----|----------|---|-----|
| A+ | 95 – 100 | B+ | 80 – <85 | C+ | 67 – <70 | D+ | 57 – <60 | F | <50 |
| A | 90 – <95 | B | 75 – <80 | C | 64 – <67 | D | 54 – <57 | | |
| A- | 85 – <90 | B- | 70 – <75 | C- | 60 – <64 | D- | 50 – <54 | | |

Attendance Policy

Attendance is required, and you are responsible for all material covered in class.

Rice Honor Code

Rice takes its honor code very seriously. All work completed in this course is subject to the Rice Honor Code pledge, which reads:

On my honor, I have neither given nor received any unauthorized aid on this assignment.

So what's authorized?

- All forms of assistance are permitted on ungraded homework. Collaborative studying is encouraged.
- You may consult notes and the text for graded homework, but all other forms of assistance are forbidden.
- No assistance of any kind is permitted on examinations—no notes, friends, internet, text, etc. If you have questions during an examination, please email both me and the TA.

If you're unclear about any of this, please talk to me about it.

Students with Disabilities

1. Any student with a documented disability seeking academic adjustments or accommodations is requested to speak with me during the first two weeks of class. All discussions will remain as confidential as possible. Students with disabilities will need to contact Disability Support Services in the Allen Center.
2. If you have a documented disability that will impact your work in this class, please contact me to discuss your needs. Additionally, you will need to register with the Disability Support Services Office in the Allen Center.
3. Just as university policy requires me to accommodate all documented disabilities, it prohibits me from accommodating any undocumented disabilities. It also prohibits me from retroactively imposing accommodations. For example, if your disability is first documented halfway through the semester I will not be able to make grade changes or other accommodations for any work completed earlier in the semester. To avoid these issues please be sure to document your disability with Disability Support Services as early as possible.

Syllabus Subject to Change!

This syllabus is subject to change. The course schedule (below) will definitely change. Reasonable notice will be given. Any changes will be announced in class and/ or posted to Canvas.

Phones and The Laptops

You are welcome to use your laptop, tablet or phone to take notes or to consult the day's readings. If you must do other things with your devices — text, email, check Instagram — then please sit in back so that you don't distract the more serious students. If your device usage is disruptive then you will be asked to put that device away or to leave. This policy is subject to change if the presence of devices in class leads to problems.

Course Schedule:

The following schedule will be revised as we go along. Any changes will be announced in class and/or via Canvas. All readings are in Grandy, Barkasi, and Reagan Mathematical Logic, available on Canvas under 'Files'.

| Date | Topic | Reading | Note |
|-------|--|---------------------|---|
| 8/26 | Introduction, Syllabus | | |
| 8/28 | Syntax of SL | 15-21 | |
| 8/30 | Truth, Models, and Logical Truth | 21-31 | Review 12-1pm in HUM 119 |
| 9/2 | No Class | | Labor Day |
| 9/3 | No Class | | Graded HW 1 due. Place in my mailbox in HUM 224B by 10am. |
| 9/4 | Entailment | 31-35 | |
| 9/6 | Recursive Proof | 10-13, 39-44 | Review 12-1pm in HUM 119 |
| 9/9 | Equivalence, Contraries, and Contradictories | 36-39 | Graded HW 2 due |
| 9/11 | More Entailment and Recursive Proof | review 31-44 | |
| 9/13 | Disjunctive Normal Form | 44-51 | Review 12-1pm in HUM 119 |
| 9/16 | Syntax of QL1 (Ch. 3) | 60-66 | Exam 1 due |
| 9/18 | Semantics of QL1 (Ch. 3) | 66-76 | |
| 9/20 | QL1 Truth, Entailment | 77-79, review 66-76 | Review 12-1pm in HUM 119 |
| 9/23 | Equivalence, Contraries, and Contradictories (Ch. 3) | review 66-79 | Graded HW 3 due |
| 9/25 | Syntax of QL (Ch. 4) | 83-86 | |
| 9/27 | Semantics of QL (Ch. 4) | 86-92 | Review 12-1pm in HUM 119 |
| 9/30 | QL Truth, Entailment (Ch. 4) | | Graded HW 4 due |
| 10/2 | QL Translations (Ch. 5) | 105-117 | |
| 10/4 | More Translations (Ch. 5) | 117- 121 | Review 12-1pm in HUM 119 |
| 10/7 | More QL Truth | | Exam 2 due |
| 10/9 | Dragnet Theorem and Applications (Ch. 4) | | |
| 10/11 | More QL Entailment, etc (Ch. 4) | | Review 12-1pm in HUM 119 |

| Date | Topic | Reading | Note |
|-------------|--|----------------|--------------------------|
| 10/14 | No Class | | Midterm Recess |
| 10/16 | SD Derivations/ SD^+ Derivations (Ch. 6) | | Graded HW 5 Due |
| 10/18 | SD Derivations/ SD^+ Derivations (Ch. 6) | | Review 12-1pm in HUM 119 |
| 10/21 | More Derivations | | Graded HW 6 Due |
| 10/23 | Still more Derivations | | |
| 10/25 | No class meeting | | Review 12-1pm in HUM 119 |
| 10/28 | Soundness of SD (Ch. 7) | | Exam 3 Due |
| 10/30 | Completeness of SD (Ch. 7) | | |
| 11/1 | Many Valued Logics (Ch. 8) | | Review 12-1pm in HUM 119 |
| 11/4 | Soundness of QD, Replacement Theorem, Soundness of SD/ QD^+ , and Prenex Normal Form (Ch. 7) | | Graded HW 7 Due |
| 11/6 | Completeness Method (Ch. 7) | | |
| 11/8 | Completeness Models (Ch. 7) | | Review 12-1pm in HUM 119 |
| 11/11 | More Completeness (Ch. 7) | | Graded HW 8 Due |
| 11/13 | Löwenheim-Skolem Theorem and Decision Methods | | |
| 11/15 | Review of the Method, etc (Ch. 7) | | Review 12-1pm in HUM 119 |
| 11/18 | Syntax and Semantics of Modal Logic | | Exam 4 Due |
| 11/20 | Modal Derivations (Ch. 8) | | |
| 11/22 | Syntax of QLI, Truth and Translations (Ch. 8) | | Review 12-1pm in HUM 119 |
| 11/25 | QDI Derivations (Ch. 8) | | Graded HW 9 Due |
| 11/27 | Review of Modality and Identity | | |
| 11/29 | No Class | | Thanksgiving Holiday |
| 12/2 | Course Review and Glimpses Beyond | | Graded HW 10 due |
| 12/4 | Course Review and Glimpses Beyond | | |
| 12/6 | Preview of Optional Final | | Exam 5 Due |