

PHIL 155.002 - Truth and Proof: Introduction to Mathematical Logic

1 | Course Overview

Number	PHIL 155.002
Title	Truth and Proof: Introduction to Mathematical Logic
Credit hours	3
Course Description	Mathematical logic is an important tool for analyzing arguments and different patterns of reasoning. In this course, we will work toward proficiency in wielding this tool so that we may better understand when and why an argument or pattern of reasoning is good or bad. Developing this proficiency will involve learning the language of different formal systems, practicing translating arguments into these systems, and learning the methods by which we can evaluate these translated arguments. Rules and Requirements: IDEAS in Action Gen Ed: FC-QUANT Making Connections Gen Ed: QR Grading Status: Letter Grade
Prerequisites	None
Target Audience	Philosophy majors/minors and all undergraduates interested in the topic
Instructor	Name: Jackson LeViness Office: 107B Caldwell Hall Email: jdlev@unc.edu
Class Time/Location	MWF 8:00 – 8:50am 105 Caldwell Hall
Office Hours	MW 9:00 – 10:30am Students may email to request an appointment.
Course Texts	Any required readings will be made available on Sakai.
Course Format	The course format will include three weekly lectures in class. The lectures will be supplemented with in-class problems to solve and collaborative work which you will present to the class.

2 | Course Goals and Learning Objectives

All our philosophy courses aim at the acquisition and nurturing of basic philosophic skills. One of the main goals of our philosophy curriculum is to instill and enable the development of skills that are distinct to philosophy, but which are foundational to all forms of knowledge.

These **basic philosophical skills** involve being able to:

- Think critically;
- Deploy philosophical concepts and terminology correctly, in either a historical or contemporary setting;
- Represent clearly and accurately the views or argument of particular philosophers, in either a historical or contemporary setting;
- Identify the premises and conclusion(s) of a philosophical argument and assess both its validity and soundness;
- Apply a philosophical theory or argument to a new topic, and being able to draw and defend reasonable conclusions about that topic;
- Develop an argument for a particular solution to a philosophical problem in either a historical or contemporary setting;
- Write clearly, precisely, and persuasively in defense of a philosophical thesis;
- Participate in respectful, critical, and reflexive dialogues about difficult philosophical positions;
- Read, interpret, and evaluate the strengths and weaknesses of different philosophical texts and the philosophical positions presented them.

Specifically, this course will enable students to:

- Analyze sentences and arguments for logical features, such as validity, equivalence, and logical truth
- Translate between English and the formal language of mathematical logic
- Understand the theory of mathematical proof, including proof techniques such as proof by cases, contraposition, reductio ad absurdum and reasoning with arbitrary objects.
- Test the validity of arguments and to produce formal proofs in a natural deduction system
- Develop counterexamples
- Produce and interpret truth-tables
- Apply the truth functional form algorithm
- Work with formal systems
- Create, evaluate, and manipulate formal models, truth tables and proofs.
- Figure out when and how to apply the methods we will be studying in the evaluation of real-life cases.

In addition, this course satisfies our logic and philosophy of science requirement for the philosophy major and minor and thereby aims at developing the following learning outcomes:

- Think more critically and systematically about the sciences and the knowledge they produce, about the scientific status of knowledge produced by the sciences and its relation to biology and physics; about the methods that scientists use to produce knowledge about the world and discover facts; about the way they confirm scientific hypotheses by empirical science; and about the role that values play in science.

- Be able to evaluate scientific claims to knowledge as a distinct form of knowledge as opposed to other forms of knowledge and also to evaluate the strengths and weaknesses of the sciences at providing knowledge to human societies including societies in which people see the world in unfamiliar ways;
- Competently deploy key philosophical concepts that relate to science, knowledge, evidence and rationality, and master a vocabulary and conceptual framework to express their ideas about these topics in a more sophisticated manner.
- Employ strategies to mitigate or adjust for preconceptions and biases and to address the challenges posed by skepticism and relativism, especially concerning scientific facts.
- Begin to develop the skills of reading and writing philosophy, with a focus on reading and interpreting charitably and empathetically, and on developing the ability to write persuasively, clearly, and precisely.
- Become competent with the basics of formal argument reconstruction.
- Be prepared for further philosophical study, as well as to be equipped with philosophical underpinnings for classes in related disciplines, and especially the sciences.”

This course is part of the IDEAs in Action General Education curriculum. It satisfies the Quantitative Reasoning requirement.

- Learning Outcomes – These are the learning outcomes that are expected of students after completing a course:
 - 1) Summarize, interpret, and present quantitative data in mathematical forms, such as graphs, diagrams, tables, or mathematical text.
 - 2) Develop or compute representations of data using mathematical forms or equations as models, and use statistical methods to assess their validity.
 - 3) Make and evaluate important assumptions in the estimation, modeling, and analysis of data, and recognize the limitations of the results.
 - 4) Apply mathematical concepts, data, procedures, and solutions to make judgments and draw conclusions.
 - 5) Synthesize and present quantitative data to others to explain findings or to provide quantitative evidence in support of a position.
- Questions for Students – These are the types of questions you should be able to answer after completing a course:
 - 1) What is the role of mathematics in organizing and interpreting measurements of the world?
 - 2) How can mathematical models and quantitative analysis be used to summarize or synthesize data into knowledge and predictions?
 - 3) What methodology can we apply to validate or reject mathematical models or to express our degree of confidence in them?
- Recurring Capacities – Every focus capacity course includes the following activities:
 - Writing, totaling at least 10 pages in length or the intellectual equivalent
 - Presenting material to the class, smaller groups, or the public through oral presentations, webpages, or other means.
 - Collaborating in pairs or groups to learn, design, solve, create, build, or research.

3 | Assignments and Exams

The typical amount of time required to complete work for this course will be 7-10 hours weekly including class/synchronous activities.

Participation 10%

During many classes, you will be given the opportunity to practice the material from the lecture and present your results to the class. Class participation will include both individual and collaborative activities.

Problem Sets 25%

The eight problem sets, each worth approximately two pages of writing, satisfy the university's ten-page writing requirement for this course. These homework assignments will cover the topics from the corresponding week's lectures. Students are expected to show their work.

Usually, the problem sets will be due by Monday at 7:45am. Please reference the schedule for exceptions. You must submit your work as an attachment in the "Assignments" section of the Sakai page.

Late Policy: The homework assignments are due before class so that we can review the questions while they are still fresh in our memories. Because of this, late submissions/grades are not permitted unless you have a valid reason (supported by the Dean of Students), in which case I will provide you with an alternative assignment.

Exams 45%

The three exams (excluding the final), each worth 15%, will take place in class and are designed to take no more than 50 minutes. Prior to each exam, we will spend time in class reviewing the relevant material.

Final Exam 20%

The final exam will take place at 8am on Tuesday, May 2nd.

Extra Credit

The four exam review sheets serve as *optional* extra credit assignments. Each review sheet is worth up to two points added to your semester grade, for a total of eight points. These assignments are graded according to accuracy rather than completeness.

Grading Scale

The final letter grade of this class is determined by your percentage grade as follows:

A (93-100), A- (90-92), B+ (87-89), B (83-86), B- (80-82), C+ (77-79), C (73-76), C- (70-72), D+ (67-69), D (63-66), F (below 60).

4 | Schedule

The instructor reserves the right to make changes to the syllabus, including homework and exam due dates. These changes will be announced as early as possible.

Week 1

<u>Date</u>	<u>Topic</u>	<u>Assignment</u>
M Jan 9	Course Introduction	
W Jan 11	Arguments (Standard Form)	
F Jan 13	Validity and Soundness	

Week 2

M Jan 16	NO CLASS	
W Jan 18	Begin Sentential Logic	
F Jan 20	Well-Formed Formulas	

Week 3

M Jan 23	Translations ($\&$, $\vee$)	
W Jan 25	Translations ($\sim$)	Problem Set 1 Due
F Jan 27	Translations ($\rightarrow$ and $\leftrightarrow$)	

Week 4

M Jan 30	Translations (All)	Problem Set 2 Due
W Feb 1	Translations (Arguments)	
F Feb 3	Exam #1 Review	Extra Credit 1 Due

Week 5

M Feb 6	Exam #1	
W Feb 8	Truth Tables	
F Feb 10	...continued	

Week 6

M Feb 13	NO CLASS	
W Feb 15	Implication & Equivalence	Problem Set 3 Due
F Feb 17	Validity	

Week 7

M Feb 20	Validity	Problem Set 4 Due
W Feb 22	Validity	
F Feb 24	Exam #2 Review	Extra Credit 2 Due

Week 8

M Feb 27	Exam #2	
W Mar 1	Derivations	
F Mar 3	Derivations	

Week 9

M Mar 6	Derivations	
W Mar 8	Derivations	Problem Set 5 Due
F Mar 10	Derivations	

Week 10

SPRING BREAK

Week 11

M Mar 20	Derivations	
W Mar 22	Derivations	
F Mar 24	NO CLASS (Cancelled)	

Week 12

M Mar 27	Derivations	
W Mar 29	Derivations	Problem Set 6 Due
F Mar 31	Derivations	

Week 13

M Apr 3	Derivations	
W Apr 5	Exam #3 Review	Extra Credit 3 Due
F Apr 7	NO CLASS	

Week 14

M Apr 10	Exam #3	
W Apr 12	Begin Predicate Logic	
F Apr 14	Translations (Quantifiers)	

Week 15

M Apr 17	Derivations	Problem Set 7 Due
W Apr 19	Derivations	
F Apr 21	Derivations	

Week 16

M Apr 24	Derivations	Problem Set 8 Due
W Apr 26	Derivations	
F Apr 28	Final Exam Review	Extra Credit 4 Due

FINAL EXAM: Tuesday, May 2nd from 8:00 – 11:00am.

5| Policies and Resources

Attendance Policy

University Policy: As stated in the University's [Class Attendance Policy](#), no right or privilege exists that permits a student to be absent from any class meetings, except for these University Approved Absences:

1. Authorized University activities
2. Disability/religious observance/pregnancy, as required by law and approved by [Accessibility Resources and Service](#) and/or the [Equal Opportunity and Compliance Office](#) (EOC)
3. Significant health condition and/or personal/family emergency as approved by the [Office of the Dean of Students](#), [Gender Violence Service Coordinators](#), and/or the [Equal Opportunity and Compliance Office](#) (EOC).

Class Policy: Instructors may work with students to meet attendance needs that do not fall within University approved absences. For situations when an absence is not University approved (e.g., a job interview or club activity), instructors determine their own approach to missed classes and make-up assessment and assignments.

University Approved Absence Office (UAAO): The [UAAO](#) website provides information and FAQs for students and faculty related to University Approved Absences.

Note: Instructors have the authority to make academic adjustments without official notice from the UAAO. In other words, it is not required for instructors to receive a University Approved Absence notification in order to work with a student. In fact, instructors are encouraged to work directly with students when possible.

Honor Code

All students are expected to follow the guidelines of the UNC Honor Code. In particular, students are expected to refrain from “lying, cheating, or stealing” in the academic context. If you are unsure about which actions violate the Honor Code, please see me or consult studentconduct.unc.edu.

Acceptable Use Policy

By attending the University of North Carolina at Chapel Hill, you agree to abide by the University of North Carolina at Chapel Hill policies related to the acceptable use of IT systems and services. The Acceptable Use Policy (AUP) sets the expectation that you will use the University's technology resources responsibly, consistent with the University's mission. In the context of a class, it's quite likely you will participate in online activities that could include personal information about you or your peers, and the AUP addresses your obligations to protect the privacy of class participants. In addition, the AUP addresses matters of others' intellectual property, including copyright. These are only a couple of typical examples, so you should consult the full [Information Technology Acceptable Use Policy](#), which covers topics related to using digital resources, such as privacy, confidentiality, and intellectual property.

Additionally, consult the [Safe Computing at UNC](#) website for information about data security policies, updates, and tips on keeping your identity, information, and devices safe.

Accessibility Resources and Service

The University of North Carolina at Chapel Hill facilitates the implementation of reasonable accommodations, including resources and services, for students with a disability and/or a chronic health diagnosis resulting in barriers to fully accessing University courses, programs and activities.

Accommodations are determined by the Office of Accessibility Resources and Service (ARS) through their Student and Applicant Accommodations Policy, which documents qualifying disabilities in accordance with applicable state and federal laws. See the ARS website (<https://ars.unc.edu>) for contact information or email ars@unc.edu.

Counseling and Psychological Services

UNC-Chapel Hill is strongly committed to addressing the mental health needs of a diverse student body. The [Heels Care Network](#) website is a place to access the many mental health resources at Carolina. CAPS is the primary mental health provider for students, offering timely access to consultation and connection to clinically appropriate services. Go to their website <https://caps.unc.edu/> or visit their facilities on the third floor of the Campus Health building for an initial evaluation to learn more. Students can also call CAPS 24/7 at 919-966-3658 for immediate assistance.

Title IX and Related Resources

Any student who is impacted by discrimination, harassment, interpersonal (relationship) violence, sexual violence, sexual exploitation, or stalking is encouraged to seek resources on campus or in the community. Reports can be made online to the EOC at <https://eoc.unc.edu/report-an-incident/>. Please contact the University's Title IX Coordinator (Elizabeth Hall, titleixcoordinator@unc.edu), Report and Response Coordinators in the Equal Opportunity and Compliance Office (reportandresponse@unc.edu), Counseling and Psychological Services (confidential), or the Gender Violence Services Coordinators (gvsc@unc.edu; confidential) to discuss your specific needs. Additional resources are available at safe.unc.edu.

Policy on Non-Discrimination

The University is committed to providing an inclusive and welcoming environment for all members of our community and to ensuring that educational and employment decisions are based on individuals' abilities and qualifications. Consistent with this principle and applicable laws, the University's [Policy Statement on Non-Discrimination](#) offers access to its educational programs and activities as well as employment terms and conditions without respect to race, color, gender, national origin, age, religion, genetic information, disability, veteran's status, sexual orientation, gender identity or gender expression. Such a policy ensures that only relevant factors are considered, and that equitable and consistent standards of conduct and performance are applied.

If you are experiencing harassment or discrimination, you can seek assistance and file a report through the Report and Response Coordinators (see contact info at safe.unc.edu) or the Equal Opportunity and Compliance Office at <https://coc.unc.edu/report-an-incident/>.

Diversity Statement

I value the perspectives of individuals from all backgrounds reflecting the diversity of our students. I broadly define diversity to include race, gender identity, national origin, ethnicity, religion, social class, age, sexual orientation, political background, and physical and learning ability. I strive to make this classroom an inclusive space for all students. Please let me know if there is anything I can do to improve. I appreciate any suggestions.

Undergraduate Testing Center

The College of Arts and Sciences provides a secure, proctored environment in which exams can be taken. The center works with instructors to proctor exams for their undergraduate students who are not registered with ARS and who do not need testing accommodations as provided by ARS. In other words, the Center provides a proctored testing environment for students who are unable to take an exam at the normally scheduled time (with pre-arrangement by your instructor). For more information, visit <http://testingcenter.web.unc.edu/>.

Learning Center

Want to get the most out of this course or others this semester? Visit UNC's Learning Center at <http://learningcenter.unc.edu> to make an appointment or register for an event. Their free, popular programs will help you optimize your academic performance. Try academic coaching, peer tutoring, STEM support, ADHD/LD services, workshops and study camps, or review tips and tools available on the website.

Writing Center

For free feedback on any course writing projects, check out UNC's Writing Center. Writing Center coaches can assist with any writing project, including multimedia projects and application essays, at any stage of the writing process. You don't even need a draft to come visit. To schedule a 45-minute appointment, review quick tips, or request written feedback online, visit <http://writingcenter.unc.edu>.

Grade Appeal Process

If you feel you have been awarded an incorrect grade, please discuss with me. If we cannot resolve the issue, you may talk to our departmental director of undergraduate studies or appeal the grade through a formal university process based on arithmetic/clerical error, arbitrariness, discrimination, harassment, or personal malice. To learn more, go to the [Academic Advising Program](#) website.