PHIL 240
Introduction to Formal Logic

Class Schedule

Course	Meet Days	Meet Time	Location	Instructor(s)
PHIL 240 001 [LEC]	**Tue, Thu** *Sep 3 - Dec 2*	10:00AM - 11:20AM	HH 150	Patricia Marino pmarino@uwaterloo.ca

schedule data automatically refreshed daily

Instructional Team

Instructor: Patricia Marino (she/her or they/them). Office: HH 329. Office Hours: Wednesdays 1:30-2:30 and by appointment. Email: pmarino@uwaterloo.ca

Teaching Assistant (TA): Ashar Khan (he/him). TA Office: HH360. TA Office Hours TBA: TA Email: ashar.khan@uwaterloo.ca

Course Description

Calendar Description for PHIL 240

An examination of classical propositional logic, covering proof methods, expressive completeness, soundness, and completeness. Also an introduction to quantificational logic.

View requirements for PHIL 240 [1]

This course is intended as a first course in formal logic. We will consider both "sentential logic" (SL, aka "propositional logic") logic and "quantified logic" (QL, aka "predicate logic" or "first-order logic). For both systems, we will discuss syntax (what makes a formal string of symbols a well-formed formula), semantics (what it means to say that a formal statement is true) and proof systems (what methods may be used to derive some sentences from others). One main objective is to become proficient at basic formal reasoning involving sentential logic and quantified logic. Students will also learn what it means to say that an argument is valid (if the premises an argument are true, the conclusion has to be true), what it means to say that an argument's conclusion is from its premises in a given system, and what the relationship is between these for SL and QL.

Learning Outcomes

By the end of this course students should be able to...

understand and explain core concepts of formal logic such as validity, soundness, and consistency.
use techniques of logic such as truth-tables and deduction proof systems.
work effectively in both sentential and quantified logic by, for instance, constructing proofs and counterexamples.

Tentative Class Plan

Week 0 Introduction.

- Thur Sept 4: Introduction to course.

Week 1: Intro and basics of sentential logic (SL, also known as propositional logic). We will discuss the nature of formal logic, define basic concepts such as tautology, contradiction, and contingent sentence, and introduce the basic logical connectives via truth-tables.

- Tue Sept 9: What is logic? And some basic concepts, pp. 5-14.

- Thur Sept 11: Sentences, connectives, and truth tables, pp 16-28.

- **Friday Sept 12: HW0: hand in student information sheet to Learn Dropbox.**

Week 2: WFFs and truth-tables for sentential logic. We will define, syntactically, what constitutes a "well-formed formula" in SL, then learn how to evaluate the truth-values of WFFs using truth-tables.

- Tue Sept 16: WFFs and more truth tables, pp. 28-31 and 35-38.

- Thur Sept 18: Using truth tables to evaluate sentential WFFs, pp 39-40.

- **Fri Sept 19: HW1 on content up to end of Thur Sept 11 reading**

Week 3: Proofs in sentential logic. We will introduce and study the inferences rules for proofs in SL.

- Tue Sept 23: Natural deduction for sentential logic, pp. 102-111.

- Thur Sept 25: More on natural deduction for sentential logic, pp. 102-111.

- **Fri Sept 26: HW2 on content up to end of Thur Sept 18 reading**

Week 4: The relationship between truth-tables and proofs in sentential logic. We will introduce what it means for a sentence to be "true" in SL then consider the relationship between truth and provability in SL.

- Tue Sept 30: More natural deduction and derived rules, pp. 112-115.

- Thur Oct 2: Interpretations, truth value assignments, and truth in SL, pp. 79-84.

- **In-class quiz on content up to end of Thur Sept 25.**

Week 5: Finish relationship for SL from week 4 and begin basics of quantified logic (QL, also known as predicate logic or "first order logic" (FOL)). We will discuss basics for QL.

- Tue Oct 7: The relationship between truth tables and proofs in SL, pp. 124 and 126-127.

- Thur Oct 9: Elements of QL part 1: predicates, names, and variables, pp. 46-51.

- **Fri Oct 10: HW3 on content up to end of Oct 2.**

READING WEEK

Week 6: Review and midterm

- Tue Oct 21: REVIEW session for midterm.

- **Thur Oct 23: In-class midterm test**

Week 7: WFFs in QL and semantics for quantified logic. We will begin to study what it means for a sentence to be true in QL by introducing the concepts of interpretations and models.

- Tue Oct 28: Elements of QL part 2: quantifiers and WFFs in QL, pp. 52-54 and 66-72.

- Thur Oct 30 Semantics for QL: interpretations and models, pp. 84-89.

- **Friday Oct 31: HW4 on content up to end of Tue Oct 21.**

Week 8: Models, interpretations, and truth in quantified logic. We will conclude our study of what it means for a sentence to be true in QL and begin to learn the inference rules for proofs in QL.

- Tue Nov 4: Interpretations, models and truth in QL, pp. 89-98.

- Thur Nov 6: More on interpretations, models, and truth in QL pp. 89-98.

- **Friday Nov 7: HW5 on content up to end of Thur Oct 30.**

Week 9: Proofs in quantified logic. We will further discuss proofs in QL and practice with examples.

* Tue Nov 11: Proofs in QL and rules for quantifiers pp. 115-122.

* Thur Nov 13: second in-class quiz no further content for this day.

* Second in-class quiz on content up to end of Thur Nov 6.

Week 10: More on proofs and revisiting soundness and completeness.

* Tue Nov 18: More on proofs in QL and rules for quantifiers pp. 115-122.

* Thur Nov 20: Proof strategies and practice with proofs, pp. 122-123; soundness and completeness of QL revisit pp. 124-127.

* Friday Nov 21: HW6 on content up to end of Thur Nov 13.

Week 11: Philosophy: the justification of the laws of logic and the significance of Gödel's Incompleteness Theorem

* Tue Nov 25: Reading: Russell, Gillian. "The justification of the basic laws of logic." *Journal of Philosophical Logic* 44, no. 6 (2015): 793-803.

* Thur Nov 27: Reading: Feferman, Solomon. "The nature and significance of Gödel's incompleteness theorems." Princeton, Institute for Advanced Study, Gödel Centenary Program 17 (2006).

* Friday Nov 28 HW6 on content up to end of Thur Nov 20.

Week 12: Review and Q and A

* Tue Dec 2 review

Required Materials & Technologies

Note: Any prices provided in course outlines are best estimates based on recent online prices and do not include shipping or taxes. Prices may vary between retailers.

> This course has **no additional costs** for students.

Readings

There is one required textbook which is open-source and posted on Learn. There may be required articles for reading which will be available to students free through their library access.

Assessments & Activities

Component / Activity	Date or Due Date	Location / Submission Method	Weight (%)
first in-class quiz	Thursday October 2	in-person	15
second in-class quiz	Thursday November 13	in-person	15
midterm test	Thursday October 23	in-person	20
Best five of six HWs	Various Fridays; see course plan	Learn	25
Final Exam	TBA	in-person	25

There are two in-class quizzes, one midterm test, HW assigments, and a final exam. There are 6 HW assignments and your HW grade will be the average of your best 5 HW submissions.

NOTE: in addition to this outline, there is also a course information sheet for this class -- please read it carefully. I will use Learn for announcements so please check it at least once per day.

Late / Missed Content

For HW assignments, there is a three-point penalty per day of lateness up to three days late (end of Monday for HW due Fri). After three days, the grade on a late assignment is zero. If you experience illness or need accommodations, let me know and we can work out a suitable plan.

Assignment Screening

There is no assignment screening. But do not use GenAI to complete the HW assignments. If you do, you will not learn the content you need to learn to pass the quizzes, midterm, and final.

Generative AI

This course includes the independent development and practice of specific skills, such as producing truth-tables, producing proofs, and evaluating arguments. Therefore, the use of Generative artificial intelligence (GenAI) trained using large language models (LLM) or other methods to produce text, images, music, or code, like Chat GPT, DALL-E, or GitHub CoPilot, **is not permitted** in this class. Unauthorized use in this course, such as running course materials through GenAI or using GenAI to complete a course assessment is considered a violation of Policy 71 [2] (plagiarism or unauthorized aids or assistance). Work produced with the assistance of AI tools does not represent the author's original work and is therefore in violation of the fundamental values of academic integrity including honesty, trust, respect, fairness, responsibility and courage (ICAI [3], n.d.).

You should be prepared to show your work. To demonstrate your learning, you should keep your rough notes, including sources, research notes, brainstorming, drafting notes and prompts. You may be asked to submit these notes along with earlier drafts of your work, either through saved drafts or saved versions of a document. If the use of GenAI is suspected where not permitted, you may be asked to meet with your instructor or TA to provide explanations to support the submitted material as being your original work. If you cannot sufficiently support your work, academic misconduct allegations may be brought to the Associate Dean.

In addition, you should be aware that the legal/copyright status of generative AI inputs and outputs is unclear. More information is available from the Copyright Advisory Committee. [4]

Students are encouraged to reach out to campus supports if they need help with their coursework including:

- Student Success Office [5] for help with skills like notetaking and time management

- Writing and Communication Centre [6] for assignments with writing or presentations

- AccessAbility Services [7] for documented accommodations

- Library [8] for research-based assignments

Administrative Policy

Pronouns and chosen or preferred first name

Students can verify their chosen or preferred first name by logging into WatIAM [9]. Your chosen or preferred first name listed in WatIAM will be used across campus (e.g., in LEARN, Quest, WaterlooWorks, WatCard, etc). Your legal first name will always be used on certain official documents, such as diplomas and transcripts.

Students can view and change their pronouns in Quest [10]. Should you choose to include your pronouns in Quest, your pronouns will be accessible by instructors, advisors, and employees with access to Quest. If no pronoun is added, the field in Quest will remain blank. The University is working to provide your pronouns to other systems across campus (e.g., LEARN, WaterlooWorks).

Accommodating religious and spiritual observances

[Applies only to students taking undergraduate courses]

The University of Waterloo has a duty to accommodate religious, spiritual, and other creed-based beliefs and practices [11] under the Ontario Human Rights Commission (2015) *Policy on preventing discrimination based on creed* [12]. Students may seek accommodations for missed course components on religious, spiritual, or other creed grounds. In such cases the students should please consult the instructor within two weeks of the announcement of the due date for which the accommodation is being sought. Students also may request accommodations for temporary absences from classes or other course-related activities to engage in prayer or other daily spiritual practices. Instructors are expected to make reasonable arrangements to respectfully accommodate such requests. The University of Waterloo has a number of multi-faith spaces [13] that students can use for faith-based practices.

Declaring absences

[Applies only to students taking undergraduate courses]

Please see the Academic Regulations [14] section of the Undergraduate Calendar for more details. Regardless of the process used to declare an absence, it is the student's responsibility to contact their instructor so that the instructor can determine how to accommodate the missed work.

Absences due to religious, creed, and spiritual observances

Beginning Fall 2024, students can submit a Religious Observance Self-Declaration Form in Quest. This form allows the student to register dates of potential conflicts with coursework. Students are expected to record their absence within two weeks of announcement of the due date or scheduled examination date for which academic accommodation is being sought. Submission through Quest will notify your instructors of your absence.

Absences due to verified illness

For absences due to illness that are not pandemic-related, students need to obtain a Verification of Illness or Extenuating Circumstances Process [15]. Submission through the Absence Verification System [16], once registered, will notify your instructors of your absence. Students should not submit their VIF or any other medical documentation to your instructors, teaching assistants, or other course personnel. To request and arrange accommodations, it is the student's responsibility to contact the instructor within 48 hours of the date of any missed course component, or as soon as the student is able to given their health condition.

Absences due to extenuating circumstances (e.g., bereavement)

For absences due to extenuating circumstances (e.g., bereavement, serious family illness), students submit a request for absence due to extenuating circumstances [17] to the Absence Verification System [18] for processing. Students use the form to submit supporting documentation, which will be considered in a comparable manner to a VIF. Official documentation is necessary before any action can be taken. Examples are plane/train/bus tickets, court documents, police reports, death certificates/obituaries/letters from funeral directors. To request and arrange accommodations, it is the student's responsibility to contact the instructor within 48 hours of the date of any missed course component, or as soon as the student is able to given their circumstances.

Self-declared short-term absences for any reason

Students can self-declare [19] one short-term absence per term on Quest for any reason. A short-term absence covers two calendar days, and no documentation is required. The student has only one self-declared short-term absence per term and this absence can only be used during the formal lecture period. Self-declared absences cannot be applied to Laboratory (LAB), Clinic (CLN), or Studio (STU) course components. Submitting the self-declaration through Quest will notify your instructors of your absence. It is the student's responsibility to contact their instructors within the first 24 hours after submitting their self-declaration to discuss accommodations for missed course components.

Recording lecture

Use of recording devices during lectures is only allowed with explicit permission of the instructor of the course. If allowed, video recordings may only include images of the instructor and not fellow classmates. Posting of videos or links to the video to any website, including but not limited to social media sites such as: Facebook, Twitter, etc., is strictly prohibited.

University Policy

Mental Health: At the University of Waterloo, we are dedicated to supporting your mental and emotional well-being. Our Counselling Services offer confidential support, including individual counselling, workshops, and crisis intervention.

If you're struggling, please reach out for help at 519-888-4096 or visit their website [20] for more information.

Academic integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. [Check the Office of Academic Integrity [21] for more information.]

Grievance: A student who believes that a decision affecting some aspect of their university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4 [22]. When in doubt, please be certain to contact the department's administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity to avoid committing an academic offence, and to take responsibility for their actions. [Check the Office of Academic Integrity [23] for more information.] A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course instructor, academic advisor, or the

undergraduate associate dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline [24]. For typical penalties, check Guidelines for the Assessment of Penalties [25].

Appeals: A decision made or penalty imposed under Policy 70, Student Petitions and Grievances [26] (other than a petition) or Policy 71, Student Discipline [27] may be appealed if there is a ground. A student who believes they have a ground for an appeal should refer to Policy 72, Student Appeals [28].

Note for students with disabilities and disabling conditions: The University of Waterloo recognizes its obligations under the Ontario Human Rights Code to accommodate students with known or suspected disabilities and disabling conditions (e.g. medical conditions, injuries, impacts of trauma such as from violence or discrimination) to the point of undue hardship. To support this obligation, AccessAbility Services [29] (AAS) collaborates with all academic departments and schools to facilitate academic accommodations for students with disabilities and disabling conditions without compromising the academic integrity of the curriculum. If you believe you may require academic accommodations (e.g., testing accommodations, classroom accommodations), register with AAS as early in the term as possible by completing the online application [30]. Students already registered with AAS must activate their accommodations for each of their courses at the beginning of each term using AAS' online system. If you require assistance, contact AAS by phone (519-888-4567 ext. 35082), email (access@uwaterloo.ca) or in-person (Needles Hall North, 1st Floor, Room 1401).

Turnitin.com: Text matching software (Turnitin®) may be used to screen assignments in this course. Turnitin® is used to verify that all materials and sources in assignments are documented. Students' submissions are stored on a U.S. server, therefore students must be given an alternative (e.g., scaffolded assignment or annotated bibliography), if they are concerned about their privacy and/or security. Students will be given due notice, in the first week of the term and/or at the time assignment details are provided, about arrangements and alternatives for the use of Turnitin in this course.

It is the responsibility of the student to notify the instructor if they, in the first week of term or at the time assignment details are provided, wish to submit alternate assignment.

Reference: Links from Document

1. https://acal.fast.uwaterloo.ca/course/1259/PHIL/240
2. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71
3. https://academicintegrity.org/images/pdfs/20019_ICAI-Fundamental-Values_R12.pdf
4. https://uwaterloo.ca/copyright-at-waterloo/teaching/generative-artificial-intelligence
5. https://uwaterloo.ca/student-success/resources
6. https://uwaterloo.ca/writing-and-communication-centre/services-0/services-undergraduate-students
7. https://uwaterloo.ca/accessability-services/students
8. https://uwaterloo.ca/library/research-supports/quick-start-guide
9. https://idm.uwaterloo.ca/watiam/
10. https://uwaterloo.ca/quest/help/students/how-do-i/view-or-update-my-personal-information
11. https://ugradcalendar.uwaterloo.ca/page/Acad-Regs-Accommodations
12. https://www.ohrc.on.ca/en/policy-preventing-discrimination-based-creed
13. https://uwaterloo.ca/multi-faith-spirituality-resource-team/multi-faith-spaces-campus
14. https://uwaterloo.ca/academic-calendar/undergraduate-studies/catalog#/policy/SkiPsB9Vp?
    bc=true&bcCurrent=Assessments%3A%20Academic%20Considerations%20and%20Accommodations&bcGroup=Academic%20Regulations&bcItemType=policies
15. https://uwaterloo.ca/arts/undergraduate/student-support/accommodations-illness-or-extenuating-circumstances#submit-other
16. https://vif.uwaterloo.ca/
17. https://uwaterloo.ca/arts/undergraduate/student-support/accommodations-illness-or-extenuating-circumstances#submit-other
18. https://vif.uwaterloo.ca/
19. https://uwaterloo.ca/quest/help/students/how-do-i/self-declare-absence-undergraduate-students
20. https://uwaterloo.ca/students/health-and-well-being/counselling-appointments
21. https://uwaterloo.ca/academic-integrity/
22. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70
23. https://uwaterloo.ca/academic-integrity/
24. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71
25. https://uwaterloo.ca/secretariat/guidelines/guidelines-assessment-penalties
26. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70
27. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71
28. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-72
29. https://uwaterloo.ca/accessability-services/
30. https://uwaterloo.ca/accessability-services/students/applying-academic-accommodations/documentation-information-forms