UNIVERSITY OF WATERLOO

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PHIL 257 Winter 2026
Philosophy of Mathematics
Section 001

Class Schedule

Course	Meet Days	Meet Time	Location	Instructor(s)
PHIL 257 001 [LEC]	**Tue, Thu** *Jan 5 - Apr 6*	10:00AM - 11:20AM	MC 4064	Patricia Marino pmarino@uwaterloo.ca

schedule data automatically refreshed daily

Instructional Team

Instructor: Patricia Marino

Office: HH 329

Office Hours: Tuesdays 3:30-4:30, Thursdays 1:00-2:00, and by appointment. Subject to change to check Learn for announcements.

Email: pmarino@uwaterloo.ca

Course Description

> Calendar Description for PHIL 257
>
> An introduction to philosophical problems concerning mathematics. Topics may include: what makes mathematical statements true (e.g., do numbers exist?); whether mathematics is a human creation or something we discover; what counts as a proof; mathematical paradoxes; the relationship between mathematics and other sciences; and mathematical pluralism.
>
> View requirements for PHIL 257 [1]

Philosophy of mathematics considers questions about mathematical truth, knowledge, methods, and applications. In this course we will consider a range of perspectives on the question of what makes mathematical statements true and knowable: do mathematical objects exist in a mind-independent realm, are they creations of the human mind, or is mathematics just the study of what conclusions follow from various assumptions? We will then consider what the role of mathematics in science tells us about mathematical truth and mathematics itself. In the latter part of the course, we will consider a range of questions such as whether there is one true logic, what makes a proof a proof, whether mathematics could be fundamentally different from what it is, and topics in machine learning and the use of data in scientific reasoning. By engaging with readings, lectures, and class discussions, students in this course will learn why these questions have sparked a wide range of answers. Students will learn to formulate their own ideas about these questions and will learn to communicate those ideas orally and in writing.

Learning Outcomes

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

give examples of disputed topics in mathematics and philosophy of mathematics
analyze and critically evaluate divergent views in mathematical foundations and practice
develop and express their own views about mathematics and philosophy of mathematics
effectively communicate their ideas about philosophy of mathematics orally and in writing

Tentative Class Plan

Schedule is subject to change; check LEARN regularly and if there are topics you are hoping to discuss do let me know.

Week 1: Introduction and context for philosophy of mathematics: what are the questions?

- Jan 6: Introduction to the course; no reading.

- Jan 8: Selections from John Stillwell *Roads to Infinity: The Mathematics of Truth and Proof*. CRC Press, 2010; 1-12, 16-27 and 29-41 (but as always, use the study questions to focus just on specific ideas). We will also discuss historical context for philosophy of mathematics.

Week 2: Hilbert's formalism and the implications of Gödel's Incompleteness Theorem: is (part of) mathematics symbol manipulation?

- Jan 13: David Hilbert, "On the Infinite," from Benacerraf and Putnam, Philosophy of Mathematics, Selected Readings, 2nd edition (Cambridge University Press, 1984) pp. 183-200, this translates the originally published 1926 article "Über das Unendliche," Mathematische Annalen, 95: 161-90.

- Jan 15: Solomon Feferman, "The Nature and Significance of Gödel's Incompleteness Theorems."

- Optional: SEP entry on https://plato.stanford.edu/ent... [2] ">Formalism in Philosophy of Mathematics.

Week 3: Mathematical intuitionism and constructive mathematics: are mathematical objects human constructions?

- Jan 20: Arend Heyting, The Intuitionistic Foundations of Mathematics," reprinted in Benacerraf and Putnam, *Philosophy of Mathematics, Selected Readings,* 2nd edition (Cambridge University Press, 1984).

- Jan 22: Arend Heyting "Disputation" reprinted in Benacerraf and Putnam, *Philosophy of Mathematics, Selected Readings,* 2nd edition (Cambridge University Press, 1984).

- Optional: SEP entry on Intuitionism in Philosophy of Mathematics [3].

Week 4: Mathematical epistemology and the argument from indispensability: why is an account of mathematical truth and knowability so difficult to find and can the use of math in science tell us about mathematical truth?

- Jan 27: Paul Benacerraf, "Mathematical Truth," *The Journal of Philosophy,* 70 (1973), 661 - 679.

- **Jan 28 first paper due.**

- Jan 29: Penelope Maddy, "Indispensability and Practice." *The Journal of Philosophy* 89, no. 6 (1992): 275-289.

- Optional: SEP entry on Indispensability Arguments in the Philosophy of Mathematics [4]

Week 5: Naturalism: what does the use of mathematics in science tell us about mathematics itself?

- Feb 3: Penelope Maddy, "Three Forms of Naturalism." *Oxford Handbook of Philosophy of Mathematics and Logic.*

- Feb 5: In-class writing assignment; no reading assigned

Week 6: Logical pluralism: is there one true logic?

- Feb 10: Finn, Suki. "Limiting Logical Pluralism." *Synthese* 198, no. Suppl 20 (2021): 4905-4923.

Feb 12: First in-class test no reading assigned

READING WEEK

Week 7: Philosophy of applied mathematics: is the usefulness of mathematics in science a miracle?

- Feb 24: Eugene Wigner, "The Unreasonable Effectiveness of Mathematics in the Natural Sciences," Richard Courant Lecture in Mathematical Sciences delivered at New York University, May 11, 1959, Communications on Pure and Applied Mathematics 8 (1960).

- Feb 26: Arezoo Islami, "A Match Not Made in Heaven: on the Applicability of Mathematics in Physics." *Synthese* 194, no. 12 (2017): 4839-4861.

Week 8: Proofs: what makes a proof a proof?

- Mar 3: Fenner Tanswell, "A Problem with the Dependence of Informal Proofs on Formal Proofs." *Philosophia Mathematica* 23, no. 3 (2015): 295-310.

- Mar 5: Silvia De Toffoli, "Groundwork for a Fallibilist Account of Mathematics." *The Philosophical Quarterly* 71, no. 4 (2021).

Week 9: Indigenous perspectives and the idea of alternative mathematics: could mathematics be fundamentally different from what it is and should it be?

- Mar 10: Nicol, Cynthia, Jennifer S. Thom, Edward Doolittle, Florence Glanfield, and Elmer Ghostkeeper. "Mathematics Education for STEM as place." *ZDM–Mathematics Education* 55, no. 7 (2023): 1231-1242.

- **Mar 11 Second paper due.**

- Mar 12: Franci Mangraviti, "Critical Math Kinds: A Framework for the Philosophy of Alternative Mathematics." *Erkenntnis* (2024): 1-21.

Week 10: Philosophy of machine learning and big data: what is the significance of opacity and spurious correlations?

- Mar 17: Humphreys, Paul. "The Philosophical Novelty of Computer Simulation Methods." *Synthese* (2009): 615-626.

- Mar 19: Calude, Cristian S., and Giuseppe Longo. "The Deluge of Spurious Correlations in Big Data." *Foundations of Science* 22, no. 3 (2017): 595-612.

Week 11: Philosophy of machine learning: do we need transparency?

- Mar 24: Creel, Kathleen A. "Transparency in Complex Computational Systems." *Philosophy of Science* 87, no. 4 (2020): 568-589.

- **Mar 26: In-class writing assignment; no reading assigned**

Week 12: TBA and second in-class test

- **Mar 30: TBA**

- **Apr 2: Second in-class test**

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

Title / Name	Notes / Comments	Required	Used Versions Allowed	Price (CAD)
Readings	Can be downloaded through the UW library or on LEARN	Required	Yes	0

Technology

Name of Technology	Notes / Comments	Required	URL (student access)	Price (CAD)
LEARN		Required		0

Assessments & Activities

Component / Activity	Date or Due Date	Location / Submission Method	Weight (%)
Paper 1	Wednesday Jan 28	LEARN dropbox	15%
In-class writing assignment 1	Thursday Feb 5	In-person in class	10%
First in-class test	Thursday Feb 12	In-person in class	20%
Paper 2	Wednesday Mar 12	LEARN	20%
In-class writing assignment 2	Thursday Mar 26	In-person in class	10%
Second in-class test	Thursday Apr 2	In-person in class	20%
Attendance and participation	Throughout term	Throughout term	5%

Both papers should be 900-1200 words and topics will be handed out. For the first paper, you have the option of handing in a rewrite based on my comments. If you choose to do this your new paper grade will be an average of the original and the rewrite; your grade will not go down if the new draft is worse, but improved grades require significant changes and not just small edits. For the second paper, I will write fewer comments; if you would like more feedback, don't hesitate to ask. Paper assignments will ask you to write about your own ideas about a philosophical problem while engaging the texts and ideas we've encountered in class. The focus is on presenting an original argument. Of course, this means the ideas in your papers must be your own; we will talk more in class about how to ensure that the ideas you present as your own really are, and how to cite any outside sources you do use appropriately. We will also discuss in class the use of generative AI and how it can and should be used. If you have any questions at any time about academic honesty and what it requires, do not hesitate to ask. For help with writing, check out The Writing Centre on campus.

There will also be two in-class writing assignments. You will be asked to apply ideas you have learned in the course to a topic, question, or short reading passage and write a few paragraphs. These will be completed with no aids (such as notes or the texts or the internet). If you are ill or you have an emergency the day of an in-class writing assignment, let me know and we can schedule a make-up.

In-class tests will be a mix of question formats including multiple choice, short answer, and very short essay. Test 1 covers the first half of the course and test 2 the second half. If you are ill or you have an emergency the day of an in-class test, let me know and we can schedule a make-up.

For a course such as this, attendance and participation are important. There are several ways to participate in this class: you can participate in class discussion, or by contributing to discussion on LEARN, or by emailing or speaking with me personally. Attendance counts toward your attendance and participation grade. If you attend class regularly, that will earn a grade of 65 for participation. If you attend class regularly and participate in any of the various forms at least once per week, that will earn a grade at least in the 70s range. Attendance plus more frequent participation will raise your participation grade; less frequent attendance will lower it. I will post attendance and participation grades on LEARN at the end of term; if you don't agree with yours please email me and we can discuss it.

Obviously if you feel unwell you should stay home. I also know that students may encounter other obstacles to attending class -- talk to me about any problems that come up. You may miss up to four class meetings in the term for any reason, but if you find that you will have to miss more meetings, let me know. Adjustments to the attendance and participation criteria above must be approved by the instructor.

I will use LEARN for announcements etc. so please check it at least once a day.

Late / Missed Content

The penalty for late papers is 3 percent per day of lateness for the first week. That is, if your paper grade is 80 and it is two days late, that is a grade of 74. If more than a week has gone by, you can still submit your paper and I will apply a late penalty that is less severe. If you have questions please get in touch.

Assignment Screening

No automated assignment screening will be utilized within this course.

Generative AI

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**, may be used under specific conditions** in this course with proper documentation, citation, and acknowledgement. **Permitted uses of and expectations for using GenAI will discussed in class and outlined on assignment instructions.**

[Recommendations for how to cite generative AI in student work at the University of Waterloo may be found through the Library.](#) [5]

Please be aware that generative AI is known to falsify references to other work and may fabricate facts and inaccurately express ideas. GenAI generates content based on the input of other human authors and may therefore contain inaccuracies or reflect biases.

To protect the privacy and security of any data entered, students should use the University's version of [Co-Pilot](#) [6] and login with their UW ID. Data entered into other systems can be added to training sets, monitored, geolocated and even reproduced as output which may share private personal information or result in intellectual property breaches.

In addition, you should be aware that the legal/copyright status of generative AI inputs and outputs is unclear. Exercise caution when using large portions of content from AI sources, especially images. [More information is available from the Copyright Advisory Committee.](#) [7]

You are accountable for the content and accuracy of all work you submit in this class, including any supported by generative AI. You should be able to readily demonstrate your knowledge of your submissions. 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.

Administrative Policy

Pronouns and chosen or preferred first name

Students can verify their chosen or preferred first name by logging into [WatIAM](#) [8]. 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](#) [9]. 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).

For the two papers, there is a late penalty of 3 percentage points per day of lateness. That is, if your paper earned a grade of 75 and it was two days late, your grade would be 69. Obviously if you have extenuating circumstances, talk to me or send me an email. For in-class exercises and tests, make-up or other options can be arranged.

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](#) [10] under the Ontario Human Rights Commission (2015) *[Policy on preventing discrimination based on creed](#)* [11]. 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](#) [12] that students can use for faith-based practices.

Declaring absences
[Applies only to students taking undergraduate courses]

Please see the [Academic Regulations](#) [13] 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](#) [14]. Submission through the [Absence Verification System](#) [15], 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](#) [16]

to the Absence Verification System [17] 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 [18] 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 [19] 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.

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 [20]. 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. 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 [21]. For typical penalties, check Guidelines for the Assessment of Penalties [22].

Appeals: A decision made or penalty imposed under Policy 70, Student Petitions and Grievances [23] (other than a petition) or Policy 71, Student Discipline [24] 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 [25].

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 [26] (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 [27]. 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/1261/PHIL/257
2. file:///Users/pmarino/Dropbox/Current/Teaching/Teaching%20Current/PhilMathW26/%3Ca%20href=
3. https://plato.stanford.edu/entries/intuitionism/
4. https://plato.stanford.edu/entries/mathphil-indis/
5. https://subjectguides.uwaterloo.ca/chatgpt_generative_ai
6. https://copilot.microsoft.com/
7. https://uwaterloo.ca/copyright-at-waterloo/teaching/generative-artificial-intelligence
8. https://idm.uwaterloo.ca/watiam/
9. https://uwaterloo.ca/quest/help/students/how-do-i/view-or-update-my-personal-information
10. https://ugradcalendar.uwaterloo.ca/page/Acad-Regs-Accommodations
11. https://www.ohrc.on.ca/en/policy-preventing-discrimination-based-creed
12. https://uwaterloo.ca/multi-faith-spirituality-resource-team/multi-faith-spaces-campus
13. https://uwaterloo.ca/academic-calendar/undergraduate-studies/catalog#/policy/SkiPsB9Vp?

bc=true&bcCurrent=Assessments%3A%20Academic%20Considerations%20and%20Accommodations&bcGroup=Academic%20Regulations&bcItemType=policies

14. https://uwaterloo.ca/arts/undergraduate/student-support/accommodations-illness-or-extenuating-circumstances#submit-other
15. https://vif.uwaterloo.ca/
16. https://uwaterloo.ca/arts/undergraduate/student-support/accommodations-illness-or-extenuating-circumstances#submit-other
17. https://vif.uwaterloo.ca/
18. https://uwaterloo.ca/quest/help/students/how-do-i/self-declare-absence-undergraduate-students
19. https://uwaterloo.ca/students/health-and-well-being/counselling-appointments
20. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70
21. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71
22. https://uwaterloo.ca/secretariat/guidelines/guidelines-assessment-penalties
23. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70
24. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71
25. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-72
26. https://uwaterloo.ca/accessability-services/
27. https://uwaterloo.ca/accessability-services/students/applying-academic-accommodations/documentation-information-forms
28. https://acal.fast.uwaterloo.ca/course/1261/PHIL/257
29. https://outline.uwaterloo.ca/viewer/view/%3Ca%20href=
30. https://plato.stanford.edu/entries/intuitionism/
31. https://plato.stanford.edu/entries/mathphil-indis/
32. https://subjectguides.uwaterloo.ca/chatgpt_generative_ai
33. https://copilot.microsoft.com/
34. https://uwaterloo.ca/copyright-at-waterloo/teaching/generative-artificial-intelligence
35. https://idm.uwaterloo.ca/watiam/
36. https://uwaterloo.ca/quest/help/students/how-do-i/view-or-update-my-personal-information
37. https://ugradcalendar.uwaterloo.ca/page/Acad-Regs-Accommodations
38. https://www.ohrc.on.ca/en/policy-preventing-discrimination-based-creed
39. https://uwaterloo.ca/multi-faith-spirituality-resource-team/multi-faith-spaces-campus
40. https://uwaterloo.ca/academic-calendar/undergraduate-studies/catalog#/policy/SkiPsB9Vp?
bc=true&bcCurrent=Assessments%3A%20Academic%20Considerations%20and%20Accommodations&bcGroup=Academic%20Regulations&bcItemType=policies
41. https://uwaterloo.ca/arts/undergraduate/student-support/accommodations-illness-or-extenuating-circumstances#submit-other
42. https://vif.uwaterloo.ca/
43. https://uwaterloo.ca/arts/undergraduate/student-support/accommodations-illness-or-extenuating-circumstances#submit-other
44. https://vif.uwaterloo.ca/
45. https://uwaterloo.ca/quest/help/students/how-do-i/self-declare-absence-undergraduate-students
46. https://uwaterloo.ca/students/health-and-well-being/counselling-appointments
47. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70
48. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71
49. https://uwaterloo.ca/secretariat/guidelines/guidelines-assessment-penalties
50. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-70
51. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-71
52. https://uwaterloo.ca/secretariat/policies-procedures-guidelines/policy-72
53. https://uwaterloo.ca/accessability-services/
54. https://uwaterloo.ca/accessability-services/students/applying-academic-accommodations/documentation-information-forms