PHILOS 126: PHILOSOPHY OF PHYSICS

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UC Berkeley, Spring 2024
Office hours: TBD
Classes: MW 6.30–8pm, Wheeler 102
GSI: Warren Thimothe (thimothe@berkeley.edu); office hours TBD

DESCRIPTION

This course is an introduction to the philosophical foundations of physics, with a focus on the nature of space and time. Questions to be discussed include: Are there instantaneous velocities? In what sense does time have a direction? Is space a thing (and what would that even mean)? What is it for space and time to have a certain structure, and how can we tell what structure they have? In what sense do moving clocks 'run slow'? Are the past and future just as real as the present? Is the passage of time an illusion? How does space differ from time?

PREREQUISITES

No formal requirements; solid high-school physics and at least one philosophy class are recommended.

READINGS

All readings will be available in pdf format through the bCourses site. Several readings are drawn from the following books, which you may consider purchasing:

D. Albert, *Time and Chance*
R. Geroch, *General Relativity from A to B*
B. Greene, *The Fabric of the Cosmos*

On average, there will be around 40 pages of reading per week. You are expected to complete all readings assigned to each class before that class. If you find some readings difficult, that's fine—in fact, that is expected! But please try to get through the reading before class. Try to formulate what you don't understand as a succinct question. We will discuss the readings in class and there will be opportunities to ask questions.

ASSESSMENT

1. Participation (15%): attendance and participation in discussion sections; posting on discussion threads (see below)
2. Homeworks (25%): 3 homeworks, due in weeks 3, 6 and 11. Mainly short essay questions.
3. Midterm Paper (25%): 1500-2000 words, choice of prompts, due Monday March 4th (week 8).
4. Final exam (35%): Short essay questions, similar in style to homeworks. In final exam week.

You will receive a letter grade for each component. Your final grade is calculated by converting each letter grade into a number, taking the average of those numbers (weighted by the percentages above), and converting the resulting number back into a letter grade, using the following schemes:

Letter-to-number conversion	Number-to-letter conversion (boundaries rounded upwards)
A+ = 98	> 96.5 = A+
A = 95	93.5 – 96.5 = A
A- = 92	90 – 93.5 = A-
B+ = 88	86.5 – 90 = B+
B = 85	83.5 – 86.5 = B
B- = 82	80 – 83.5 = B-
C+ = 78	76.5 – 80 = C+
C = 75	73.5 – 76.5 = C
C- = 72	70 – 73.5 = C-
Etc…	Etc…
F = 60	< 60 = F

COURSE POLICIES

Failure to turn in a take-home assignment on time will result in the lowering of your grade. For each day late, the grade will be lowered one letter grade (e.g., from a B to a B-). Extensions will be granted only in serious circumstances. Please do not hesitate to talk with me about these policies. I understand that people get sick, have family situations, etc. and I am willing to be quite accommodating. But you should make every effort to let me know ahead of time.

I discourage you from missing classes, not only because it will affect your participation grade but also because many topics discussed will be presupposed later on. If you need to miss a class, it is your responsibility to catch up on the material missed. Handouts are not intended to be substitutes for lectures and discussions. For recommendations about handling scheduling conflicts, see: teaching.berkeley.edu/checklist-scheduling-conflicts-academic-requirements

CLASSROOM CLIMATE

Discussion is essential to doing philosophy. It can take many forms: ideas can be proposed, developed, supported, clarified, and criticized. Criticism is important, but all discussion should be collaborative, not competitive. Listen carefully to what others have to say, and do not interrupt. If you're not following the discussion, please speak up — the chances are that others will be grateful for some clarification too. It is everyone's responsibility to maintain a fun, welcoming and inclusive class environment. There will be no tolerance for bullying, harassment, or disrespectful behavior. In addition, all students are expected to comply with the Student Code of Conduct: https://sa.berkeley.edu/code-of-conduct.

Academic Integrity

I will not tolerate acts of academic dishonesty, including plagiarism or the use of unauthorized materials during exams. Any such act may result in a failing grade on the assignment or in the class, depending upon the severity of the case. Examples of academic dishonesty include copying material from an AI tool, a website or classmate and handing it in as your own, copying another student's work on an exam, quoting from or paraphrasing someone's work without proper citation.

Disabled Students' Program

UC Berkeley is committed to creating a learning environment that meets the needs of its diverse student body including students with disabilities. If you anticipate or experience any barriers to learning in this course, you are encouraged to discuss your concerns with me. If you have a disability or think you may have a disability, you can work with the Disabled Students' Program (DSP) to request an official accommodation letter. If I have a letter on file for you from the DSP office, you may assume that you have been granted the requested accommodations. You can find more information about DSP, including contact information and the application process, here: https://dsp.berkeley.edu.

Graduate Student Instructors

Graduate Student Instructors (GSIs) assist in various aspects of teaching here at Berkeley. Your GSI runs your weekly section and is available to talk during their office hours each week. Please note that your GSI is *not* expected to be available to talk outside their office-hour times, respond to involved philosophical questions by email (they will respond to administrative questions within 2 business days), or read and comment on drafts of your work prior to submission.

Policy on Sexual Violence and Harrassment

Sexual violence and sexual harassment have no place in a learning environment. Therefore, in alignment with Title IX of the Education Amendments of 1972, it is the policy of the University of California (Sexual Harassment and Sexual Violence Policy) to prohibit sexual harassment, sexual assault, domestic/dating violence, and stalking. The UC Sexual Violence and Sexual Harassment Policy requires that the University immediately implement interim remedies and permanent support measures, when necessary, for victims/survivors. If you or someone you know experiences sexual violence or harassment, there are options, rights, and resources, including assistance with academics, reporting, and medical care. Visit survivorsupport.berkeley.edu or call the 24/7 Care Line at 510-643-2005.

Overview of Schedule

A detailed schedule (including the readings for each week) is posted on the bCourses site. This schedule is provisional and will be updated during the semester. There will be six discussion/review sessions in total (at the end of each unit). As part of your participation credit, you are required to post questions/comments on the bCourses site discussion thread by 11.59pm the day before *at least four* of these sessions.

Here is an overview of the topics I plan to cover:

Unit I: Motion

Weeks 1–2: Zeno's paradox, the "at-at" theory, determinism, Markovianism, intrinsicality, instantaneous velocities, time-reversal invariance

Unit II: The Direction of Time

Weeks 3–4: The arrows of time, probability, entropy, the Second Law of Thermodynamics, Maxwell's demon, statistical mechanics, phase space, the Statistical Postulate, the reversibility objection, the Past Hypothesis

Unit III: The Nature of Space

Weeks 5–7: Substantivalism vs relationalism, fundamentality, Newton's bucket, Leibniz's shifts, invariance, Kant's glove

Unit IV: Spacetime Structure

Weeks 8 – 9: Events, coordinatizations, time-slices, Newtonian spacetime, absolute vs relative velocities, reference frames, Galilean spacetime, the Principle of Galilean relativity

Unit V: Special Relativity

Weeks 10–12: the Michelson-Morley experiment, Minkowski spacetime, the relativity of simultaneity, the spacetime interval, time dilation, length contraction, the twins paradox, light-cones

Unit VI: The Metaphysics of Time

Weeks 13–14: the A-theory vs the B-theory, presentism, eternalism, the growing block theory, the passage of time, perspectival truths, the connection between time and laws