Philosophy 4542: Philosophy of Space and Time
Syllabus

PHI 4542; Section 3261
Fall 2020
M/W/F 10:40am - 11:30am
Class Meets over Zoom

Instructor Information

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Office Hours: M/W 12:30pm - 1:30pm, or by appointment
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Course Description

This course will explore some contemporary philosophical questions about the nature of space and time. Our approach will be informed by some of our best current physical theories, such as special and general relativity, quantum mechanics, and statistical mechanics. No prior background with these physical theories will be expected, but students should be prepared to learn some of the fundamentals of these theories as part of the course. Emphasis will be placed on gaining an intuitive understanding of the theories, while requiring only a minimal amount of mathematics.

Some of our primary topics will include: the implications of special and general relativity for the nature of spacetime (e.g. the relativity of simultaneity and the resolution of the twins paradox); what quantum mechanics implies about the nature of the world's fundamental space; how statistical mechanics might explain certain temporal asymmetries; and the interactions between a theory's dynamical laws and spacetime geometry. Time permitting (though it probably won't), we will also explore some additional topics like the possibility of time travel, the spatial non-locality implied by quantum mechanics, and whether causation has an inherent temporal direction.

Learning Objectives

At the end of this course, students will be able to:

- Construct spacetime diagrams to answer questions about various physical situations
- Articulate the basic structure of quantum mechanics and how the wave function is related to the dimensionality of space
- Describe how statistical mechanics accounts for various thermodynamic phenomena, and what motivates the postulation of the Past Hypothesis
- Answer various conceptual questions related to special relativity, general relativity, quantum mechanics, and statistical mechanics

Academic Honesty

UF students are bound by The Honor Pledge, which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor

and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: 'On my honor, I have neither given nor received unauthorized aid in doing this assignment.'"

The Honor Code (http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor. **Plagiarism on any assignment will automatically result in a grade of "E" for the course.** Plagiarism is defined in the University of Florida's Student Honor Code as follows: "A student shall not represent as the student's own work all or any portion of the work of another. Plagiarism includes (but is not limited to): a. Quoting oral or written materials, whether published or unpublished, without proper attribution. b. Submitting a document or assignment which in whole or in part is identical or substantially identical to a document or assignment not authored by the student." Students found guilty of academic misconduct will be prosecuted in accordance with the procedures specified in the UF honesty policy.

Attendance and Zoom Classroom Policies

Students are expected to attend all scheduled Zoom meetings and to have done all assigned reading in advance. Failure to do so will adversely affect students' ability to perform well in this course. Students are strongly encouraged to have their cameras turned on during Zoom class meetings, and to communicate via microphones rather than text in the meeting chat. Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx.

Canvas e-Learning Environment

This course is supplemented by online content in the e-Learning environment known as "Canvas." To login to the e-Learning site for this course, go to https://lss.at.ufl.edu/, click the **e-Learning in Canvas** button, and on the next page enter your Gatorlink username and password. You can then access the course e-Learning environment by selecting PHI 4542 from the **Courses** pull-down menu at the top of the page. If you encounter any difficulties logging in or accessing any of the course content, contact the UF Computing Help Desk at (352) 392-4537. Please do not contact the course instructor regarding computer issues.

Online Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

Accommodation for Students with Disabilities
Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc/) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

Counseling and Wellness Center:
http://www.counseling.ufl.edu/cwc/Default.aspx, 392-1575
University Police Department:
392-1111 or 9-1-1 for emergencies.

Required Course Texts
- Maudlin, Tim. (2012) *Philosophy of Physics: Space and Time*. Princeton, NJ: Princeton University Press.
- Albert, David. (2000) *Time and Chance*. Cambridge, MA: Harvard University Press.

Optional Course Text
- Ney, Alyssa and David Albert (eds.). *The Wave Function: Essays on the Metaphysics of Quantum Mechanics*. New York: Oxford University Press.
    - NB: A physical copy of this text is optional because it is also available as an eBook through the UF library.

Units
The course is divided into three units, which match up with the textbooks. In chronological order, the units are:
1. Relativity (Maudlin text)
2. Statistical Mechanics (Albert text)
3. Quantum Mechanics (Albert and Ney text)

Course Requirements
Quizzes: 20%
Attendance/Participation: 5%
Take-Home Exam 1: 25%
Take-Home Exam 2: 25%
Take-Home Exam 3: 25%

Participation
Respectful participation is expected of everyone. It can take a variety of forms: contributing to class discussions, coming to office hours, emailing me with questions, etc. Each class has assigned readings, which will require critical engagement and reflection. You should come to class prepared to discuss these readings and demonstrate that you have thought critically about them beforehand.

Quizzes

To prepare for our discussions, we need to study the readings very carefully. Many of the readings contain subtle arguments that often need to be read multiple times. To reward you for doing this work, there will be occasional unannounced quizzes during the course of the semester. Each quiz will contain a few short questions about the material covered in the reading. At the end of the semester, I will drop your two lowest quiz grades. If you miss a quiz, you will not be able to retake it. The drop policy is meant to accommodate unforeseen absences. If you will miss a quiz for a religious holiday or another official university activity, you must notify me ahead of time; quizzes missed for these reasons will not count toward your two dropped quizzes for the semester.

Take-Home Exams

Much of the material in this course concerns philosophical insights gleaned from physical theories. So we need to have a good conceptual grasp of the physical theories in question. To that end, there will be three take-home exams designed to test your grasp of both (i) the conceptual foundations of these theories, and (ii) their philosophical implications. The exams will consist of a set of prompts, to which you must provide relatively short responses. A small proportion of these prompts may require some high-school level algebra, but on the whole they will not be math-heavy. The exam prompts will be provided one week before the due date. *These exams will be open-note, but* ***you may not collaborate with other students on the preparation of your answers.*** If you have questions about the prompts, you should ask me directly (I'm happy to help!) rather than going to other students.

Course Schedule and Readings

The following is a tentative schedule for the course. Any official changes to the schedule will be announced in class and over email. The syllabus is divided into weeks; the items listed for a given week are to be read before classes that week.

Unit 1: Relativity and the Nature of Spacetime

Week 1: August 31 - September 4

- Maudlin Chapter 1: Classical Accounts of Space and Time

Week 2: September 8 - 11 (September 7 is a holiday)

- Maudlin Chapter 2: Evidence for Spatial and Temporal Structure

Week 3: September 14 - 18

- Maudlin Chapter 3: Eliminating Unobservable Structure
- Maudlin Chapter 4: Special Relativity

Week 4: September 21 - 25

- Maudlin Chapter 4: Special Relativity

Week 5: September 28 - October 2

- Maudlin Chapter 5: The Physics of Measurement
- Maudlin Chapter 6: General Relativity

Week 6: October 5 - 9

- Maudlin Chapter 6: General Relativity

- Maudlin Chapter 7: The Direction and Topology of Time

Take-Home Exam 1 (on Relativity) due October 16 by 5pm

Unit 2: Statistical Mechanics and Temporal Asymmetries

Week 7: October 12 - 16
- Albert Chapter 1: Time Reversal Invariance

Week 8: October 19 - 23
- Albert Chapter 2: Thermodynamics
- Albert Chapter 3: Statistical Mechanics

Week 9: October 26 - 30
- Albert Chapter 3: Statistical Mechanics

Week 10: November 2 - 6
- Albert Chapter 4: The Reversibility Objections and the Past Hypothesis

Week 11: November 9 - 13 (November 11 is a holiday)
- Albert Chapter 6: The Asymmetries of Knowledge and Intervention

Take-Home Exam 2 (on Statistical Mechanics) due November 20 by 5pm

Unit 3: Quantum Mechanics and the Dimensionality of Space

Week 12: November 16 - 20
- Ney and Albert Introduction

Week 13: November 23 (rest is Thanksgiving break)
- Ney and Albert Chapter 5: Dimension and Illusion (Lewis)

Week 14: November 30 - December 4
- Ney and Albert Chapter 6: The Nature of the Quantum State (Maudlin)

Week 15: December 7- 9 (rest is reading period)
- Ney and Albert Chapter 9: The Structure of a Quantum World (North)

Take-Home Exam 3 (on Quantum Mechanics) due December 16 by 5pm