PHILOSOPHY 2032: EINSTEIN FOR EVERYONE
MWF 10:30 - 11:30; WSC 240

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Course Description

This course considers the work of Albert Einstein, focusing mainly on the theories of relativity, but also touching on quantum physics. Mathematics will be kept to a minimum, and no physics background will be assumed. The course starts with special relativity, as formulated by Einstein in 1905. We will discuss Einstein's two postulates and explore their strange consequences for the behavior of measuring rods and clocks, and explain the meaning and importance of the relativity of simultaneity. How did Einstein discover special relativity? We will look at the historical context of his work, showing how it related to 19th century physics. We will also consider various consequences of the theory, such as $E = mc^2$, and alleged paradoxes (such as the twin paradox). We then turn to Einstein's most striking achievement, the general theory of relativity (1915). This theory is based on the remarkable idea that spacetime is curved. We will develop the background needed to understand this concept and the other basic ideas of the theory, and consider consequences of the theory related to cosmology and black hole physics. We will also consider Einstein's innovative path to general relativity as exemplifying an effective critical analysis of a physical theory. The course will close with discussion of Einstein's important contributions to the development of quantum theory and his later criticisms of it.

Objectives

This course has two main objectives. The first is to give students the background needed to appreciate Einstein's contributions to physics and the broader implications of his theories. The course is structured to introduce students to the basic conceptual puzzles of 19th century physics that Einstein confronted and resolved, using a minimal physics and mathematics. The second goal is to provide students with an example of creative achievement in science, and an understanding of how Einstein discovered relativity. The course will characterize Einstein's philosophical approach to physics.

Texts

The following texts are required. They are available from the University of Western Ontario Bookstore, except where noted.

J. Schwartz and M. McGuinness, *Einstein for Beginners*. New York: Pantheon.
D. Giulini *Special Relativity: A First Encounter*. Oxford: Oxford University Press.
John Norton, *Einstein for Everyone*. (Online text: `http://www.pitt.edu/~jdnorton/teaching/HPS_0410/chapters/index.html`)
Online Articles. Articles posted on course OWL site.

Requirements

1. Homework (20 %): 10 assignments over the term; no late assignments are accepted, but only 8 of the 10 assignments count toward the final grade.
2. Midterm exam (20 %): In class midterm exam, consisting of short essay questions.
3. Paper (30 %): one 4-6 page paper due at the end of term; suggested topics and guidelines will be distributed. The late penalty is 3 % per work day and 5 % for the weekend, with a maximum penalty of 20 %.
3. Final Exam (30 %): cumulative essay exam.

TENTATIVE SCHEDULE

Date	Topic	Assigned Reading
Jan. 4	Introduction and Overview Historical Background	
Jan. 6 - 8	Historical Background	G 1–2; EB, pp. 5–68; N 8
11 – 15	Einstein's Path to Special Relativity	W 1; EB pp. 69–106; N 9
18 – 22	Basics of Special Relativity	W 2; G 3; EB, pp. 107–169; N 2–4
25 – 29	Paradoxes of Relativity & $E = mc^2$	W 2; G 3; N 5–7
Feb. 1–5	Spacetime	W 2; N 10–13
8–10	Philosophical Significance	N 14–15
Feb. 12	Mid-term exam	
Feb. 22	Newtonian Gravity	W 4
24–26	From Euclid to Riemannian Geometry	N 17–20
Feb. 29 – March 4	Einstein's Path to General Relativity	W 4; N 25
March 7 – 11	Basics of General Relativity	N 21–24
March 14 – 18	Relativistic Cosmology	W 5; N 26–28
March 21 – 25	Black Holes & Time Travel	N 30–31
March 28 – April 1	Einstein & Quantum Theory	W 6; N 33–36
April 4-6	Einstein-Podolsky-Rosen	W 7 (selectcions) ; N 37

Note: W refers to the articles or handouts posted on the OWL website, listed below; EB = *Einstein for Beginners*, N = *Einstein for Everyone* by John Norton (Online course text; numbers refer to chapters or section numbers).

Materials posted in OWL

1. Einstein (1905), "On the Electrodynamics of Moving Bodies" (translation by John Walker).
2. Appendix on special relativity, by Michel Janssen (from the *Cambridge Companion to Einstein*).
3. Selection from I. B. Cohen, *The Birth of a New Physics*.
4. Einstein's path to general relativity: selections from Einstein, On the Relativity Problem (1914).
5. "Einstein's Role in the Creation of Relativistic Cosmology," by Chris Smeenk (from in the *Cambridge Companion to Einstein*).
6. Einstein (1905), "Concerning an Heuristic Point of View..."
7. Einstein, Podolsky, and Rosen (1935), "Can Quantum-Mechanical Description of Reality be Considered Complete?"

Audit: Students wishing to audit the course should consult with the instructor prior to or during the first week of classes.

The Department of Philosophy Policies which govern the conduct, standards, and expectations for student participation in Philosophy courses is available in the Undergraduate section of the Department of Philosophy website at http://uwo.ca/philosophy/undergraduate/proceduresappeals.html. It is your responsibility to understand the policies set out by the Senate and the Department of Philosophy, and thus ignorance cannot be used as grounds of appeal.