

Monday and Wednesday
9:30 – 10:45 p.m.
Assistant Professor Jeremy Tinker
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Office hours: Wednesdays @ 3.30-4:30pm



A photograph of Einstein taken in 1912.

The laws of physics are the same regardless of your motion. That's the theory of relativity. Though the statement of the relativity principle is simple, the implications of it will challenge your notions of space, time, energy, mass and gravity. This course focuses on what relativity tells us about the nature of time and space. We will also look at applications to astrophysics and cosmology. In parallel with the main course texts, we will also be reading a biographical work (*Einstein: His Life and Universe*) that presents the scientific concepts as well as the man himself. Your lab manual contains a chronology of the life of Einstein and you will see a documentary called *Einstein Revealed*.

Course texts

1. *Simply Einstein* by Richard Wolfson, Norton.
2. *Einstein: His Life and Universe* by Walter Isaacson, Simon and Schuster.
3. *The Fabric of the Cosmos*, Brian Greene, Vintage.
4. *Einstein's Universe Laboratory Manual*.
5. *Relativity and Its Roots* by Banesh Hoffmann, Dover. (Optional)

Readings available for download:

Conceptual Physics by Benjamin Crowell (download at <http://www.lightandmatter.com/cp/>)

The Modern Revolution in Physics by Benjamin Crowell (download at <http://www.lightandmatter.com/area1book6.html>)

Popular Readings:

Mr. Tompkins in Paperback by G. Gamow, R. Penrose, McLerran, Cambridge University Press

Homework

Homework problems will be given in lecture and in lab in the form of worksheets. These assignments help you understand the material and prepare for course examinations. They will not be graded.

Lecture Questions

In order to help you organize the course material and to let you know what you are responsible for, question sheets will be handed out in lecture each week. Examinations will be based on these questions and the homework, so you should write out the answers to these questions each week.

Examination Schedule and Course Grade

First examination:	20%
Second examination:	20%
Laboratory:	30%
Final examination:	30%

Laboratory Sessions

These weekly sessions are an important part of the course. You must be registered for one lab section. You will have to submit a lab report for each experiment performed. The lab report has to include answers to all questions and any data you may have collected. The lab report will be due in lab *one week* after the experiment has been performed. **The laboratory sessions will begin the week of February 4th.**

The laboratory sessions will be devoted to: (1) Doing experiments, (2) doing worksheets that will be handed out in lab, (3) discussing the homework problems and (4) discussing the lecture questions.

The laboratory grade will be based on the following assignments, depending on the particular session: (1) Lab experiment and report, (2) assignments given out in lab.

Attendance

If you arrive at least 10 minutes late for the lab session you will lose some credit for that lab session.

Absence Policy

Excused absences will only be given in the case of illness (with a doctor's note) or observation of a religious holiday. You must notify your lab instructor in advance in writing if you miss a lab due to religious reasons. All other absences will be considered unexcused and will result in a lab grade of zero.

You cannot make up a lab by attending a laboratory session that you are not registered for.

Late Assignments

Late assignments will be penalized five points for each day late (excluding weekends). If you wish to submit a late lab report you must do so only at your laboratory instructor's office.

Lab Instructors

Each lab instructor will hold a weekly office hour where you can discuss lecture and laboratory material. Office locations and office hour time and day will be announced during the first laboratory session.

Missed Exams

There are no make-up exams for students who miss one or both of the exams given during the semester. If you miss an exam because of illness, you must contact Dr. Tinker by email **before** the start of the exam and follow up with a doctor's note. If you miss an examination, for a valid reason (illness, injury or family emergency), your grade will be based on the following allocations:

Examination I:	25%
Laboratory:	30%
Final examination (cumulative):	45%

If you miss both in-class examinations your grade will be based on the following scheme:

Laboratory	30%
Final examination (cumulative)	70%

Final Exam

There will be no make-up for the final examination. A doctor's note must be provided in the case of illness. Under exceptional circumstances, which must be discussed with Dr. Tinker before the examination, an incomplete grade will be assigned and **the make-up will be scheduled for the beginning of the Fall 2013 semester in the form of an oral examination.** Please avoid making travel plans before the date of the final exam. No alternative date for the final examination will be offered before the end of the Spring 2013 semester.

Schedule of Lecture Topics and Readings

W1: Jan23	History of Motion; <i>Hoffmann (optional)</i> , Chapters 1-3; Simply Einstein, Chapters 1-3; Crowell (<i>Conceptual Physics</i>), Chapter 1: 1.1, 1.3, 1.4 section entitled "The principle of inertia" (page 16), Chapter 2: 2.1, 2.2
W2: Jan 30	Galilean Relativity and Kinematics
W3: Feb6	Newton's Laws and The Law of Universal Gravitation
W4: Feb13	Electricity and Magnetism; Simply Einstein, Chapters 4-7 <i>Hoffmann (optional)</i> , Chapter 4, Crowell (<i>Conceptual Physics</i>), Chapter 5: Sections 1 and 2, Chapter 6: Sections 1, 2 and 3, Isaacson, Chapter 7: Light can be a wave and a particle
W5: Feb 20	No Classes Feb 20th. Electromagnetic Waves
W6: Feb 27	Sound Wave and the Michelson-Morley Experiment
W7: Mar6	Review and MIDTERM 1 (March 8).
W8: Mar13	Spring Break
W9: Mar 20	Special Relativity; Simply Einstein, Chapters 7-13 Greene, Chapter 3, pages 39-61, Isaacson, Chapter 6, <i>The Background, Einstein's Road to Relativity, "Induction and Deduction in Physics", The Two Postulates, "The Step", The E = mc², Coda, September 1905</i> Crowell (<i>Conceptual Physics</i>), Chapter 1: 1.7 Isaacson, Chapter 21: <i>The Letter, Citizen Einstein, Atomic Fears</i>
W10: Mar27	The Twin Paradox and Length Contraction
W11: Apr3	Relativity of Simultaneity and the concept of Spacetime
W12: Apr10	Mass-Energy equivalence and the Equivalence Principle: Isaacson, Chapter 7: <i>The Equivalence of Gravity and Acceleration</i> Isaacson, Chapter 9, <i>Light and Gravity, The Math, The Zurich Notebook 1912, Freundlich and the 1914 Eclipse, The Race to General Relativity,</i>

W13: Apr17	MIDTERM 2 (April 19) General Relativity Greene, Chapters 8, 9, 10, 11
W14: Apr24	The Big Bang and the Expansion of the Universe: Simply Einstein, Chapters 13-16 Greene, Chapter 3, pages 62-78 Isaacson, Chapter 11: <i>The Eclipse, 1919</i> Isaacson, Chapter 20: <i>"Lights All Askew"</i> Crowell (<i>Conceptual Physics</i>), Chapter 1: 1.5
W15: May1	Black Holes and Hidden Dimensions: Isaacson, Chapter 11: <i>Cosmology and Black Holes, 1917</i> Isaacson, Chapter 15: <i>His Greatest Blunder?</i>
W16: May8	Review

Weekly Schedule of Laboratories

<i>Week of</i>	<i>Weekly Lab</i>
Jan 23	No Lab
Jan 30	Math Review
Feb 6	Kinematics
Feb 13	Young's Experiment
Feb 20	No Lab
Feb 27	Speed of Sound
Mar 6	Michelson Interferometer
Mar 13	Spring recess
Mar 20	Video: "Einstein Revealed"
Mar 27	Relativity
Apr 3	Relativity (continued)
Apr 10	Principle of Equivalence
Apr 17	Observing the Cosmological Redshift
Apr 24	Hubble's Law
May 1	Final Exam Review