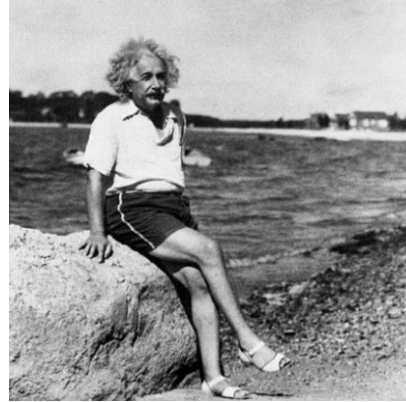


Tuesday and Thursday
11:00 – 12:15 p.m.
Professor Jasna Brujić
726 Broadway, Room 875
Office Phone: (212)-998-3586
E-mail: jb2929@nyu.edu
Office hours: Wednesdays @ 3.30-5.50PM



A photograph of Einstein taken in 1941.

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 text (*Einstein's Universe*), 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: Relativity Demystified* by Richard Wolfson, W.W. Norton and Co.
2. *Einstein: His Life and Universe* by Walter Isaacson, Simon and Schuster.
3. *Einstein's Universe Laboratory Manual*.

Other readings:

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

Relativity and its roots by Banesh Hoffmann

The fabric of the cosmos by Brian Greene

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% | Th Oct 19 |
| Second examination: | 20% | Tu Nov 21 |
| Laboratory: | 30% | |
| Final examination: | 30% | DECEMBER 19 TH FINAL EXAM (10:00-11:50am) |

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 SEPTEMBER 11TH.** 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. Brujic 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. Brujic before the examination, an incomplete grade will be assigned and **the make-up will be scheduled for the beginning of the Spring 2018 semester in the form of an oral examination.** Please avoid making travel plans before the date of the final exam.

Schedule of Lecture Topics and Readings

| | |
|-----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Tu Sep 5 | Introduction to Course |
| Th Sep 7 | History of Motion; <i>Simply Einstein</i> , Chapters 1-4; 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 |
| Tu Sep 12 | Galilean Relativity |
| Th Sep 14 | Kinematics |
| Tu Sep 19 | Newton’s Laws |
| Th Sep 21 | Gravitational Law |
| Tu Sep 26 | Electricity and Magnetism; <i>Simply Einstein</i> , Chapters 4-7, 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 |
| Th Sep 28 | Properties of Waves |
| Tu Oct 3 | Electromagnetic Waves; |
| Th Oct 5 | Sound Waves |
| Tu Oct 10 | Michelson-Morley Experiment |
| Th Oct 12 | Special Relativity; <i>Simply Einstein</i> , Chapters 7-13, Greene, Chapter 3, pages 39-61, Isaacson, Chapter 6, <i>The Background, Einstein’s Road to Relativity</i> , “ <i>Induction and Deduction in Physics</i> ”, <i>The Two Postulates</i> , “ <i>The Step</i> ”, <i>The E = mc², Coda, September 1905</i> Isaacson, Chapter 21: <i>The Letter, Citizen Einstein, Atomic Fears</i> |
| Tu Oct 17 | REVISION |
| Th Oct 19 | MIDTERM |
| Tu Oct 24 | Time Dilation |
| Th Oct 26 | Twin Paradox |
| Tu Oct 31 | Length Contraction |
| Th Nov 2 | Relativity of Simultaneity |
| Tu Nov 7 | Space-Time diagrams |
| Th Nov 9 | $E=mc^2$ |
| Tu Nov 14 | Equivalence Principle; <i>Simply Einstein</i> , Chapters 13-16, Greene, Chapter 3, pages 62-78 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> , Isaacson, Chapter 11: <i>The Eclipse, 1919</i> Isaacson, Chapter 20: “ <i>Lights All Askew</i> ” |
| Th Nov 16 | REVISION |
| Tu Nov 21 | MIDTERM 2 |
| Th Nov 23 | Thanksgiving break |
| Tu Nov 28 | Black Holes; Isaacson, Chapter 11: <i>Cosmology and Black Holes, 1917</i> Isaacson, Chapter 15: <i>His Greatest Blunder?</i> Greene, Chapters 8, 9, 10, 11 |
| Th Nov 30 | General Relativity |
| Tu Dec 5 | Dark Energy and the Expansion of the Universe |
| Th Dec 7 | Hubble’s Law |
| Tu Dec 12 | No Class |
| Th Dec 14 | REVISION |
| Tu Dec 19 | FINAL EXAM (10am-1150am) |

Weekly Schedule of Laboratories

| <i>Week of</i> | <i>Weekly Lab</i> |
|----------------|-----------------------------|
| September 11 | Math review |
| September 18 | Kinematics |
| September 25 | Young's Experiment |
| October 2 | Speed of Sound |
| October 9 | Homework and Lab Worksheets |
| October 16 | Michelson Interferometer |
| October 23 | Relativity Worksheet 1 |
| October 30 | Relativity Worksheet 2 |
| November 6 | Homework and Lab Worksheets |
| November 13 | Principle of Equivalence |
| November 20 | THANKSGIVING |
| November 27 | Cosmological redshift |
| December 4 | Hubble's Law |
| December 11 | Final Exam Review |