The twentieth century saw a tremendous advance in our understanding of the physical universe. Even concepts so fundamental to human experience such as space and time were found to have a subtle substructure with astonishing implications. The ultimate theory of matter – the so called *standard model* – was also the result of a great deal of work throughout the century. We will treat each of these as the semester progresses. The course will also present the few remaining questions that theoretical physics is tackling in the present century.

My intention is to provide you with an in-depth introduction to these concepts. The emphasis will not be on the traditional approach of solving lots of mathematically modeled problems. You should, however, be facile with ordinary high school algebra because we will need to manipulate some simple equations. A few concepts from trigonometry and geometry will come up as well. I will help you along when needed.

**Required books:** (Available in the bookstore or elsewhere)

- David J. Griffiths *Revolutions in Twentieth-Century Physics* (Cambridge University Press, 2013)
- Richard Wolfson *Simply Einstein: Relativity Demystified.* (Norton and Co.)

**Other books of interest:** (they’ll make valuable reading and are generally quite cheap)

- Richard Feynman *The Character of Physical Law* (MIT Cambridge 1965)
- Richard Feynman *Six Easy Pieces by Its Most Brilliant Teacher* (Basic Books NY 2005)

**Homework assignments:** will also be posted periodically. I’ll announce them in class and they can be found in the NYU Classes course web site. They’re to be handed in at the end of the Thursday class the week after they are first assigned. We will then post solutions.

**Some Coordinates:**
- Lectures: Tues, Th, 11:00 – 12:15, Meyer Hall, 122.
- Me: 726 Broadway, room 838, *fm70@nyu.edu* (212) 998-7907
- Recitation: Tues OR Th 12:30 – 1:45, Meyer Hall 264
- Recitation Instructor: Lauren Greenspan, *lbg251@nyu.edu*, 726 Broadway
Friendly advice (informed by years of experience):

- **Lectures:** In this class, it is especially important that you attend lectures. The two required books are not text books and we will not follow them very closely. Simply reading the books, understanding everything you read, and then expecting to do well on all the exams – as is conceivable in other classes – will not work for this one. A great deal of the material in lecture will simply not be in the books.

- **Reading:** On the other hand, the books do cover a good amount of the background physics necessary to understand the topics we will treat. Therefore, the assigned reading is important and should be done before the lecture on it. Again, I will make this clear to you beforehand. Please feel free to ask questions about the reading in lecture. I will ask if there are any.

- **Homework:** Assignments will be made most weeks and announced in class and on the messages from the class site. See above. Late handed in problems are not fair to the TA as she has to do extra work. Our default policy is that late homework will not be accepted.

- **Exams:** There will be two in-class exams, call them midterms, and a final. Absence from these exams is serious. Of course, in the case of (serious) illness, proof would be required.

- **Questions:** You are HIGHLY urged to ask questions in lecture. We’re a fairly small group – about 30 in a largish lecture hall, so I ask you to sit up front! This material is, or was, at the frontiers of human knowledge during its time. It is unlikely you can master all the concepts without some areas of uncertainty – something you simply don’t understand. So, do speak up!

- **Office Hours:** It is important not to get lost in this class. Please come and see me if anything confounds you. I am very available. My official office hours are M, W 2:00-3:00, but if you email me, I’ll meet with you anytime I’m free. Similarly, Lauren Greenspan is a very experienced instructor who worked in this course extensively. She asked me to specifically invite you to avail yourself of her services.

**Grading:** The letter grade you receive for this course will be calculated according to the following scheme:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>First Midterm</td>
<td>20%</td>
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<tr>
<td>Second Midterm</td>
<td>20%</td>
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<tr>
<td>Homework</td>
<td>25%</td>
</tr>
<tr>
<td>Final exam</td>
<td>35%</td>
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</tbody>
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Lecture Schedule (approximate)
Homework and reading will be assigned separately

1. Overview and some history. Mathematical review
2. A sneak peek into special relativity – the light clock and time dilation.
4. Background: Newton's Laws, forces.
5. Background: coordinates, frames, relative motion, Galilean transformations.
7. Two observer spacetime diagrams. The Lorentz transformation.
8. Relative velocity, paradoxes, causality.
10. Relativistic momentum and \( E = mc^2 \).
11. Background: Newtonian gravity, local g.
12. Equivalence principle and time dilation.
15. **Midterm I**
16. Background: waves and electric and magnetic fields
17. Background: wave superposition, interference.
18. The atomic structure of matter.
19. Photoelectric effect, black body radiation.
20. DeBroglie’s hypothesis.
22. Other quantum effects. measurement, spin, entanglement, Pauli,
23. **Midterm II**
24. The periodic table, degeneracy pressure, hidden variable.
25. Quantum vs classical matter, BEC, superconductivity, superfluidity
27. Nuclear physics, half-lives, fission, fusion.