Course Outline: Physics 201: Modern Physics
Winter 2013

1. **Contact Information & Office Hours:** Carl Adams, Rm 1006 Physical Sciences Complex, x5337, in research lab PS 1070, or in undergrad labs 1023/1026 or 1067. Email: cadams@stfx.ca. I am usually in my office or lab from 9 to 5 each day except for classes and labs (although I have a lot of meetings in January). Formal office hours will be Monday 11:15 to 12:05 and 1:15 to 3:05, Wednesday 10:15 to 11:05 and 1:15-2:05, and Thursday 10:15 to 11:05. Let me know if you would like a special appointment.

2. **Summary:** This course deals primarily with the crucial developments in physics that occurred in the late 19th and early 20th centuries. I will highlight the differences between classical and modern physics and at the same time motivate a deeper appreciation for how closely we can describe nature. Experimental labs will also be a crucial part of the course. Current examples will be cited whenever possible.

3. **Text:** *Modern Physics* 6e, Tipler and Llewellyn. We will cover chapters 1-6 and parts of chapters 11 and 12. I also have quite a few references I am happy to loan out for short periods and others will be on the shelf outside of my office. Sometimes I will go beyond what is included in the text and you will be responsible for this. (95% of the course will still be included in the text)

4. **Website:** http://www.stfx.ca/people/cadams and follow the PHYS 201 links. It is not a great website by any means but it is a good place to put things.

5. **Grading scheme:**

Assignments (4)	20%
Labs	25%
Midterm	15%
Final Exam	40%

6. **Expectations:** I refer your attention to Section 3.8 of the Academic Calendar **Academic Integrity Policy**. These codes and policies extend to material and data in the laboratory as well as exams, midterms, and assignments. I support a safe classroom environment free of harassment or discrimination for all students regardless of race, religion, gender, sexual orientation, gender identity, or disability. Assignments are due at the beginning of class if there is a class on the due date and by 4 p.m. if there is no scheduled class that day. The assignment mark will be penalized by 10% for each teaching day the assignment is late after the due date up to a maximum of one week. After one week or if in special circumstances where I circulate solutions prior to that time (a warning will be given) the assignment will be worth zero. (I may still mark the assignment if you would like to see how well you did.) I will do my best to return the assignments within 7 days or sooner.

7. **General:** A considerable portion of the midterm and exam questions will be based on assignment questions and examples covered in class and in the book so it is very important that you understand these solutions. *All midterms and exams will be closed book with a formula sheet that I will provide to you in advance.* The midterm will take place in class on Friday, Feb. 15. We will have an optional tutorial on Feb. 13 rather than a lab. We can also schedule a tutorial prior to the final exam.

8. **Labs:** The labs take place in rooms 1023 and 1026 in the Physical Sciences Complex. I will give you a separate description of lab requirements and layout when you come to the lab. *But* you will need a lab book so try to get one before then. (A classic black one is best with fairly wide line spacing and included graph paper. "Recycled" is fine.) I will take the lab books in for marking on Jan. 25, Feb. 8, March 8, and the last day of classes April 5. The last day of labs will be March 27.

9. **Course Outline (12 weeks total):**

   (a) Special Relativity (4 weeks)
      i. Frames of Reference and Coordinate Transformations
      ii. Consequences of Lorentz transforms
      iii. Meaning of relativity
      iv. Classical relativity and Michelson-Morley Experiment
      v. Einstein's Postulates
      vi. Relativity of simultaneity
      vii. Space-time diagrams
      viii. Time Dilation, Length Contraction, Doppler Effect
      ix. Paradoxes
      x. Relativistic momentum and energy
      xi. 4-vectors
      xii. Equivalence principle in general relativity

   (b) Quantization (2 weeks)
      i. Discovery of the electron
      ii. Blackbody Radiation
      iii. Photoelectric Effect
      iv. X-rays and the Compton effect

   (c) Early Atomic Quantum Theory (1.25 weeks)
      i. Rutherford Scattering and the Nuclear Atom
      ii. Bohr Hydrogen Atom
      iii. X-ray spectra
      iv. Franck-Hertz experiment

   (d) Wave Description of Matter (1.25 weeks)
      i. deBroglie relations
      ii. Young's Double Slit Experiment: Classical Waves
      iii. Wavelike properties of particles
      iv. Heisenberg Uncertainty Principle

   (e) Schrödinger's Quantum Mechanics (2.5 weeks)
      i. Motivation for Schrödinger Equation
      ii. Free Particles
      iii. Particle in a Box
      iv. Operators and Commutators

v. Simple Harmonic Oscillator
vi. Barrier Penetration and Tunneling

(f) Introduction to Nuclear and Particle Physics (1 week)

i. Nuclear Model and Alpha, Beta, Gamma Decay
ii. Basic Concepts of Particle Physics
iii. Fundamental Forces
iv. Conservation Laws and Symmetries
v. The Standard Model