Physics 322: Elementary Modern Physics
Spring Semester 2009 (3 Credits)

Instructor: Juan E. Cabanela
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Lecture: T & TH 10:30 AM - 11:45 AM in Hagen 325
Class Website: *http://phys322.cabanela.com/*

TROUBLE CONNECTING? Some people living in the dorms or using GoMoorhead have reported problems accessing the above URL, in which case you should use:
http://199.17.102.218/~juan/classes/phys350/

Course Bulletin Description

special relativity, wave-particle duality, Bohr atom, quantum mechanics, hydrogen atom, many electron atoms, nuclear properties and nuclear reactions. *Prerequisite:* PHYS 201**.**

Materials Required or Suggested:

1. **[Required]** Access to the Internet, since all course materials that would traditionally be "handouts" will be posted online (see us if this is an issue).
2. **[Required]** *Modern Physics (2nd Edition)* by Randy Harris (Pearson, Addison Wesley) ISBN: 0-8053-0308-1

Course Objectives

By the end of this course you should be able to:

- Describe qualitatively the relationship between special relativity, quantum mechanics, and classical mechanics. Notably how classical mechanics is really a special case situation for non-relativistic speeds and macroscopic situations.
- Describe, using words, diagrams and tables, the basic atomic and subatomic constituents of matter.
- Explain qualitatively, using the quantum nature of light and matter, and the conservation of momentum, the observed interaction between photons and matter in a given situation.
- Predict, using the Heisenberg Uncertainty Principle, the lower limit of size, momentum, energy or time that could be expected in a given atomic/subatomic measurement or situation.

Course Components/Instructional Strategies

- **In Class Activities (10%):** In lecture I will introduce new topics and work examples. We will also (I hope) have some in class active learning activities to help make some of the more abstract concepts in the course more familiar. Attendance at lecture and participation in lecture is strongly encouraged.

- **Problem Sets (50%):** Modern physics covers topics that are typically outside of our everyday experience and as such can be quite challenging to to develop an intuitive feel for. The assigned problem sets are crucial to developing your mathematical skills and physical intuition. I encourage you to exert all reasonable efforts in tackling the problem sets I assign. You must be clear about your line of thinking and show not only mathematics, but write out your reasoning. **Full credit on problem sets will only be given to students who clearly show me not only their mathematical approach to the answer, but clearly state their reasoning.**
    - I will provide solutions to all the problem sets shortly after they are turned in.
    - **ON COLLABORATING WITH OTHERS:** You may work together to check each other's work. **However, the work you present must be your own.** You will get little out of the problem sets if you just copy someone else's solutions. To avoid the appearance of plagiarism, I would also strongly suggest you state clearly if you work with someone on your homework.

- **Exams: (10% for each midterm, 20% for final)**
    - There will be two mid-term exams during the semester in addition to the final exam. Study Guides showing the list of topics covered or each exam will be provided. **The final exam is Thursday, May 7, 12 noon – 2pm.**

Course Grading Policy

- **You are expected to turn your work in on time.**
- Your grade will be determined by your scores on the homework, labs, and exams, weighted as follows:

Exams	Homework	Lab
40%	30%	30%

- Grades will be assigned according to your percentage score. Plusses and minuses will be used. The initial grading scale is shown below (I reserve the right to adjust it as necessary)

A	**B**	**C**	**D**	**F**
89.9%-100%	79.9%-89.9%	65%-79.9%	50%-65%	0-50%

From the Student handbook:

The University expects all students to represent themselves in an honest fashion.

In academic work, students are expected to present original ideas and give credit for their ideas of others. The value of a college degree depends on the integrity of the work completed by the student.

When an instructor has convincing evidence of cheating or plagiarism, the following actions may be taken: assign a failing grade to the assignment in question, or assign a failing grade for the course in which the student cheated. For informational purposes, instructors may choose to report the offense, the evidence, and their action to the Dean of their college, or the Vice President for Academic Affairs. If the instructor (or any other person) feels the seriousness of the offense warrants a different or additional penalty, the incident may be reported to the Student Conduct Committee through the Student Support Services Office. The Student Conduct Committee will follow procedures set out in the Student Conduct Code. After its review of the case, and fair and unbiased hearing, the Student Conduct Committee may take disciplinary action if the student is found responsible (see Student Conduct Code for details).

A student who has a course grade reduced by an instructor because of cheating or plagiarism, and who disputes the instructor's finding, may appeal the grade, but only by using the Course Grade Appeal Policy, which states that the student must prove the grade was arbitrary, prejudicial, or in error.

In this course, all instances of academic dishonesty will be reported to the Dean of the College of Social and Natural Sciences for informational purposes.

Special Accommodations

Students with disabilities who believe that they may need an accommodation in this class are encouraged to contact Greg Toutges, Coordinator of Disabilities Services, at 477-2652 (phone) or 477-2047 (TTY), CMU 222, as soon as possible to ensure that accommodations are implemented in a timely fashion.

Tentative Class Schedule

This schedule is **tentative** and we reserve the right to adjust as necessary. Items listed in *italics* are optional and may be skipped if we run behind. Check the online schedule on the class website for the most up to date subject list and readings.

		Lecture Topics	
Week #	**Week of …**	**Tues**	**Thurs**
1	Jan. 11	Introductions / Partial Review of Classical Mechanics (Harris Chapter 1)	Special Relativity: Basic Postulates and Frames of Reference (Harris Chapter 2)
2	Jan. 18	Special Relativity: Lorentz Transformation, Time Dilation, Lorentz Contraction (Harris Chapter 2)	Special Relativity: Relativistic Velocity (Harris Chapter 2)
3	Jan. 25	Special Relativity: Momentum and Energy (Harris Chapter 2)	*General Relativity: Loose Ends (Harris Chapter 2)*
4	Feb. 1	Light as a Particle: Blackbody Radiation, Photoelectric Effect (Harris Chapter 3)	Light as a Particle: Compton Effect, Pair Production (Harris Chapter 3)
5	Feb. 8	Particles as Waves: Double-Slit Experiment, Matter Waves (Harris Chapter 4)	Particles as Waves: Free-Particle Schrödinger Equation and the Uncertainty Principle (Harris Chapter 4)
6	Feb. 15	Particles as Waves: Bohr Model (Harris Chapter 4)	Simple Bound States: The Schrödinger Equation, Stationary States (Harris Chapter 5)
7	Feb. 22	**Midterm #1**	Simple Bound States: The Infinite Well (Harris Chapter 5)
8	Mar. 1	Simple Bound States: The Finite Well, SHO (Harris Chapter 5)	Simple Unbound States: Quantum Tunneling (Harris Chapter 6)
9	Mar. 8	3D Quantum Mechanics: 3D Schrödinger Equation (Harris Chapter 7)	3D Quantum Mechanics: 3D Infinite Well (Harris Chapter 7)
	Mar. 15	**Spring Break**	
10	Mar. 22	3D Quantum Mechanics: Central Forces (Harris Chapter 7)	3D Quantum Mechanics: Hydrogen Atom and Hydrogenlike Atoms (Harris Chapter 7)

11	Mar. 29	Spin and Atomic Physics: Angular Momentum Quantization (Harris Chapter 8)	*Spin and Atomic Physics: Exclusion Principle, Multielectron Atoms, and the Periodic Table (Harris Chapter 8)*
12	Apr. 5	**Midterm #2**	Nuclear Physics: Basic Structure, Binding (Harris Chapter 11)
13	Apr. 12	Nuclear Physics: Radioactivity and Radioactive Decay law (Harris Chapter 11)	Nuclear Physics: Nuclear Reactions (Harris Chapter 11)
14	Apr. 19	**No Lecture (Student Academic Conf.)**	Fundamental Particles: How Forces Act, Antiparticles (Harris Chapter 12)
15	Apr. 26	Fundamental Particles: Particle Production and Detection (Harris Chapter 12)	Fundamental Particles: Decay Modes and Unified Theories (Harris Chapter 12)
16	May 3	Catch-up Lecture	**No Lecture (Finals)**

The final exam is Thursday, May 7, 12 noon – 2pm.