PHYS 2D
Relativity and Quantum Mechanics

Summer Session II, 2011

Instructor: Grigor Aslanyan, aslanyan@physics.ucsd.edu
Office hours: Tuesday, Wednesday, 11am-12pm, MHA 4514

Teaching assistant: Joe Salamon, jsalamon@ucsd.edu
Office hour: Thursday, 4-5pm, MHA 2702 (physics tutorial center)

Grader: Ben Holladay, bholladay@ucsd.edu

Course webpage: http://physics.ucsd.edu/students/courses/summer2011/session2/physics2d/

Textbook: Serway, Moses, Moyer, "Modern Physics", third edition, Brooks Cole 2005

Lectures: Monday, Tuesday, Wednesday, Thursday, 2:00-3:20pm, YORK 2722
Discussion sections: Monday, 4:00-5:50pm, CSB 001
Problem sessions: Tuesday, 4:00-5:50pm, HSS 1330
Midterm 1: Wednesday, 08/10/2011, 2:00-3:20pm, YORK 2722
Midterm 2: Wednesday, 08/24/2011, 2:00-3:20pm, YORK 2722
Final exam: Friday, 09/02/2011, 3:00-6:00pm, TBA

Course description (informal): This course gives an introduction to the most profound discoveries of the beginning of 20^{th} century – relativity and quantum mechanics. You will learn how time can "slow down" for moving objects, how particles can behave as waves and vice-versa, what gives the periodic table its periodicity, etc. Although these topics may sound far from real life, we encounter their applications every day: all the electronics work thanks to quantum mechanics, the sun shines thanks to the relativistic energy-mass equivalency... By the end of the course you will be able to determine if it is important to apply relativity or quantum mechanics to a given problem, and actually apply it if needed!

Course description (formal): Foundations of special relativity: Lorentz transformations, relativistic energy and momentum. Introduction to quantum mechanics: wave-particle duality, Heisenberg uncertainty principle. Schrödinger equation and applications: particle in a box, harmonic oscillator, hydrogen atom. Spin and Pauli exclusion principle.

Homework: Homework will be assigned each week but not collected for grading. Each weeks assignment will be posted on the course webpage on or before Monday. The solutions will be posted later in the week to give you enough time to work on your own, with the exception of weeks 2 and 4 (midterm weeks) when they will be posted together with the homework. It is strongly encouraged to do the homework **before** the problem session. Homework solutions should be checked only after considerable effort on your own. Doing the homework is the best way to prepare for the exams. Each of the exams will contain at least one problem almost (or completely) identical to a homework problem.

Additional reading: Feynman, Leighton, Sands, "The Feynman Lectures on Physics", volumes 1, 3.

Grading: The overall course grade will be based on two midterm exams (**25% each**) and the final exam (**50%**). Attendance to the exams is **mandatory** and there will be **no makeup exams**. Make sure to **bring your student ID** to all three exams, you may not be allowed to take the exam without it. You need a bluebook, a pen/pencil and a calculator for each exam (having an extra bluebook for the final would not be a bad idea). You are not allowed to have anything else during the exams, the main equations you need will be provided (the equation sheet will be posted on the course webpage 1-2 days in advance).

Course Schedule

Week 1	
Mon, 08/01	Principle of relativity, Galilean transformations, Michelson-Morley experiment, 1.1-1.3
Tue, 08/02	Postulates of special relativity, length contraction, time dilation, Doppler shift, 1.4-1.5
Wed, 08/03	Spacetime interval and causality, Lorentz transformations, velocity transformations, 1.6-1.7
Thu, 08/04	Relativistic energy and momentum, 2.1-2.2
Week 2	
Mon, 08/08	Energy vs. mass, intro to general relativity, 2.3-2.5
Tue, 08/09	Examples
Wed, 08/10	Midterm 1
Thu, 08/11	Photoelectric effect, Compton effect, 3.4-3.5
Week 3	
Mon, 08/15	Rutherford's model of the atom, 4.1-4.2
Tue, 08/16	Bohr's model of the atom, 4.3-4.4
Wed, 08/17	De Broglie waves, wave packets, 5.1, 5.3
Thu, 08/18	Heisenberg uncertainty principle, wave-particle duality 5.5-5.7
Week 4	
Mon, 08/22	Foundations of quantum mechanics: wave functions, operators, expectation values, Schrödinger equation, 6.1-6.3, 6.7, 6.8
Tue, 08/23	Examples: particle in a box, simple harmonic oscillator, 6.4-6.6
Wed, 08/24	Midterm 2
Thu, 08/25	Square barrier and tunneling, 7.1-7.2
Week 5	
Mon, 08/29	Quantum mechanics in 3 dimensions: particle in 3D box, central forces, angular momentum, 8.1-8.4
Tue, 08/30	Hydrogen atom, Zeeman effect 8.5, 9.1
Wed, 08/31	Spin, Pauli exclusion principle, periodic table 9.2, 9.4, 9.6
Thu, 09/01	Review
Fri, 09/02	**FINAL EXAM**