Introduction to Modern Physics

PHYS 20A
Fall 2007
MWTh 9:10-10:00

Instructor Information

Name	:	Jim Bensinger
E-Mail	:	bensinger@brandeis.edu
Office	:	312
Phone	:	781-736-2875
Office Hours	:	By appointment

Prerequisites

PHYS 11a, 11b, or equivalent
Textbooks
Required : Serway, Moses, and Moyer *Modern Physics*, third edition
: French, *Vibrations and Waves*, first edition

Homework assignments

Homeworks will be graded and count toward 25% of the final grade. Collaboration with fellow students is permitted, but copying is not. Homework assignments will be posted on webct on Sundays and are due the Monday of the following week at the beginning of class. Late homework sets will be corrected, but a failing grade of 50% will be given. Optional homework problems for extra credit may be occasionally given.

Please be neat with your calculations, write on one side of paper only, number your equations and put a circle or box around your final answer.

Exams

There will be a closed book, mid-term exam and a cumulative final exam. The exams, homework and in-class participation will be the basis for the grade

Course Contents

In this course we study three main topics, the Special Theory of Relativity, Vibrations and Waves of classical systems and introductory Quantum Mechanics.

For the first part of the course, we will spend three weeks studying the following topics in relativity:

- Review of Newtonian physics, vector algebra and vector calculus
- Galilean relativity
- Einsteinian relativity
- Simultaneity, time dilation, length contraction
- Lorentz transformations, four vectors
- Relativistic kinematics
- Relativistic dynamics

We will then begin our investigations of vibration and waves of classical systems. This part of the course will take about 6 weeks and will cover the following:

- Simple harmonic motion and solutions to second order, inhomogeneous, linear differential equations with constant coefficients.
- Some complex variables
- Forced oscillator, damped oscillator
- Coupled oscillators
- N coupled oscillators on a loaded string
- Wave equation
- Traveling waves, impedance, reflection and transmission at a boundary
- Standing waves, normal modes
- Fourier series, complex representation, fourier integral
- Interference and diffraction

With this background in wave phenomena, our time for the remainder of the semester, about 4 weeks, will be occupied studying introductory quantum mechanics. This first presentation of quantum mechanics is also known as wave mechanics, so our previous study of waves in familiar classical

surroundings will help us understand them in the more abstract quantum mechanical arena.

Specific items for study are

- Why we need quantum mechanics - photoelectric effect, discrete spectral lines, Compton effect
- de Broglie waves, wave function, Bohr Atom
- Schrodinger Equation, Heisenberg Uncertainty Principle
- Wave function as a probability amplitude
- Infinite square well and finite square well potentials
- Expectation values, observables and operators
- One dimensional scattering, tunneling