



**PC 2380 Electromagnetism and Optics 3.0(3-0-3/2) UT(3.0) Winter 94**  
**U of A Equivalent - Phys 238**  
**Course Information**

**Calendar Description:**

**PC 2380 Wave Motion and Electricity 3.0(3-0-1.5) UT(3.0)** Magnetic field, Ampere's Law; Faraday's law; inductance; magnetic properties of materials; geometrical optics; interference; diffraction.

**Prerequisite:** PC 1370 or PC 1430

**Instructor:** Dr. Jaime P. Santiago  
J209, 539-2865

**Lecture:** MWF 10:00 - 10:50 a.m., J229

**Laboratory:** R 3:00 - 5:50 p.m., J107

**Textbook:** **Physics for Scientists and Engineers, 3rd Edition, Updated Version**  
by R. A. Serway (Saunders)

**Laboratory Manual:** **PHYSICS Laboratory Manual**  
**PHYS 238**  
by Physics Department, University of Alberta (McGraw-Hill Ryerson)

<b>Assignments:</b>	12 problem sets No late assignments accepted.
<b>Grading:</b>	Assignments 10% Laboratory 20% Midterm Examination 25% Final Examination 45%

**Marking:**

Students must pass the laboratory course in order to pass the course. Passing mark is 50%. A student who fails to pass the laboratory course must repeat the entire course. Students who have previously taken the course and passed the laboratory component with at least 65% may choose not to repeat the lab.

Re-writing of the final examination may be allowed in special circumstances under rules approved by the College.

**Assignments:**

There will be approximately 12 problem sets in this course. Assignments are normally due on Mondays.

**Laboratory:**

The laboratory schedule will be decided later depending on class size and progress in the lecture. A tentative lab timetable is given in the course calendar. Laboratory reports are due at the end of the period. No late reports will be accepted. Lab reports should be handwritten (pencils are OK) on black Physics Laboratory Books available at the bookstore. A student who misses a lab due to illness or other extreme reasons may perform the lab at a different time if the lab equipment for the experiment is still set up or if the lab technician agrees to set them up again. The lab technician has sole discretion whether to set up the equipment again or not. If the equipment is not available anymore and the absence is excused by the instructor, the student will not be required to hand the lab and his/her mark adjusted accordingly.

**Midterm Examination:**

The midterm exam is tentatively scheduled for 18 February, 1994 from 11:00 a.m. to 11:50 a.m. Writing of midterm exams will done in the regularly assigned classroom. There is no provision for rescheduling if a student misses the exam.

**Final Examination:**

Final exams are 3 hours long and are normally held at the College Gym. Dates and times will be announced later by the registrar's office. Any conflicts should be reported to the registrar.

**PC 2380 - Electromagnetism and Optics  
Course Outline (Winter, 1994)**

**A. The Magnetic Field  $B$**  (3) January W5, F7, M10, Chapter 29 of Serway

1. Definition of the magnetic field
  - force on a moving charge
  - force on a current carrying wire
2. Torque on current carrying loop
  - magnetic moment
3. Motion of charged particles in a magnetic field
  - motion in crossed electric and magnetic fields
  - Hall Effect
  - applications

**B. Source of Magnetic Field** (5) January W12, F14, M17, W19, F21 Chapter 30 of Serway

1. Biot-Savart Law
  - force between current carrying conductors
2. Ampere's Law
  - Magnetic field calculations using ampere's law
3. Gauss' Law for Magnetism
  - generalized Ampere's Law
4. Magnetism in Matter
  - magnetic dipole moments
  - quantum numbers
  - diamagnetism, paramagnetism and ferromagnetism
5. Magnetization and Magnetic Field Strength ( $M$  and  $H$ )

**C. Faraday's Law** (3) January M24, W26, F28 Chapter 31 of Serway

1. Faraday's Law of Induction
  - Lenz' Law
  - motional emf
2. Induced Electric Fields
  - generators and motors
  - eddy currents
3. Integral Form of Maxwell's Equations

**D. Inductance** (4) January M31, February W2, F4, M7 Chapter 32 of Serway

1. Self-Inductance
  - definition of  $L$
  - energy stored in an inductor; energy density in magnetic field
  - RL circuits
2. Mutual Inductance
  - RL circuits with mutual inductance
3. LC and RLC circuits
  - underdamped, overdamped and critically damped oscillations

**E. Electromagnetic Waves (4) February W9, F11, M14, W16, Chapter 34 of Serway**

1. Maxwell's Equations
  - plane em waves
  - speed of light
2. Energy Carried by Electromagnetic Waves
  - Poynting vector
3. Momentum and Radiation Pressure
4. Production and Detection of Electromagnetic Waves
  - electric dipole antenna
  - magnetic dipole antenna

The midterm exam is based on material up to the end of section D. The midterm exam will be on Friday, 18 February, 1994 at 10:00 a.m. The exam is 50 minutes long.

**F. The Nature of Light and the Laws of Geometric Optics (3) February M28, March W2, F4, Chapter 35 of Serway**

1. Wave and Particle Nature of Light
  - the speed of light in vacuum and in material media
  - measurement of the speed of light
2. Ray approximation; Huygen's Principle
3. Laws of Reflection and Refraction
4. Dispersion

**G. Geometric Optics (6) March M7, W9, F11, M14, W16, F18 Chapter 36 of Serway**

1. Image formed by reflection
  - plane mirrors
  - spherical mirrors
2. Image formed by refraction
  - single refraction surface
  - thin lenses
  - combinations of lenses
3. Image formed by combined reflecting and refracting surfaces
4. Optical Instruments

**H. Interference of Light (4) March M21, W23, F25, M28 Chapter 37 of Serway**

1. Interference
  - coherence, monochromaticity
  - double slit experiment
2. Intensity Distribution From a Double Slit
3. Phasors
4. Interference in Thin Films
  - temperature dependence
  - model for electrical conduction
4. Electrical Energy and Power; Energy Conversion

**I. Diffraction of Light (6) March W30, April M4, W6, F8, M11, W13 Chapter 38 of Serway**

1. Fresnel and Fraunhofer Diffraction

2. Diffraction from a Single Slit
  - intensity distribution
3. Diffraction from a Double Slit
4. Diffraction from a Circular Aperture
  - optical resolution
5. Diffraction from Multiple Slits
6. Diffraction Grating
  - resolving power
  - dispersion
7. Polarization of Light

**PROBLEM SETS: (Physics for Scientists and Engineers - Serway)**

1. Chapter 29 - #10, 21, 23, 68, 64, 54
2. Chapter 30 - #82, 63, 73, 84, 44
3. Chapter 30 - #55, 56, Chapter 31 - #16, 53, 69
4. Chapter 31 - #62, 37, Chapter 32 - #78, 42, 77
5. Chapter 32 - #31, 52, 61, 68, 76
6. Chapter 34 - #20, 29, 46, 58, 59
7. Handout
8. Chapter 35 - #56, 52, 45, Chapter 36 - #3, 54
9. Chapter 36 - #24, 36, 59, 64, 66
10. Chapter 36 - #65, 74, 76, Chapter 37 - #55, 70
11. Chapter 37 - #53, 62, 66, 64, 68
12. Chapter 38 - #10, 19, 73

(I) Design a double-slit system in which the fourth bright fringe not counting the central maximum is missing. What other fringes, if any, are also missing?

(II) How many complete fringes appear between the first minima of the fringe envelope to either side of the central maximum for a double-slit pattern if  $\lambda = 550 \text{ nm}$ ,  $d = 0.150 \text{ mm}$ , and  $a = 30.0 \mu\text{m}$ ? What is the ratio of the intensity of the third fringe to one side of center to the intensity of the central fringe?