



**PC 2380 Electromagnetism and Optics
3.0(3-0-1.5) UT(3.8) 1996-1996 Y
U of A Equivalent - Phys 238
Course Information**

Calendar Description:

PC 2380 Wave Motion and Electricity 3.0(3-0-1.5) UT(3.8) Magnetic field, Ampere's Law; Faraday's law; inductance; magnetic properties of materials; geometrical optics; interference; diffraction.

Prerequisite: PC 1020, PC 1370 or PC 1430

Instructor	Dr. Jaime P. Santiago/Dr. Bert Hunt 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)

Assignments	12 problem sets No late assignments accepted.								
Grading	<table> <tr> <td>Assignments</td> <td>10%</td> </tr> <tr> <td>Laboratory</td> <td>20%</td> </tr> <tr> <td>Midterm Examination</td> <td>25%</td> </tr> <tr> <td>Final Examination</td> <td>45%</td> </tr> </table>	Assignments	10%	Laboratory	20%	Midterm Examination	25%	Final Examination	45%
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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. Late assignments will not be accepted.

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 valid reason may perform the lab at a different time. The student making up a lab should make arrangements with the lab technician.

Midterm Examination

You will be given at least two weeks notice of the date of writing of the midterm exams.

Final Examination

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

PC 2380 - Electromagnetism and Optics Course Outline 1995-96

A. The Magnetic Field B (3 hours) 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 hours) 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 hours) 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 hours) 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 hours) 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

F. The Nature of Light and the Laws of Geometric Optics (3 hours) 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 hours) 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 hours) 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 hours) 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?