



PC 2380 ELECTROMAGNETISM AND OPTICS
3.0(3-0-3/2) UT(3.0) Fall 92
U of A Equivalent - Phys 238
Course Outline

Calendar Description:

PC 2380 Electromagnetism and Optics 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; and diffraction.

Prerequisite: PC 1370 or PC 1430

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

Lecture: MWF 12:00 - 12:50 p.m., J229

Laboratory: M 3:00 - 5:50 p.m., J103

Textbook: **Fundamentals of Physics, 3rd Edition**
D. Halliday and R. Resnick (Wiley)

Laboratory Manual: **Physics 204/238 Laboratory Manual**
Physics Department, University of Alberta
(McGraw-Hill Ryerson)

Assignments: 10 problem sets
25% deduction per day late
Assignments more than 2 days late will not be accepted

Grading:	Assignments	15%
	Laboratory	15%
	Midterm Exam	20%
	Final	50%

Notes: An average of **50%** must be obtained in laboratory work in order to pass the course.
An average of **45%** must be obtained in written examinations must be obtained in order to pass the course.
There is no supplemental or final examination re-write.

Detailed Course Description

- A. **The Magnetic Field (4 50-minute lectures)**
1. Definition of the magnetic field, \mathbf{B} ; Lorentz force
 2. Comparison of magnetic field with electric field
 3. Motion of charge particles in the presence of electric and magnetic fields
 4. Magnetic force of a current
 5. The magnetic dipole; comparison with electric dipole; torque on a magnetic dipole in a \mathbf{B} field
- B. **Ampere's Law (5)**
1. Connection between electric current and magnetic field
 2. Biot-Savart Law; right hand rule
 3. Magnetic force on a current-carrying wire
 4. Force between current carrying wires; definition of the ampere
 5. Ampere's Law; calculation of magnetic fields using Ampere's Law
 6. Current loops as magnetic dipoles
- C. **Faraday's Law of Induction (3)**
1. Experimental and historical background
 2. Faraday's Law
 3. Lenz's Law
 4. Induced electric fields
- D. **Inductance (3)**
1. Definition of inductance; self-inductance; mutual inductance
 2. Calculation of inductance
 3. LR circuits
 4. Energy stored in a magnetic field; magnetic energy density

E. Magnetism and Matter (3)

1. Permanent magnets
2. Magnetism and the electron
 - electron spin and magnetism
 - electron orbital angular momentum and magnetism
3. Gauss's law for magnetism
4. The earth's magnetic field; interaction with the solar wind
5. Magnetism in matter
 - paramagnetism
 - diamagnetism
 - ferromagnetism (magnetization curve and hysteresis)
 - nuclear magnetism

F. Maxwell's Equations (2)

1. Speed of light
2. Induced magnetic fields
3. Displacement current
4. Maxwell's equations

G. Electromagnetic Waves (4)

1. The electromagnetic spectrum
2. Generating EM waves; LC oscillator
3. Traveling EM waves; electric and magnetic dipole antennas
4. Energy and momentum transport
 - Poynting vector
 - radiation pressure
5. Polarization of EM Waves
 - plane, circular and elliptical polarization
 - sheet and crystal polarizers

H. Geometrical Optics (6)

1. Law of reflection
2. Law of refraction (Snell's law)
3. Total internal reflection; fiber optics
4. Polarization by reflection (Brewster angle)

5. Plane and spherical mirrors
 - real and virtual objects and images
 - lateral magnification
 - focal length
 - ray tracing
 - mirror equation
6. Spherical refracting surfaces
 - lensmaker's formula
 - paraxial rays; paraxial approximation
 - ray tracing
 - thin lenses; thin lens formula
7. Optical instruments
 - magnifying glass
 - simple lens systems
 - compound microscope
 - astronomical telescopes
8. Aberrations (time permitting)
 - longitudinal and transverse spherical aberration
 - chromatic aberration
 - astigmatism
 - coma, distortion, field curvature

I. Interference of Light (4)

1. Light as a wave
 - frequency, wavelength, amplitude, intensity
 - spatial and temporal coherence
2. Huygen's Construction; the principle of Kirchoff and Fresnel
3. Young's double slit experiment
4. Intensity in double-slit
5. Phasor diagrams
6. Interference in thin films; thin film coatings; Newton's rings
7. Interferometers (time permitting)

J. Diffraction (5)

1. Fresnel and Fraunhofer diffraction
2. Fraunhofer diffraction from a single slit
 - location and distribution of intensity maxima and minima
3. Fraunhofer diffraction from a circular aperture (qualitative)
 - Rayleigh criterion

4. Fraunhofer diffraction from a double-slit
5. Multiple slits
6. Diffraction gratings
 - dispersion
 - resolving power
 - x-ray diffraction

Laboratory Work

All laboratory reports are due at the end of the laboratory period. There will be a 25% deduction per day late. No late reports will be accepted after two days.

Schedule

Number	Date	Expt. #	Title
1	Sept. 14	Handout	Measurement of e/m
2	Sept. 28	4	Electromagnetism
3	Oct. 5	Handout	Speed of light
5	Nov. 2	8	Geometric optics
6	Nov. 16	10	Interference of light