Grande Prairie Regional College

Department of Science

# PC 1370 Wave Motion and Electricity 3.8(3-1-1.5)UT(4.3)
## U of A Equivalent - Phys 137
## Course Outline

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|---|---|
| **Instructor:** | Dr. Jaime P. Santiago<br>J209 539-2865 |
| **Lecture:** | TR 9:30 - 11:00 a.m. |
| **Seminar:** | T or R 1:30 - 2:30 p.m. |
| **Laboratory:** | T 3:00 - 5:50 p.m. |
| **Pre-requisite:** | PC 1310 Mechanics |
| **Co-requisite:** | MA 1010 Calculus II |
| **Textbook:** | Physics for Scientists & Engineers, 3rd Edition<br>by Raymond Serway |
| **Laboratory Manual:** | Physics 131/137/141/143 Laboratory Manual<br>University of Alberta, Department of Physics |

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| **Assignments:** | 12 Problem Sets<br>No late assignments accepted. |
| **Midterm Exam:** | Tuesday, February 16, 1993<br>9:30 - 11:00 a.m. (regular lecture hour) |

| **Marks Distribution:** | |
|---|---|
| Assignments | 15% |
| Seminars | 5% |
| Laboratory | 20% |
| Midterm Exam | 20% |
| Final Exam | 40% |

**Students must pass the laboratory component of the course independently in order to pass the course. Students failing the laboratory must repeat the entire course.**

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## DETAILED COURSE INFORMATION

**A. Oscillatory Motion (3 - 80 minute lectures) January 5, 7, 12**
**Chapter 13 of Serway**

1. Simple Harmonic Motion
   - amplitude, period, frequency, phase
   - velocity and acceleration
   - differential equation for SHM
   - relationship between SHM and uniform circular motion
2. Simple Harmonic Oscillator
   - mass attached to a spring
   - energy of SHO
   - simple pendulum; physical pendulum; torsion pendulum
3. Damped Oscillations
   - underdamped, overdamped and critically damped motion
4. Forced Oscillations and Resonance

**B. Mechanical Waves (2 lectures) January 14, 19**
**Chapter 16 of Serway**

1. Traveling Waves
   - wavelength, frequency, period, amplitude, phase velocity
   - functional form for traveling waves
2. Types of Waves
   - transverse, longitudinal, combination of transverse and longitudinal waves
   - dispersion
3. Superposition and Interference of Waves
4. Mechanical Waves on a String
   - velocity
   - reflection and transmission at boundaries
   - harmonic waves
   - energy transmitted by harmonic waves
5. Linear Wave Equation

**C. Sound Waves (2 lectures) January 21, 26**
**Chapter 17 of Serway**

1. Velocity of Sound
2. Harmonic Sound Waves
   - displacement and pressure
   - energy and intensity
   - decibel unit
   - plane and spherical sound wave
3. Doppler Effect
   - moving source
   - moving observer
   - source and observer both moving
   - shock waves; Mach number

**D. Superposition and Standing Waves (1 lecture) January 28**
**Chapter 18 of Serway**

1. The Superposition Principle
   - constructive and destructive interference
2. Standing Waves
   - in a string fixed at two ends

- in an air column open on two ends
- in an air column open on one end and closed on the other

3. Beats - interference in the time domain

**E. Coulomb's Law and the Electric Field (4 lectures) February 2, 4, 9, 11**
**Chapter 23 of Serway**

1. Properties of the Electric Charge
2. Insulators and Conductors
3. Coulomb's Law
4. Electric Field
   - point charge
   - dipole
   - continuous charge distributions
   - electric field lines
5. Motion of Charged Particles in a Uniform Electric Field
   - applications

**F. Gauss' Law (3 lectures) February 18, March 2, 4**
**Chapter 24 of Serway**

1. The Electric Flux
   - vector representation of an area
   - surface integrals
2. Gauss' Law for Electric Charge
   - Gaussian surfaces
   - Using Gauss' Law to calculate electric fields
3. Conductors in Electrostatic Equilibrium
   - surface charge density
   - surface electric fields
4. Equivalence of Gauss' Law and Coulomb's Law

**G. The Electric Potential (3 lectures) March 9, 11, 16**
**Chapter 25 of Serway**

1. Electrical potential energy and potential difference
2. The electric potential (voltage)
   - point charges
   - continuous charge distributions
3. Obtaining **E** from V
4. Potential of Charged Conductors

**H. Capacitance and Dielectrics (3 lectures) March 18, 23, 25**
**Chapter 26 of Serway**

1. Definition of Capacitance
2. The Parallel Plate Capacitor
3. Capacitors in Series and in Parallel
4. Energy Stored in a Capacitor
   - electric field energy density
5. Electric Dipole in an External Electric Field
6. Atomic Description of Dielectrics

**I. Electric Current and Resistance (3 lectures) March 30, April 1, 6**
**Chapter 27 of Serway**

1. The Battery and Other Sources of EMF
2. Electric current

- current density, drift velocity, charge density
- positive and negative charge carriers
- direction of conventional current

3. Resistance and Ohm's Law
4. Resistivity
   - conductors and superconductors
   - classical electron model of conduction
5. Electrical Energy and Power
6. Electrical Energy Conversion

**J. Direct Current Circuits (3 lectures) April 8, 13, 15**
**Chapter 28 of Serway**

1. EMF -- voltage sources
2. Resistors in Series and in Parallel
3. Kirchoff's Rules or Laws
   - KVL
   - KCL
4. Single and Multiloop Circuits
5. RC Circuits
6. Electrical Instruments
   - ammeter, voltmeter, Wheatstone Bridge, potentiometers
   - meter loading and input resistance

## LABORATORY SCHEDULE

| Number | Date | Expt. # | Title |
|---|---|---|---|
| 1 | January 12/19 | 13 | Hooke's Law: Spring |
| 2 | January 26<br>February 2 | 15 | Standing Waves on a String |
| 3 | February 9<br>March 2 | 14 | Standing Waves in Air |
| 4 | March 9/16 | 18 | The Oscilloscope |
| 5 | March 23/30 | 17 | Mapping of Electric Fields |
| 6 | April 6 (both groups) | 19 | Capacitance |

Laboratory reports are to be written on black Physics Laboratory Books and submitted at the end of the lab period. For the last lab (Capacitance), both groups will simply take experimental **data on April 6**. Reports are **due on April 8**.