PHYSICS 208

Week 1 Mechanics Review and Coulomb's Law

a. Calculate the potential energy function for various conservative forces in Cartesian coordinates
b. Calculate the potential energy function for gravity in polar coordinates
c. Calculate the Coulomb force exerted on a charged particle by other charged particles, using Coulomb's Law and Superposition

Week 2 Electric Forces and Fields

a. Define vector fields
b. Calculate the gravitational field from Newton's Law of gravity
c. Calculate the electric field produced by a point charge
d. Calculate the force on a charge due to a continuous distribution of charges
e. Calculate the electric field produced by various charge distributions

Week 3 Electric Potential Functions

a. Determine the electric potential function for simple electric fields in Cartesian coordinates
b. Determine the electric potential function due to a single charge
c. Determine the electric potential function due to a collection of charges
d. Determine the electric potential function due to a continuous distribution of charges

Week 4 Derivation of Gauss's Law

a. To define the area vector
b. The define solid angles and the total solid angle
c. To calculate electric flux for simple fields and surfaces
d. To calculate the contributions to flux for a single charge enclosed in an arbitrary surface

Week 5 Applications of Gauss's Law and Capacitors

a. To determine the symmetry of the electric field for the three soluble geometries
b. To determine the appropriate Gaussian surface to evaluate the flux
c. To distinguish the difference between perfect insulators and perfect conductors
d. To determine the appropriate charge inside a Gaussian surface for the two cases

e. To combine the calculation of fields and potential functions to derive the capacitance of the three soluble systems
f. To analyze circuits with capacitors and batteries

Week 6 Current and Ohm's Law

a. To define current and gain qualitative understanding of resistivity, resistance, and Ohm's Law
b. To obtain microscopic form of Ohm's Law in terms of current density vector
c. To derive drift velocity

Week 7 Simple, Time Independent Circuits

a. To obtain Kirchhoff's Laws from Conservative Nature of electric fields and conservation of charge
b. To analyze time independent circuits with batteries, capacitors and resistor

Week 8 Magnetic Fields

a. Consider phenomena leading to introduction of magnetic fields
b. To calculate the motion of charged particles in magnetic and electric fields
c. To find the magnetic force on a current carrying wire

Week 9 Ampere's Circuital Law

a. To apply Ampere's Principle to infinitely long thin wire
b. To apply Ampere's Principle to a current carrying loop
c. To evaluate magnetic flux through a surface
d. To verify Ampere's Circuital Law for simple paths
e. To apply the Circuital Law to simple situations, e.g. coaxial cable

Week 10 Induced EMF and Inductance

a. To see the need for introducing induced EMF by a demonstration
b. To calculate the time derivative of magnetic flux for various situations
c. To understand the non-conservative nature of the resulting electric field

Week 11 More Inductance and Simple Time Dependent Circuits

a. To analyze RL circuits
b. To analyze RC circuits, ignoring L

Week 12 Time Dependent Circuits

a. Analyze RLC Circuits with batteries
b. Analyze RLC circuits with time varying power supplies
c. Compare RLC circuits with forced, damped harmonic oscillator
d. Understand the origin of resonances

Week 13 Maxwell's Equations

a. To analyze a charging capacitor to see the need for displacement currents
b. To demonstrate the resulting consistency of Ampere's Law with displacement currents included
c. To demonstrate the effect of including displacement current in conservation of charge equation
d. To obtain the differential form of Faraday's Law and Ampere's Law in vacuum

Week 14 Electromagnetic Waves

a. To obtain the wave equation from Maxwell's Equations
b. To demonstrate that a sinusoidal electric and magnetic field satisfy the wave equation
c. To calculate the resulting wavelength, frequency relations
d. To determine the velocity of propagation of the wave, the speed of light.