PHYSICS AP C E&M COURSE OUTLINE

Textbook: Tipler, Physics for Scientists and Engineers 4th edition

Course description

Our Physics C course is a two semester course covering mechanics in the first semester and electricity and magnetism in the second semester. The course is designed to be equivalent to a two semester physics sequence for college students majoring in engineering and physical science.

The prerequisites for the course are Physics I and concurrent enrollment in Calculus I. Grades are determined according to the following:

Exams: 60%

Homework: 10%

Labs: 30%

The course includes a laboratory component comparable to a semester long, college level physics laboratory. Each student is required to write up lab reports and maintain a lab notebook. All the labs are open ended and student designed. The primary goal of these labs is to develop independent thinking and problem solving skills. Students spend about 30% of class time doing labs.

This course utilizes a wide variety of instructional methods including guided inquiry and student centered learning to foster the development of critical thinking skills. We promote cooperative learning, authentic instruction and active learning, not only for their instructional benefits, but also for their ability to put students at the center of their own learning.

Some examples include:

• Socratic dialog
• Peer tutoring
• Interactive online java applets
• Student construction projects (radio kits, speaker systems, vandegraff generators, tesla coils, magnetic ring launchers, magnetohydrodynamic water pump, ionic lifter)

week	topic	reading	labs
19	E fields, Coulomb's law Around point charges Conductors and insulators Field lines Superposition principle	Chapter 22 Sections 1 through 8	Mapping E fields Charging an electroscope by induction and conduction
20	continuous charge distributions Methods of integrations	Chapter 23 Section 1	
21	Gauss law Electric flux	Section 2	
22	Gauss law Fields for various geometries and conductor surfaces	Section 3,4,5,6	

23	electric potential, capacitance Voltage Potentials due to multiple charges	Chapter 24 section 1,2	
24	electric potential, gradient Calculating V from E Equipotential surfaces	Section 3,4,5	
25	Electrostatic potential energy and capacitance Calculating capacitance Series and parallel combinations Dielectrics	Chapter 25	Charging and discharging a capacitor Designing a parallel plate capacitor
26	dc circuits, Ohm's law Current Resistance Ohms Law Energy Series and parallel resistors	Chapter 26 Sections 1,2,3,4	Using voltmeters and ammeters Determining an unknown resistance
27	Kirchoff's laws, mutliloop	Section 5	Designing series and parallel

	circuits		circuits
28	RC circuits Voltage and current vs. time graphs RC time constants	Section 6	Measuring RC constants using an oscilloscope
29	B fields, motion of charges particles in B fields, Lorenz force Right hand rule Force between two current carrying wires Torque on current loops B Field around a straight current carrying wire	Chapter 28 Sections 1,2,3	Determining charge to mass ratio of an electron
30	sources of B fields, BioSavart law B fields due to various currents	Chapter 29 Sections 1,2,3,4	Measuring the magnetic field inside a solenoid
31	Ampere's law	Section 5	
32	electromagnetic induction, Faraday's law	Chapter 30 Sections 1,2,3,4	Investigating generator effect using electric

	Magnetic flux Electromotive force Motional emf Faraday's law Lenz's law		motors Electromagnetic induction 1 Electromagnetic induction 2
33	Inductance, RL circuits	Sections 5,6,7	
34	Maxwell's Equations Displacement current Electromagnetic waves Derivation of speed of light E.M. spectrum	Chapter 32	
35	AP review		
36	AP exams		

LAB DETAILS

Mapping E fields Students use carbon paper, a power supply and a voltmeter to trace equipotential lines around various shaped conductors. Then E field lines are constructed perpendicular the the constant voltage lines.
Charging an electroscope by induction and conduction Students investigate methods of charging by using gold foil electroscopes, glass and

plastic rods, fur, silk and an electrophorous.
Charging and discharging a capacitor Students investigate the behavior of a capacitor using a 1 farad capacitor, hand held generator and a light bulb.
Designing a parallel plate capacitor Students are provided with a fixed amount of foil and wax paper and asked to build a capacitor. Then the caps are charged using a Van De Graff. The cap that produces the largest and loudest spark when shorted, wins the contest. Extreme safety is practiced during this lab. The charging and discharging is all done by the instructor.
Using voltmeters and ammeters Students use voltmeters and ammeters to measure the voltage across and current through different light bulbs connected to a power supply.
Determining an unknown resistance Students are given a resistor who's color code has been taped over. Using a power supply, voltmeter and ammeter students are asked to determine the value of the resistor.
Designing series and parallel circuits Students are given a collection of resistors and a power supply and a proto typing board. They are then asked to build circuits that provide a specific voltage drop across one of the resistors and a specific current through one branch of the circuit.
Measuring RC constants using an oscilloscope Students use a function generator, an oscilloscope, a proto typing board and a cap and resistor to study charging and discharging curves.
Determining charge to mass ratio of an electron Students use an electron tube inside a solenoid to create a curved beam of electrons. By

measuring the radius of the path and the strength of the B field q/m for electrons can be determined.
B Field around a straight current carrying wire Students use a pasco magnetic field sensor and science workshop to investigate the field around a section of coat hanger wire connected to a D.C. power supply.
Measuring the magnetic field inside a solenoid Students use a pasco magnetic field sensor, science workshop, and a solenoid to plot B as a function of position inside a solenoid.
Investigating generator effect using electric motors Students connect hand held generators together to investigate electromagnetic induction.
Electromagnetic induction 1 Students use a magnet, solenoid and ammeter to investigate how currents can be created with magnets and coils.
Electromagnetic induction 2 Students use a function generator, voltage probes and science workshop along with pairs of coils around a common core to investigate how transformers work.