AP Physics C-Electricity and Magnetism

Textbook: *Fundamentals of Physics*, Halliday, Resnick, and Walker; 6th ed. New York: John Wiley Vols. 1 and 2

Class Schedule: Classes meet daily for 47 minutes with an additional 47 minute lab period scheduled every fourth day. Formal, Hands-on lab experiences are therefore scheduled for 94 minutes every fourth day.

Mid Term and Final Exams are averaged together to make a "fifth" quarter that is averaged with the four quarters to determine the final grade. Each exam is a teacher generated "mock" AP exam composed of 35 MC and 3 FR. The exams are scored in the same way that an actual AP test would be scored.

Course requirements: Since this is a calculus-based physics course, students are required to take Calculus AB concurrently as a minimum requisite. However, many students have already had Calculus AB upon entering the course and take Calculus BC concurrently. Students are expected to solve problems with a high degree of complexity consistent with a university-level electricity and magnetism syllabus.

Lab Component: Students are expected to perform a comprehensive sequence of formal laboratory investigations.

Formal Extended Time Labs Performed (Hand-On, Discovery)

L1) Electric Field Mapping. (*The students explore E-field lines for various symmetries*)

L2) Equal Potential Mapping (Follow-*up to L1. Students discover the relation between field lines and potential*)

L3) Ohm's Law (*Ohmic and Non-Ohmic loads*) Students are asked to determine why an incandescent light bulb provided a quadratic V vs. I graph.

L4) Resistance and Resistivity (*Students are asked to make resistors of particular value from given raw materials*)

L5) Parallel and Series Circuits (Students *manipulate various loads in the circuit and measure the effect on other elements in the circuit*)

L6) Multi-Branch Circuits (*Students discover Kirchoff's rules empirically*)

L7) Capacitance (*Students study the effects of dielectric materials*)

L8) RC Circuits (*Graphically determine* τ*)*

L9) Magnetic Field Mapping #1: Bar magnets (*Hall effect sensor)*

L10) Magnetic Field Mapping #2: The Solenoid (*Hall effect sensor*)

L11) Mass of the electron (*Using radio tubes and solenoids*) Students use advanced graphing techniques to determine the mass of an electron.

L12) Build an Electric Motor. This is the PRISM'S Lab referred to as "It can't work!" Students have to determine why it does work.

L13) LR Circuits. (*Students discover the properties of LR circuits*)

L14) LC Circuits. (*Students discover the properties of LC circuits*)

Topic Outline and Related Problem Solving

* Indicates where calculus is used extensively.

Topics	Chapters in HRW	# Weeks (Approx.)	Problems
Electric Forces and Fields Elementary Charge Conservation of Charge Conductors and Insulators Coulomb's Law Electric Field Due To Point Charges Electric Field of a Dipole Electric Field Due To Charge Distributions* Electric Field Lines Statics and Dynamics of Charges in Fields	**22,23**	**2**	Various teacher generated problems as well as: Chpt.22 Q: 2,3,5,9,14,16,26,32 Chpt.22 P: 4,5,8,13,15,26,44,46 Chpt.23 Q: 1,6,7,12,15,18,23,29,34,35,37-39 Chpt.23 P: 1,2,6,9,15,17,19,22,23,27,32,34,38,43,46,49,60
Electrostatic Fields and Gauss's Law Electric Flux and Gauss's Law* Gauss's Law Applications: Cylindrical, Spherical, and Planar Symmetries*	**24**	**2**	Various teacher generated problems as well as: Chpt. 24 Q: 2,3,6,7,10,14,17,37,38 Chpt.24 P: 3,5,6,11,13,17,20,21,28,31,35,39,41,43,52,60,68
Electric Potential Energy and Potential Potential Energy Due to a Point Charge Potential Energy Due to Multiple Point Charges Conservative Fields Electric Potential Potential Due To a Point Charge Potential Due to Charge Distribution* General Eqn. for Potential (V and E)* Electrostatic Properties of a Charged Conductor	**25**	**2**	Various teacher generated problems as well as: Chpt.25 Q: 2,6,7,9,10,14,15,18,21,25,30,35,36,40 Chpt.25 P: 2,4,8,14,17,21,26,31,33,39,40,46,48,51,52,64,73,83
Capacitance The Capacitor Capacitance of:* • Parallel Plate Capacitor • Cylindrical Capacitor • Spherical Capacitor Capacitors: Series/Parallel The Electric Field and the Capacitor Energy and the Capacitor Dielectrics	**26**	**1**	Various teacher generated problems as well as: Chpt.26 Q: 1-4,9,11,22,29,33,35,36 Chpt.26 P: 3,6,7,12,15,18,20,25,27,39,40,42,45,47,53,62,68,81
Circuits The Electric Current Resistance and Resistivity Ohm's Law Series and Parallel circuits Multiple Branch Circuits Kirchoff's Rules RC Circuits* Energy Dissipation*	**27,28**	**2**	Various teacher generated problems as well as: Chpt.27 Q: 3-6,10,15-17,21,22,30,32,35 Chpt.27 P: 1,7,9,13,15,18,20,37,40,43,49,50,55,62 Chpt.28 Q: 2,4,5,6,10,11,12,16,17,18,22,23,25,28,30,31,35 Chpt.29 P: 5,9,10,13,21,24,28,33,37,45,47,51-53,63,64,67,71,87,90

Topics	Chapters	# Weeks (Approx.)	Problems
Magnetic Fields Magnetism Magnetic Field Loops Force on a Moving Charge Moving charge in a Uniform Field Force on a Current Carrying Wire Torque on Loops	**29**	**1**	Various teacher generated problems as well as: Chpt 29 Q: 1,2,6,13,14,17,21,25,26,31 Chpt.29 P: 3,5,8,9,15,17,24,29,35,37,41,47,50,68,76
Magnetic Fields Due to Currents The Biot-Savaart Law:* Long Straight Wire, Loop of Wire Ampere's Law: *Long Straight Wire, Current Sheet, Solenoid	**30**	**2**	Various teacher generated problems as well as: Chpt.30 Q: 1,3,4,9,15,27,30 Chpt.30 P: 4,7,8,9,11,18,22,25,29,30,34,38,40,42,63,79
Faraday's Law Magnetic Flux* Motional emf Electromagnetic Induction* Lenz's Law Applications The Generator*	**31**	**2**	Various teacher generated problems as well as: Very heavy emphasis on released AP FR questions and in class collaboration.
Inductance Self-Inductance* LR Circuits* Energy Stored in the Magnetic Field LC Circuits and Oscillations* Mutual Inductance Transformers	**33**	**1**	Various teacher generated problems as well as: Very heavy emphasis on released AP FR questions and in class collaboration.
Electromagnetism Another Look at the Laws of Gauss, Faraday and Ampere. The Displacement Current 'Maxwell's" Equations	**32**	**0.5**	Various teacher generated problems as well as: Very heavy emphasis on released AP FR questions and in class collaboration.

Problem Solving, Student Collaboration and Final Assessments: The students are given opportunities to work collaboratively during regular classroom problem solving sessions. Students will typically work in small groups during these sessions and report their solutions on a whiteboard in the classroom**.**

In addition, a series of culminating activities occur toward the end of the semester, where students are given packets of six problems to solve during that week. The problems are based on released free response questions and provide the students an opportunity work collaboratively in small groups. This also provides the teacher with an opportunity to monitor student understanding. Typically, the students will work together and provide insight on each others strengths and weaknesses. The packets are collected and each set counts as an exam grade. These packet grades are then averaged in with the other independent exam, quiz, and lab grades