AP® Physics C Electricity & Magnetism
The Mississippi School for Mathematics & Science

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TEXTBOOK: Raymond Serway and Robert Beichner *Physics for Scientists and Engineers* 5th Edition, Saunders College Publ., 2000.

DESCRIPTION: The course provides students with a vector-calculus based introduction to the principles of classical electricity and magnetism. Both differential and integral calculus concepts will be utilized throughout the course. The course length is one semester. In order to foster critical thinking skills necessary to pursue a career in science or engineering, the course includes two separate hands-on components (Labs and Extended Design Projects) which utilize guided inquiry and student-centered, team-based design of experiments. The class will meet for lecture on Monday, Wednesday & Fridays for one hour each day, and the lab will meet on Tuesdays or Thursdays for 1.5 hours each week. (Lab time constitutes 33% of the total in-class contact hours for the course.) The course is designed to prepare students to take the AP® Physics C Electricity & Magnetism examination which is administered each May.

CHRONOLOGY:
Weeks 1-2: Electrostatics, Coulomb's Law, Electric Fields &Electric Flux
Week 3: Gauss's Law
Week 4-5: Electric Potential
Week 6: Capacitance and Dielectrics
Week 7: Electric Current, Conductance & Resistance, Conductors & Resistors
Weeks 8-9: Ohm's Law, DC Circuits & RC Circuits
Weeks 10-11: Magnetic Fields, Ampere's Law & Gauss's Law in Magnetism
Weeks 12-13: Faraday's Law, Inductance & Lenz's Law
Week 14: Displacement Current & Maxwell's Equations
Weeks 15-16: AC Circuits, LR Circuits & RLC Circuits
Week 17: Electromagnetism &Electromagnetic Waves
Week 18: Semester Exam

PREREQUISITES: AP® Physics C Mechanics & and a semester-long course in Waves, Electricity & Magnetism; Calculus II (1 semester) or equivalent, or permission of Academic Director

COREQUISITE: none, but Calculus III and Differential Equations are recommended

GRADING SCALE: A: 90 – 100 B: 80 – 89 C: 70 – 79 NC: 0 – 69

ASSESSMENT: **Homework / Class-Work**: Homework will consist of reading, taking notes, answering conceptual questions and working problems. "Problem Sets" will be assigned from each chapter. Both the teacher and students will model many of these problems in class. In addition to lecture, class-work also will include "whiteboard problem solving" where each table is given its own 3'x4' whiteboard and one marker. When needed the teacher can offer suggestions, but the student teams must communicate effectively as a team and bring all their problem solving skills to bear upon the problem at hand. When completed, the team will present their solution before the classroom. The homework & class-work average will count 20**%** of the nine-weeks grade.

Quizzes: In order to reinforce the reading assignments, one out-of-class, computer-based "Concept Quiz" per unit will be averaged into the homework grade. The student may work the "Concept Quiz" as many times as he or she likes in order to score a higher score.

Labs: In order to foster critical thinking skills necessary to pursue a career in science or engineering, students will complete a hands-on lab component which utilizes guided inquiry and student-centered, team-based design of experiments. Lab grades will consist primarily of an inquiry-based design of experiment, followed by a collection of data and writing up the methods, results and conclusions in a professionally acceptable format. By the semester's end, the student will have generated a portfolio of experimental designs and lab write-ups. The lab average will count 20**%** of the nine-weeks grade.

At least ten or more of the following investigations (labs) will be performed:
1. 3D Voltage Mapping using EXCEL
2. Ohm's Law & Internal Resistance of Batteries
3. Ohm's Law & DC Circuits
4. The Wheatstone Bridge
5. Magnetic Field Lines
6. The Force Between Electric Currents
7. Magnetic Field due to a Current-carrying Straight Wire
8. Magnetic Field due to a Slinky
9. Magnetic Lensing of Charged Particles
10. Joule's Law: $P=I^2R$
11. The Electric Motor
12. Determination of Time-constants in RC Circuits
13. The Cathode-ray Oscilloscope
14. Rectifier Circuits & Power Supplies
15. Electromagnetic Wave Production from Dipole Antennae

Projects: In order to foster critical thinking skills necessary to pursue a career in science or engineering, students will complete team-based engineering design units which utilize guided inquiry and student-centered, team-based engineering design projects. These extended engineering design projects will require the student teams to bring all their physics knowledge to bear upon a problem of engineering design, and also may incorporate the use of numerical methods, statistical methods and computer programming in order to complete the team-based designs. Two extended "Engineering Design" projects will be assigned during the semester leading to team-based PowerPoint presentations of engineering designs in competition with other teams within the class. The Projects will be averaged into the lab average which will count 20% of the nine-weeks grade.

At least two of the following "Design of Experiment" projects will be performed:
1. Programming 3D Electric Field Visualization using Maple or Mathematica
2. Investigation of Insulator Breakdown at the MSU High Voltage Laboratory
3. Investigation of Electromagnetic Wave Diffraction with X-rays (XRD) at the MSU Electron Microscope Center
4. other

Unit Tests: There will be 2 – 4 tests each nine-weeks. These tests will cover the material assigned for study on the particular topics. The average of these tests will count 60**%** of the nine-weeks grade. Missed unit tests will be made up no later than 5 days after the test is given.

Semester Exam: The semester exam shall count 20% of the semester grade. Each nine-weeks grade shall count 40% of the semester grade

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Academic Dishonesty

The Physics Department defines academic dishonesty to be any action in which a student claims any work done by another person or machine as his or her own work. Some examples of academic dishonesty are as follows:

- Copying another person's homework, lab report, etc.
- Putting a student's name on a project in which that student has not done an equal part.
- Reporting on an assignment that has not been read, such as a book report, extra-credit reading etc.
- Using on test a calculator that has been programmed.
- Using unauthorized notes or another person's work on tests.
- Discussing material on test with others who have not yet taken the test.
- **Plagiarism**

Honor Code

In this course, anything the student turns in for a grade must be "pledged" according to the following honor code:

"I promise that I have neither given nor received any unauthorized help on this assignment."

Simply writing "**I promise**" near your name will serve as shorthand for the full pledge.

To clear up any confusion, note that any help at all on a test is unauthorized. On homework and labs, students are urged to give and receive help from others and to work in small groups in order to learn, as long as copying is not the result. Help each other and compare answers on homework and other assignments done outside of class. Discuss those answers on which you disagree, changing your answer if you choose. The goal is for you to become an independent learner, capable of group interaction. However, after receiving help on a problem outside of class from another student, keep in mind that if you have the answer but do not understand how to get it yourself, then you have been helped to cheat, not to learn.