PHY 406 – Electricity and Magnetism I
Syllabus

Credit
3 semester hours

Prerequisites
PHY 152 or 252 and MAT 222

Course Description
The fundamental principles of electrostatic fields, electric potential, electrostatic boundary conditions, work and energy in electrostatics, conductors and insulators, and special techniques in solving electrostatics problems.

Rationale for Course
Part of the mission of Mississippi College is to stimulate the intellectual development of students through the liberal arts and sciences. Physics is the science that seeks to describe the physical phenomena that are observed in the universe. It is broad ranging, essential to all the sciences, and typically divided into the following sub-fields: classical mechanics, electricity and magnetism, thermodynamics and statistical mechanics, modern physics, and quantum mechanics. The primary focus of this course is to further explore the fundamental concepts of electricity and magnetism, focusing primarily on the subject of electrostatics. Students will develop problem solving skills and learn how to logically approach and evaluate a variety of physical situations related to this topic.

Learning Objectives
After successful completion of this course, students will be able to

- Calculate the force experienced by a charged particle that is located within static external electric and magnetic fields
- Use Coulomb's law to determine the electric field produced by discrete and continuous charge distributions
- Use Gauss's law to determine the electric field produced by charge distributions that possess exploitable symmetries
- Calculate the electric potential at some distance away from a charge distribution
- Determine the electric field in regions where the electric potential has been defined as a function of position
- Derive the boundary conditions for electric and magnetic fields at the interface of two media
- Describe the behavior of electric fields in conductors and insulators
- Calculate the energy stored in static electric and magnetic fields
- Describe how capacitors and inductors store energy in electric and magnetic fields, respectively
- Apply Poisson's and Laplace's Equations to solve electrostatic boundary value problems
- Express the law of conservation of charge in mathematical form by deriving the continuity equation
- Use the Biot-Savart law to determine the magnetic field produced by steady electric currents
- Use Ampere's law to determine the magnetic field produced by steady currents that possess exploitable symmetries
- Describe the phenomenon of magnetism and the different methods by which materials may become magnetized.

Course Outline
- Introduction
- Vector Analysis
    - » Vector Addition and Subtraction

    - » Products of Vectors
    - » Coordinate Systems
    - » Line, Surface, and Volume Integrals
    - » Gradient of a Scalar Field
    - » Divergence and Divergence Theorem
    - » Curl and Stokes Theorem
- Static Electric Fields
    - » Fundamental Postulates of Electrostatics in Free Space
    - » Coulomb's Law and Electric Fields
    - » Gauss's Law and Applications
    - » Scalar Electric Potential
    - » Conductors and Dielectrics in Static Electric Fields
    - » Electric Flux Density
    - » Boundary Conditions for Electrostatic Fields
    - » Capacitance and Capacitors
    - » Electrostatic Energy and Forces
- Solution of Electrostatic Problems
    - » Poisson's and Laplace's Equations
    - » Uniqueness of Electrostatic Solutions
    - » Method of Images
    - » Boundary Value Problems
- Steady Electric Currents
    - » Current Density and Ohm's Law
    - » Electromotive Force and KVL
    - » Continuity Equation and KCL
- Static Magnetic Fields
    - » Fundamental Postulates of Magnetostatics in Free Space
    - » Vector Magnetic Potential
    - » Biot-Savart Law and Applications
    - » Magnetic Dipole
    - » Magnetization
    - » Magnetic Field Intensity
    - » Behavior of Magnetic Materials
    - » Boundary Conditions for Magnetostatic Fields
    - » Inductance and Inductors
    - » Magnetic Energy
    - » Magnetic Forces and Torques

Academic Integrity

Mississippi College students are expected to be scrupulously honest. Dishonesty, such as cheating or plagiarism, or furnishing false information, including forgery, alteration or misuse of University documents, records or identification, will be regarded as a serious offense subject to severe penalty, including, but not limited to, loss of credit and possible dismissal. See the *Mississippi College Student Handbook* or University Policy 2.19 for specific information regarding penalties associated with dishonest behavior at Mississippi College. Copies of the *Mississippi College Student Handbook* are available in the Office of the Vice President for Enrollment Management and Student Affairs, Nelson 313. Copies of University policies are available on the Mississippi College web site.

Attendance Policy

Class attendance and participation is an essential part of a university education, and students are expected to attend and participate regularly and punctually in all classes and laboratories. The responsibility for any work missed as the result of an absence rests entirely with the student. Cumulative absences and nonparticipation may result in a lowered grade or loss of credit for the course. Tardiness is also subject to penalty, as is any failure to complete required class work on time. A student will receive a grade of F immediately upon accumulating the following number of absences, whether excused or unexcused:

- 12 in semester classes meeting three times per week
- 8 in semester classes meeting two times per week

If a student misses more than the number of class periods specified in university policy and believes that there are reasonable explanations for the absences, he/she may appeal the absences to the Dean of the School of Science and Mathematics.

Method of Instruction

Classes will consist primarily of presenting fundamental topics related to the subject, working example problems, and discussing in-class demonstrations. Key points will be highlighted by the choice of examples, and these points will be discussed in the context of the example.

Instructional Materials

The required text for the course is Introduction to Electrodynamics, 4th edition, by Griffiths. A scientific or graphing calculator is also required.

Methods of Evaluation

Grading for this course will follow a standard 10-point grading scale:

Letter Grade	Final Numerical Average
A	90-100
B	80-89
C	70-79
D	60-69
F	0-59

The numerical average will be determined as follows: 65% from periodic tests, 15% from homework and other class assignments, and 20% from the final exam. The final exam in this course is comprehensive.

Makeup Tests

Makeup tests will be given only under the following circumstances:

- Consent of the instructor has been obtained prior to the test.
- An excused absence is obtained from a doctor or the Vice-President for Academic Affairs

Dropping the Course

Refer to the Mississippi College Academic Calendar for the final drop date for the course. Drops after this date will only be permitted for extreme circumstances and will require approval from the course instructor, department chair, Dean of the School of Science and Mathematics, and the Vice-President for Academic Affairs.

Early Alert System

Mississippi College has adopted the practice of finding students early in the semester who may be exhibiting behaviors that could ultimately have a negative impact on their academic progress. These behaviors are often called “red flag”

behaviors and include, but are not limited to, excessive absences, poor test grades, and lack of class participation or evidence of non-engagement. Identifying these behaviors early gives the instructor the opportunity to raise the "red flag" on behalf of a particular student so that the student can take the appropriate action to redirect his/her progress. The system alerts the student, the student's advisor, and the Office of Student Success.

These messages are intended to help a student recognize an area of concern and to encourage him/her to make some choices to improve the situation. When a student receives an Early Alert message, the student should quickly make an appointment to talk with his/her professor about the situation. Also, students can make full use of the Office of Student Success to set academic goals and connect to campus resources.

Students with Disabilities

In order for a student to receive disability accommodations under Section 504 of the Americans with Disabilities Act, he or she must schedule an individual meeting with the Director of Student Counseling Services immediately upon recognition of their disability (if their disability is known they must come in before the semester begins or make an appointment immediately upon receipt of their syllabi for the new semester). The student must bring with them written documentation from a medical physician and/or licensed clinician that verifies their disability. If the student has received prior accommodations, they must bring written documentation of those accommodations (example Individualized Education Plan from the school system). Documentation must be current (within 3 years).

The student must meet with SCS face-to face and also attend two (2) additional follow up meetings (one mid semester before or after midterm examinations and the last one at the end of the semester). Please note that the student may also schedule additional meetings as needed for support through SCS as they work with their professor throughout the semester. Note: Students must come in each semester to complete their Individualized Accommodation Plan (example: MC student completes fall semester IAP plan and even if student is a continuing student for the spring semester they must come in again to complete their spring semester IAP plan).

Student Counseling Services is located on the 4th floor of Alumni Hall) or they may be contacted via email at mbryant@mc.edu . You may also reach them by phone at 601-925-7790. Dr. Morgan Bryant is director of MC Student Counseling Services.