University of Arkansas – Fort Smith
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General Syllabus

PHYS 3803 Principles of Electricity and Magnetism

Credit Hours: 3 Lecture Hours: 3 Laboratory Hours: 0

Prerequisite: PHYS 2923 University Physics II.

Effective: 2018~2019

I. Course Information

A. Catalog Description

Introduces the modern theory of classical electrodynamics. Uses the tools of vector calculus for solving static and dynamic properties of electromagnetic fields.

B. Additional Information

An introductory course dealing mainly with electrostatics and magnetostatics. The following topics will be covered: vector calculus; Coulomb's law; Gauss's and Ampere's law; electric and magnetic fields; potentials and potential energies; solution of Laplace's equation for rectangular, cylindrical, and spherical geometries in the presence of conductors, dielectrics, and magnetic materials; electric and magnetic susceptibilities; resistance; capacitance; inductance; electromotive force; and electromagnetic induction.

II. Student Learning Outcomes

A. Subject Matter

Upon successful completion of this course, the student will be able to:

1. Solve problems in electrostatics by direct integration of charge distributions, by image methods, and by separation of variables in rectangular, cylindrical or spherical coordinates.
2. Apply the multipole expansion of the electrostatic field.
3. Calculate electric fields and potentials in systems containing linear dielectric materials.
4. Calculate magnetic forces on charged particles and current elements.
5. Assess magnetic fields in linear and permanently magnetized magnetic materials.
6. Evaluate the various aspects of motional EMF and electromagnetic induction.
7. Assess the meaning, use and relationship of the Maxwell equations in both integral and differential form.

8. Evaluate the use of the fundamental results of vector calculus (gradient, divergence, curl, path independence, divergence theorem, Stokes's theorem) as applied to the electric and magnetic fields.
9. Analyze the energy and momentum of the electromagnetic field and their conservation laws, including Poynting's theorem.
10. Evaluate the nature and behavior of electromagnetic waves and their boundary conditions, both in free space and in matter.

B. University Learning Outcomes

This course enhances student abilities in the following areas:

Analytical Skills

Critical Thinking Skills: Students will identify a problem or issue and will research, evaluate, and compare information from varying sources in order to evaluate authority, accuracy, recency, and bias relevant to the problems/issues. The student will generate solutions/analysis of problems/issues evaluated and will assess and justify the solutions and/or analysis.

Communication Skills (written and oral)

Students will communicate proficiently. The student will compose coherent documents appropriate to the intended audience and effectively communicate orally in a public setting.

Ethical Decision Making

Students will model ethical decision-making processes. The students will identify ethical dilemmas and affected parties and will apply ethical frameworks to resolve a variety of ethical dilemmas.

Global & Cultural Perspectives

Students will reflect upon cultural differences and their implications for interacting with people from cultures other than their own. The students will demonstrate understanding or application of their discipline in a global environment and will demonstrate how their discipline impacts or is impacted by different cultures.

III. Major Course Topics

A. Vector Analysis
(Vector Algebra, Differential Calculus, Integral Calculus, Curvilinear Coordinates, Dirac Delta Function, and Helmholtz Theorem)

B. Electrostatics
(Electric Field, Electric Potential, Work & Energy, and Conductors)

C. Special Techniques
(Laplace's Equation, Method of Images, Separation of Variables, and Multiple Expansion)

D. Electric Fields in Matter
(Polarization, Electric Displacement, and Linear Dielectrics)

E. Magnetostatics
(Lorentz Force, Biot-Savart Law, and Magnetic Vector Potential)
F. Magnetic Fields in Matter
(Magnetization, Field of Magnetized Object, Auxiliary Field H, and Linear & Nonlinear Media)