PHYS 3741 - Electromagnetic Field Theory 1

Fall 2026 Syllabus, Section 02, CRN 43979,

Credit hours: 3

Instructor

Donald Priour

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Public Instructor Information

Instructor Title: Associate Professor
Instructor Professional Qualifications: B. A. in Physics, Rice University (1995); M. A. in Physics, Princeton (1997); Ph. D. in Physics, Princeton (2000)
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Course Description

3741. Electromagnetic Field Theory 1. Intermediate theory of electric and magnetic fields. Topics include electric field, scalar potential, techniques for calculating scalar potential (method of images, Laplace's and Poisson's equations, multipole expansion, Green's Function approach), dielectrics and polarization, Maxwell's equations and their application to the propagation of electromagnetic waves including reflection, refraction, transmission, and absorption; guided waves, retarded potentials, radiating systems, special relativity. Must be taken in sequence, before PHYS 3742. Prereq.: MATH 3705 or MATH 3705H and either PHYS 2611 or ECEN 2633. 3 s.h.

Course Readings

Group	Title	Author	ISBN
	Introduction to Electrodynamics (any edition)	David Griffiths	

The course readings are subject to change in the event of extenuating circumstances, research developments, current events, and/or to ensure better learning.

Schedule of Topics and Assignments

Day	Date	Proposed Topic	Due/To Prepare for Class
Mon	8/24		Introductory remarks and hisorical perspectives
Wed	8/26		Part I: Mathematical review (vector mathematics)
Fri	8/28		Part I: Mathematical review (vector differential operators)
Mon	8/31		Part I: Mathematical review (vector differential operators)
Wed	9/2		Part I: Mathematical review (vector calculus integral theorems)
Fri	9/4		Part I: The Dirac Delta function in one, two, and three dimensions
Mon	9/7		Labor Day Recess; class not scheduled
Wed	9/9		Part II: Coulomb's Law
Fri	9/11		Part II: Electric field due to point charges
Mon	9/14		Part II: Gauss's Law
Wed	9/16		Part II: Applications of Gauss's Law

Fri	9/18	Part II: Electric Potential of point charges and charge distributions
Mon	9/21	Part II: Electric potential energy stored in a charge distribution
Wed	9/23	Part II: Conductors and capacitance
Fri	9/25	Part II: Conductors and capacitors continued
Mon	9/28	First Midterm Examination
Wed	9/30	Part III: Special Approaches in electrostatics (Laplace's equation and uniqueness of its solutions)
Fri	10/2	Part III: Separation of variables to solve a partial differential equation as applied to Laplace's equation in 2D
Mon	10/5	Part III: Separation of variables in the case of Laplace's Equation in 3D rectangular geometries
Wed	10/7	Part III: The image charge method for flat conducting surfaces and spherical conductors
Fri	10/9	Part III: Separation of Variables in spherical coordinates for situations with azimuthal symmetry
Mon	10/12	Part III: Multipole Expansions
Wed	10/14	Part III: Electric dipoles and their electric fields and electric potentials
Fri	10/16	Part IV: Electric Fields in media (polarizability and dielectrics)
Mon	10/19	Part IV: Bound charges of a polarized object
Wed	10/21	Part IV: The electric displacement field and Gauss's law in a dielectric medium
Fri	10/23	Part IV: Examples of calculations involving dielectrics, including a variant of the image charge method used in the context of flat conducting surfaces.
Mon	10/26	Part V: Magnetostatics (magnetic fields and forces) beginning with the Biot-Savart Law
Wed	10/28	Part V: The Biot-Savart Law and ring currents and long straight wires
Fri	10/30	Part V: Ampere's Law and applications
Mon	11/2	Part V: Ampere's Law and applications (continued)
Wed	11/4	Part V: The magnetic Vector potential
Fri	11/6	Part V: The multipole expansion in magnetostatics
Mon	11/9	Part V: Magnetic Dipoles: the magnetic field and magnetic vector potentials of magnetic dipoles
Wed	11/11	Class not schedules due to YSU's observance of Veteran's Day
Fri	11/13	Part VI: Magnetic fields in media (magnetization of materials)
Mon	11/16	Part VI: The auxiliary field

Wed	11/18	Part VI: The counterpart of Ampere's Law for magnetized media
Fri	11/20	Part V: Electrodynamics (The charge continuity condition)
Mon	11/23	Part V: The microscopic version of Ohm's Law
Wed	11/25	Part V: Instances of using the microscopic version of Ohm's Law to calculated the resistance of a macroscopic object
Fri	11/27	Part V: Magnetic flux and Faraday induction
Mon	11/30	Part V: Self inductance and mutual inductance
Wed	12/2	Part V: Motivation of the modified version of Ampere's Law that yield the four Maxwell's Equations
Fri	12/4	Part V: Further discussion of Maxwell's Equation
Mon	12/7	Final Exam (take home) to be scheduled with the consensus of the students enrolled in the course.

The course schedule, policies, procedures, and assignments in this course are subject to change in the event of extenuating circumstances, by mutual agreement, and/or to ensure better learning.