ECE 307 – Electrodynamics

Credits: 4, **Contact Hours:** Two 75 minute lecture sessions per week, one 160 minute recitation lab session per week.

Coordinator: S. Borkar, Senior Lecturer of ECE

Textbook: William H. Hayt and John A. Buck, *Engineering Electromagnetics*, McGraw-Hill, 9th Edition, 2019, ISBN 978-0-07-802815-1

2019 Catalog Data: ECE 307: Electrodynamics: Vector analysis applied to static and time-varying electric and magnetic field. Coulomb's law, electric-field intensity, flux density and Gauss's law. Energy and potential. Biot-Savart and Ampere's law. Maxwell's equations with applications including uniform-plane wave propagation. Transmission lines with transient and sinusoidal excitations. Graphical methods. Prerequisite(s): [(ECE 213, MATH 251, and PHYS 221)]

Prerequisites or co-requisites by topic: (Physics) Electricity and Magnetism, Differentiation and Integrations, Vector Analysis

Enrollment: Required course for EE majors; elective for CPE majors

Specific outcomes of instruction:

After completing this course, the student should be able to do the following:

1. Solve problems involving the concept of field (scalar or vector), and of flux of a vector field from both the strictly mathematical viewpoint and the physical one.
2. Describe physical situations in terms of the appropriate differential operators used in electrodynamics.
3. Solve problems involving the microscopic phenomena that originate from the electromagnetic properties of bulk materials.
4. Solve problems involving time variations of the flux of magnetic field. Discuss the conceptual equivalence of the flux variation due to geometrical factors (generator configuration) and to a time-varying magnetic field (transformer configuration).
5. Apply Maxwell's equations in both point and integral form; derive special cases from the general formulation.
6. Solve problems involving the concept of magnetic potentials, with particular emphasis on the vector magnetic potential, and the mechanism of propagation of electromagnetic waves in different dielectric media.
7. Obtain solutions to transmission line equations under transient and sinusoidal excitations; perform impedance transformation on transmission lines employing the Smith chart.

Relationship of ECE 307 specific outcomes of instruction to student outcomes:

	Student Outcomes	Course Goals
1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics	1, 3, 4, 5, 6, 7
2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors	1, 2,3, 4, 6, 7
3	An ability to communicate effectively with a range of audiences	4
4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts	
5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	1, 3, 5, 6, 7
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions	
7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies	1, 4, 5, 6, 7

Topics:

- Vector Analysis (1 weeks)
- Coulomb's Law and Electric Fields (1 week)
- Electric Flux and Gauss' Law (1 week)
- Energy and Potential (1 week)
- Conductors, Dielectrics, Capacitance (1 week)
- Mapping and Graphical Methods (1 week)
- Poisson's and Laplace Equations (1 week)
- Steady Magnetic Fields (1 week)
- Magnetic Forces and Inductance (1.5 week)
- Magnetization in Materials (0.5 week)
- Time-Varying Fields and Maxwell's Equations (1 week)
- Transmission Line Equations and Solutions (1 weeks)
- Impedance Transformation and the Smith Chart (1 week)
- Uniform Plane Waves (1 week)

Recitation Lab topics:
Individual and team oriented problem solving for Lecture topics

Prepared by: S. Borkar **Date:** February 27, 2020