ECE 307 - Electrodynamics

Prerequisite(s): [(ECE 213, MATH 251, and PHYS 221)]

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


Coordinator: T. Wong, Professor of ECE

Course goals:

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.

Prerequisites by topic:
1. Physics (Electricity and Magnetism)
2. Vector Analysis

Lecture schedule: Three 75-minute sessions per week

Topics:
1. Vector Analysis (1 weeks)
2. Coulomb’s Law and Electric Fields (1 week)
3. Electric Flux and Gauss’ Law (1 weeks)
4. Energy and Potential (1 weeks)
5. Conductors, Dielectrics, Capacitance (1 weeks)
6. Mapping and Graphical Methods (1 week)
7. Poisson’s and Laplace Equations (1 weeks)
8. Steady Magnetic Fields (1 weeks)
9. Magnetic Forces and Inductance (1.5 weeks)
10. Magnetization in Materials (0.5 week)
11. Time-Varying Fields and Maxwell’s Equations (1 week)
12. Uniform Plane Waves (1 weeks)
13. Transmission Line Equations and Solutions (1 week)
14. Impedance Transformation and the Smith Chart (1 week)
**Computer usage:**
None.

**Laboratory topics:**
None.

**Relationship of ECE 307 Course Goals to Student Outcomes:**

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<thead>
<tr>
<th>Student Outcomes</th>
<th>Course Goals</th>
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<tbody>
<tr>
<td>a  Apply knowledge of math, engineering, science</td>
<td>1, 2, 5, 7</td>
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<td>b  Design and conduct experiments / Analyze and interpret data</td>
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<td>c  Design system, component, or process to meet needs</td>
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<td>d  Function on multi-disciplinary teams</td>
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<tr>
<td>e  Identify, formulate, and solve engineering problems</td>
<td>1, 3, 4, 6</td>
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<td>f  Understand professional and ethical responsibility</td>
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<td>g  Communicate effectively (written / oral)</td>
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<td>h  Broad education</td>
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<td>i  Recognize need for life-long learning</td>
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<td>j  Knowledge of contemporary issues</td>
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<td>k  Use techniques, skills, and tools in engineering practice</td>
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**Prepared by:** T. Wong  
**Date:** November 1, 2013