ECE3025 Course Syllabus

ECE3025

Electromagnetics (3-0-0-3)

CMPE Degree
This course is Elective for the CMPE degree.

EE Degree
This course is Required for the EE degree.

Lab Hours
0 supervised lab hours and 0 unsupervised lab hours

Course Coordinator
Swaminathan,Madhavan

Prerequisites
See topical outline

Corequisites
None

Catalog Description
To present the laws and applications of electromagnetics.

Textbook(s)
Hayt & Buck, *Engineering Electromagnetics* (9th edition), McGraw Hill, 2018. ISBN 9780078028151 (required) (comment: A free note packet is available through on PDF through the GT Library.)

Peterson and Durgin, *Transient Signals on Transmission Lines: An Introduction to Non-Ideal Effects and Signal Integrity Issues in Electrical Systems*, Morgan Claypool, 2009. ISBN 9781598298260 (required) (comment: This book is free to GT students & faculty through the GT Library. ISBN listed is for e-book. ISBN for paperback version is 9781598298253.)

Course Outcomes
Upon successful completion of this course, students should be able to:

1. determine parameters associated with waves on lossless and lossy transmission lines, including frequency, phase velocity, attenuation and phase consts
2. solve transient problems involving initially uncharged or charged transmission lines with resistive and reactive loads
3. design transmission line terminations to minimize reflections and maximize received power
4. explain the fundamental processes by which crosstalk between transmission lines occurs
5. determine frequency-domain parameters associated with a transmission line system, including input impedance, reflection coefficient, and SWR
6. analyze transmission line problems in the frequency domain with complex load impedances, to determine input and load voltage/current, power delivered

7. calculate the electric field, scalar potential, stored energy, and capacitance associated with simple distributions of charge
8. calculate the magnetic field, stored energy, and inductance for simple distributions of current density
9. calculate the resistance of simple structures of given conductivity
10. apply boundary conditions to determine current and charge densities produced on conducting boundaries by applied fields
11. identify Maxwell's equations and apply them in both their integral and differential forms to time-varying field problems
12. identify an electromagnetic wave and determine parameters (frequency, phase constant and velocity, associated intrinsic impedance) and power density
13. determine the attenuation constant, phase constant, and skin depth for waves in a lossy medium, where the conductivity may range from low to high
14. distinguish between linear polarization, circular polarization, and elliptical polarization with right-hand/left-hand orientation
15. calculate reflection and transmission coefficients and fields for uniform plane waves normally-incident and obliquely-incident on planar interfaces

Student Outcomes

In the parentheses for each Student Outcome:
"P" for primary indicates the outcome is a major focus of the entire course.
“M” for moderate indicates the outcome is the focus of at least one component of the course, but not majority of course material.
“LN” for “little to none” indicates that the course does not contribute significantly to this outcome.

1. (P) An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. (LN) 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
3. (LN) An ability to communicate effectively with a range of audiences
4. (LN) 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. (LN) 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
6. (LN) An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. (M) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topical Outline

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(ECE 2040 [min C] or ECE 3710) and (ECE 2025/2026 [min C] or NRE 21

Electrostatics
  Scalar Potential, Energy Density, Force; Electrostatic Field of C

Magnetostatics
  Vector Potential, Energy Density, Force; Magnetostatic Field of C

Time-Varying Fields
  Maxwell's Equations; Transformers; Motors and Generators; Energy,
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Transmission Lines
  Lumped Circuit Model; Transmission Line Equations; Pulse Excitati

Plane Waves and Geometric Optics
  Concept of a Plane Wave, Polarization; Lossy Media, Skin Depth

Radiation
  Hertzian Dipole; Antenna Parameters (Directivity, Beamwidth, etc.