ECE4350 Course Syllabus

ECE4350

Electromagnetic and Microwave Applications (3-0-0-3)

CMPE Degree
This course is Elective for the CMPE degree.

EE Degree
This course is Elective for the EE degree.

Lab Hours
0 supervised lab hours and 0 unsupervised lab hours

Course Coordinator
Tentzeris,Emmanouil M

Prerequisites
ECE 3025 [min C]

Corequisites
None

Catalog Description
presents concepts of electromagnetics applied to the design of microwave/RF circuits, modules, and systems encompassing transmission and radiation for applications up to optical frequencies

Textbook(s)
F.T.Ulaby et al., *Fundamentals of Applied Electromagnetics*, Prentice Hall Eds.. (required)

Course Outcomes
Upon successful completion of this course, students should be able to:
1. Identify different topologies of transmission lines and their matching networks
2. Design a transmission line matching network
3. Use a Smith Chart for design, problem-solving, and interpreting/reporting results
4. Identify the basics of electromagnetic plane wave mechanics
5. Analyze planar reflections of electromagnetic waves
6. Design and model a rectangular, metallic waveguide
7. Analyze the operation of a cavity resonator
8. Characterize multi-port microwave devices with standard parameters, such as X-parameters, Y-parameters, scattering matrices, and transmission matrices
9. Analyze a basic of radiating systems
10. Design a basic microwave or optical filter

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. (M) 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. (LN) An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Topical Outline

? Review of wave definitions-Phasors
? Transmission line equations-Lumped element model
? Reflection coefficient, Input impedance, Standing Wave Rati
? Matching techniques (quarter wavelength, stubs, lumped elem
? The Smith Chart
? Application Talk 1: Additive Manufacturing for ?Green? RF a
? Plane waves and polarizations
? Reflection of normally incident plane waves
? Oblique incidence - Wave impedance
? Total reflection, Brewster angle, optical fibers
? Application Talk 2: Energy Harvesting and ?Zero-Power? EM/R
? Waveguides - Laplace and Helmholtz equations in rectangular
? Parallel plate waveguides (Modes and Losses)
? Planar transmission lines/waveguides
? Rectangular waveguides
? Waves below and near cutoff - Quasi-TEM modes
? Dispersion, loss and practical mode excitation
? Resonators and quality factor
? Application Talk 3: Applications of EM to sensing, biomedic
? Microwave networks and Reciprocity
? Equivalent circuits, Z-, Y-, scattering (S) and transmissio
? Cascaded 2-port networks, microwave and optical filters
? S-parameters of N-ports, directional couplers
? Electric and magnetic dipoles, power, potentials
? Half-wave dipole, gain, radiation resistance and patterns
? Antenna efficiency, conjugate matching
? Friis formula and superposition principle
? Linear arrays
? Application Talk 4: Nanotechnology, 5G and EM: the path to