332:580 – Electric Waves and Radiation
332:481 – Electromagnetic Waves
Fall 2010

Course Description:

This course is a basic introduction to electromagnetic waves and antennas.

The undergraduate version will follow the graduate course's schedule and content. Both graduate and undergraduate versions have basically the same syllabus (with some antenna topics added to the undergraduate one), and the same prerequisites, that is, an undergraduate Electromagnetic Fields course and familiarity with vector analysis, including programming in MATLAB, Fortran, or C.

The material is divided into the following topic areas:

1. *Review of Maxwell's Equations.* (1 week) Maxwell's equations, constitutive relations, boundary conditions, current density, Poynting vector, energy conservation, power dissipation, electrostatic and time-varying harmonic fields, simple models of dielectrics, conductors, and plasmas.
2. *Uniform Plane Waves.* (5 weeks) Uniform plane waves in lossless and lossy media, power loss calculations and skin depth, polarization, normal incidence on interfaces, reflection and transmission coefficients, wave impedance, impedance transformations, half-wave and quarter-wave media, multilayer structures, optical filters and antireflection coatings, oblique incidence, Snel's law of refraction, Brewster angle, total internal reflection, surface plasmons, photonic crystals and omnidirectional dielectric mirrors, metamaterials and negative-index media. Pulse propagation in dispersive media, concepts of phase, group, and front velocities, dispersion compensation in optical fibers, slow, fast, and negative group velocity media, pulse compression in radar.
3. *Transmission Lines and Waveguides.* (4 weeks) TEM transmission lines, coaxial, parallel wire, and microstrip lines, Smith chart, impedance matching methods, S-parameters and their application to microwave amplifier design, Rectangular waveguides, cutoff frequency, group and phase velocities, dielectric waveguides and optical fibers, power flow and power loss calculations, cavity resonators.
4. *Antennas.* (3 weeks) Radiation fields from current sources and apertures, radiated power, radiation resistance, radiation pattern, directivity and gain, beamwidth, effective area, communicating antennas, Friis formula, antenna noise temperature, satellite links, radar, linear and loop antennas, dish antennas, antenna arrays, uniform, binomial, Dolph-Chebyshev, Taylor-Kaiser, multibeam, sector-beam array design methods.

Text:

S. J. Orfanidis, *Electromagnetic Waves and Antennas*, 2008. Available in PDF format from the web page: `www.ece.rutgers.edu/~orfanidi/ewa`.

Course Requirements:

The final grade is based on:

1. Final exam.
2. Two in-class exams.
3. Computer assignments and homeworks.

The two exam dates are *Wednesday, October 13, 2010* and *Wednesday, November 17, 2010*. The final exam is scheduled by the ECE department for the period of December 16–23.

Instructor:

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