THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Electromagnetic Field Theory I

ECE 6010

Credit Hours:
3.00 - 3.00

Course Levels:
Graduate (5000-8000 level)

Course Components:
Lecture

Course Description:
Maxwell's Equations; plane waves; field representations and solutions in unbounded space; waveguides and cavities; elements of Green's Functions; cylindrical and spherical waves; electromagnetic theorems.

Prerequisites and Co-requisites:
Prereq: 5010 (713), and 5011 or 613; or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.

Course Goals / Objectives:
- Learn some fundamental laws of electrodynamics based on Maxwell's equations
- Learn electrical properties of materials, solutions of the wave equation as plane waves in source free regions
- Learn about wave polarization, and reflection/transmission of plane waves
- Learn about modal solutions in waveguides and cavities
- Learn about cylindrical and spherical waves in the context of canonical scattering problems
- Learn about electromagnetic theorems such as duality, uniqueness, reciprocity, and conservation laws

Course Topics:

- Maxwell's equations: Differential and integral forms; continuity equation; constitutive relations; media classification; boundary conditions; Poynting theorem; time harmonic fields; complex Poynting vector, homogeneous wave equation and its solution
- Plane waves: Polarization, attenuation, reflection, and refraction
- Field representations and solutions in unbounded space: Electromagnetic sources, solutions of 2D and 3D inhomogeneous wave equation, vector and scalar potentials, Hertz potentials, potentials for static fields, near zone and far zone representations
- Waveguides and cavities: Parallel plate waveguide, grounded dielectric slab, rectangular waveguide and cavity
- Elements of Green's functions
- Cylindrical waves and structures: Cylindrical wave functions, circular metallic guide, dielectric rod, cylindrical wave transformations, scattering by metallic cylinder
- Spherical waves: Plane wave scattering by spheres, radar cross section
- Electromagnetic theorems: Duality, uniqueness, image theory, equivalence principle, reciprocity and reaction theorem, conservation laws

---

Designation:

Elective