THE OHIO STATE UNIVERSITY
COLLEGE OF ENGINEERING

Introduction to Computational Electromagnetics

ECE 5510

Credit Hours:
3.00

Course Levels:
Undergraduate (1000-5000 level)
Graduate (5000-8000 level)

Course Components:
Lecture

Course Description:
Numerical methods for solving maxwell equations both static and electrodynamics, introduction to finite difference, finite element and integral equation methods, and applied linear algebra.

Prerequisites and Co-requisites:
Prereq: 3010; or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.

Course Goals / Objectives:
- Learn the basics of finite difference methods for solving Maxwell equations, both static and electrodynamics
- Learn the basics of finite element methods for solving Maxwell equations, both static and electrodynamics
- Learn the basics of integral equation methods for solving Maxwell equations, both static and electrodynamics
- Learn basics of applied linear algebra and graph theories for solving matrix equations, both sparse and dense, using direct methods
- Learn basics of singular value decomposition (SVD) algorithm
- Learn basics of Krylove based iterative matrix solution techniques for solving both sparse and dense matrix equations

Course Topics:

- Finite difference methods, Central/forward/backward differences, solving Poisson equations on a rectangular domain
- Finite difference time domain methods, stability analysis, dispersion analysis, simple first order absorbing boundary condition
- Finite element methods, bary-centric coordinate systems, Lagrange interpolation polynomials, applying FEM to solve Poisson equations, vector finite element basis functions
- Solving dielectric waveguides using vector finite element methods, modeling three dimensional inhomogeneous cavities, and application of vector finite element methods to 3D vector wave equations
- Integral equation methods for computing capacitances for multiple arbitrarily shaped conductors, numerical integrations for smooth and weakly singular kernels, RWG basis functions, EFIE, MFIE, CFIE
- Applied linear algebra for solving matrix equations, singular value decomposition (SVD) algorithm, graph theory for direct factorization and sparse direct matrix solvers, Krylov methods

---

Designation:
Elective