Spring 2018

E&CE770-T04
Computational Methods for Engineering Electromagnetics

Instructor: S. Safavi-Naeini
Class Time: [redacted]
Location: [redacted]

General description:
The main theme of this course is the description of most widely used computer techniques for engineering problems dealing with the electromagnetic wave radiation, propagation and scattering. Applications of these methods to RF/Microwave and millimeter wave planar circuits and antennas, radiowave propagation in wireless communication systems, photonic integrated circuits, and nano-structures are addressed.

Contents:
1. Review of fundamental theorems and concepts: uniqueness theorem, principle of equivalence, electromagnetic reciprocity, theory of Green's function, Green's function for static and dynamic problems.

2. Finite Difference Time Domain (FDTD) method: finite difference method for static field problems, finite difference time domain methods for circuits and scattering problems, numerical boundary conditions, stability and accuracy

3. Integral equation formulations and the Method of Moment (MOM): review of scalar and vector potential theories, mixed potential integral equation (MPIE) method, numerical solution by method of moments, Galerkin method

4. Planar and quasi-planar circuits and antennas in multi-layer media: spectral representation of the fields in planar multi-layer media, spectral and spatial domain formulations.

5. Variational principle and Finite Element Method (FEM)

6. Asymptotic techniques: ray and beam fields, geometrical and physical optics, geometrical theory of diffraction, radiowave propagation in wireless communication systems , applications in guided-wave optics

7. Research trends

Prerequisites:
Undergraduate course(s) in electromagnetic fields and waves.

Textbook:
1. Lecture Notes and papers from the current literature.

2. Jian-Ming Jin, ***Theory and Computation of Electromagentic Fields***, 2nd Edition, Wiley-IEEE Press, 2015 (eBook available from the UW Library). Parts of the chapters 8, 9, and 10.