

## ECE 222b: Applied Electromagnetics

**Webpage:** <http://cem.ucsd.edu/~vitaliy/courses/ece222b>

**Lectures:** Tue, Thu 11pm-12:20pm; HSS 2152

**Instructor:** Prof. Vitaliy Lomakin

**Office:** EBU1 3201, **E-mail:** [vlomakin@eng.ucsd.edu](mailto:vlomakin@eng.ucsd.edu)

**Office hours:** Tue, Thu, 2pm-3pm (or by appointment)

### **Text book:**

J. M. Jin, *Theory and Computation of Electromagnetic Fields*, IEEE Computer Society Press, 2010.

### **References:**

- [1] C. A. Balanis, *Advanced Engineering Electromagnetics*, Wiley, 1989.
- [2] R. F. Harrington, *Time-Harmonic Electromagnetic Field*, McGraw-Hill.
- [3] J. A. Kong, *Electromagnetic Wave Theory* (2nd Ed.), John Wiley & Sons.
- [4] J.A. Stratton, *Electromagnetic Theory*, Wiley, 2007.

### **Exams & Homework:**

- Midterm: 35%
- Final exam: 45%
- Homework: 20%

## Detailed outline

1. Electromagnetic wave equations
  - a. Definition of field vectors
  - b. Electric and magnetic polarizations, constitutive relations
  - c. Maxwell's equations
  - d. Boundary conditions across interfaces and thin surfaces
  - e. Poynting theorem and power in electromagnetic systems
2. Transmission Lines
  - a. Transmission line equations
  - b. Wave propagation transmission lines, reflection and transmission in multi-section transmission lines
  - c. Relation to 3D electromagnetic problems
3. Electromagnetic theorems
  - a. Uniqueness theorem
  - b. Image theory
  - c. Reciprocity theorem
  - d. Equivalence principle
  - e. Babinet principle
4. Plane waves
  - a. Reduction to vector Helmholtz (wave) equation, separation of variables
  - b. Uniform and non-uniform plane waves
  - c. Wave impedance, reflection and transmission at a single interface and thin film
  - d. Polarization of plane waves
  - e. Plane waves in materials
  - f. Scattering from multiple interfaces
5. Fields in waveguides
  - a. Fields in metallic waveguides: parallel plate, rectangular, circular, and coaxial waveguides
  - b. Fields in metallic waveguides partially filled with a dielectric material
  - c. Fields in dielectric waveguides, slabs and circular dielectric waveguides
6. Electromagnetic resonators
  - a. Transmission line resonators
  - b. Parallel plate and rectangular resonators
  - c. General theory of resonators

7. Scattering from canonical shapes
  - a. Scattering from a cylinder
  - b. Scattering from a sphere
8. Anisotropic media
  - a. Description
  - b. Wave propagation