ECE107 – Electromagnetism

Webpage: http://cem.ucsd.edu/~vitaliy/courses/ece107

Lectures: Tue, Thu 9:30-10:50am; EBU1 2315

Discussion sessions: Thu 1-1:50pm, PCYNH 121

Instructor: Prof. Vitaliy Lomakin

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Office hours: Tue, Thu, 3-4pm (or by appointment)

Teaching Assistant: Simon Couture

Email: scouture@ucsd.edu

Office hours: TBD (see updates in the course webpage)

Text book:

F.T. Ulaby, Fundamentals of Applied Electromagnetics, Prentice Hall, Fifth Edition, 2006 or Sixth Edition, 2010.

References:

[1] M. N. O. Sadiku, *Elements of Electromagnetics*, Oxford University Press, 2001.

[2] H. H. Skilling, *Fundamentals of Electric Waves*, Wiley, 1948.

[3] R. Ramo, J.R. Whinnery and T. Van Duzer, *Fields and Waves in Communication Electronics*, Third Edition, Wiley, 1994.

[4] S. Schwarz , *Electromagnetics for Engineers*, Saunders, 1990.

[5] J.A. Stratton, *Electromagnetic Theory*, Wiley, 2007

Exams & Homework:

- Midterm: Tue, Nov 1, 9:30-10:50am (tentative), EBU 1, 2315
- Final exam: Thu, Dec 8, 8-10:59pm, TBD
- Weekly homework

Grade Distribution:

- Homework: 15% (7 best counted, out of 9 to 10 assignments total)
- Project: 5%

- Midterm: 35% each
- Final Exam: 45%

Detailed outline

1. Introduction
    a. Electric and magnetic fields, static and dynamic fields, traveling waves, electromagnetic spectrum, review of complex numbers and phasors
2. Transmission Lines for Communications
    a. Lumped element model, transmission line equations
    b. Wave propagation in lossy and lossless transmission lines
    c. Reflection from loads and standing waves
    d. Input impedance and concepts of matching
    e. Power flow in transmission lines
3. Vector analysis
    a. Basic laws of vector algebra, orthogonal coordinate systems, gradient, divergence, curl, and Laplacian and associated theorems
4. Maxwell's equations
    a. Basic equations, differences between static and dynamic equations
5. Electrostatics
    a. Charges, currents, Coulomb's law, superposition principle, electrostatic scalar potential, Poisson's equation
    b. Electrical properties of materials, conductors, resistance, dielectrics
    c. Electric field boundary conditions, capacitance, image method, electric energy
    d. Method of moments for capacitance extraction
6. Magnetostatics
    a. Biot-Savart Law, magnetic dipole, magnetostatic equations, magnetic potentials
    b. Magnetic permeability, magnetic boundary conditions, inductance, magnetic energy
7. Dynamic fields
    a. Faraday's law, charges in time varying magnetic fields, transformers, generators, displacement current and Amper's law, boundary conditions, continuity equation
    b. Electromagnetic potentials, retarded and time harmonic potentials
8. Plane wave propagation

a. Time harmonic fields and Maxwells' equations, concept of a plane wave, transmission-line analog
b. Plane wave propagation in lossless media, plane wave polarization
c. Plane wave propagation in lossy media
d. Electromagnetic power density

9. Electromagnetic waves at boundaries
    a. Reflection and transmission of waves under normal incidence on planar interfaces, transmission line analog, power flow
    b. Reflection and transmission of waves under oblique incidence on planar interfaces: Snell's law, perpendicular and parallel polarizations, reflection and transmission coefficients, Brewster angle
    c. Wave guiding phenomena, basics of fiber optics
10. Radiation
    a. Principles of EM Radiation
    b. Infinitesimal dipole radiators
    c. Far field approximation, radiation resistance, directivity, antenna pattern