

Spring 2015

Syllabus

Physics 482-02: Introduction to Microwave Engineering with Electromagnetic Simulation

W noon-1pm and M noon-3pm in Small Hall room 230

Prerequisite: None

Instructors

Prof. Seth Aubin

Office: room 255, Small Hall, tel: 1-3545

Lab: room 069, new wing of Small Hall, tel: 1-3532

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Office hours: Aubin: Wednesday, 3-4 pm

Description

This independent study course will use electromagnetic simulation software to introduce transmission lines, passive microwave circuit elements, and antennas. The course will also feature a small simulation project.

Objectives

The primary purpose of this course is to introduce basic microwave and radio-frequency (RF) engineering design concepts using commercial software for full 3D electromagnetic simulation of RF circuits, and associated electric and magnetic fields and currents.

The course will cover the following topics:

- Maxwell's equations in vacuum and linear materials.
- Transmission lines (coaxial, 2-wire, stripline, microstrip, and co-planar waveguide).
- Waveguides.
- Skin effect and proximity effect.
- Smith charts.
- Microstrip capacitors and inductors.
- Impedance matching.
- Resonators.
- Basic antennas.
- Method of moments (MoM), finite element method (FEM), and finite difference finite time method (FDTD).

Course Materials

This course relies heavily on the following commercial software packages:

FEKO by *EM Software & Systems – S. A. (Pty) Ltd.*

HFSS by Ansys.

Reference texts for the course:

Foundations for Microwave Engineering, 2nd Ed., by R. E. Collin (Wiley, Hoboken, NJ, 2001).

Electromagnetic Waves and Antennas, by S. J. Orfanidis (Rutgers University, 2014, web page: www.ece.rutgers.edu/~orfanidi/ewa).

Evaluations

Your final grade for the course will be determined from the following grading weight distribution:

Tutorial simulations:	60%
Project:	40%

Tutorial simulations: The course built around weekly in-class tutorials that simulate an RF circuit. The results of the tutorial are summarized in a one-page report.

Project: The student and instructor will decide on a simulation project for an RF circuit that includes a significant fraction of the RF components studied in the course. The results of the project simulation will be summarized in a short report.

Weekly Schedule (tentative)

Week 0: 1/21-23	Maxwell's Equations
Week 1: 1/26-30	Electromagnetic Simulations I Introduction to EM simulation with FEKO
Week 2: 2/2-6	Transmission line: basic theory
Week 3: 2/9-13	2-port devices and s-parameters
Week 4: 2/16-20	Waveguides
Week 5: 2/23-27	Microstrip Transmission Lines
Week 6: 3/2-6	Impedance Matching
----- Spring Break -----	
Week 7: 3/16-20	Antennas
Week 8: 3/23-27	Project
Week 9: 3/30-4/3	Project
Week 10: 4/6-10	Project
Week 11: 4/13-17	Project
Week 12: 4/20-24	Smith Charts + Project
Week 13: 4/27-5/1	Project