EE 40458/60558 **RF and Microwave Circuits for Wireless Communications**

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http://www.nd.edu/~hscdlab

Text: David M. Pozar, *Microwave Engineering, 4th. ed.*, John Wiley & Sons, 2012.

Supplementary reading:

Guillermo Gonzalez, *Microwave Transistor Amplifiers, 2nd. ed.*, Prentice-Hall, 1997.

Class notes, handouts. Additional material is also available on the course web page at http://www.nd.edu/~hscdlab

Prerequisites: EE 30348, EE 30358 or consent of instructor

Catalog Description: (2-3-3)

This course is an introduction to RF and microwave circuit design and analysis techniques, with particular emphasis on applications for modern wireless communication and sensing systems. An integrated laboratory experience provides hands-on exposure to specialized high-frequency measurement techniques. Students will develop an enhanced understanding of circuit design and analysis principles as applied to modern RF & microwave circuits, as well as gain familiarity with design techniques for both hand analysis and computer-aided design. A design project will be designed, built, and tested using the computer-aided techniques and instrumentation in the lab.

Course Outline:

- Review of electromagnetics; Maxwell's equations, plane wave solutions, transmission lines. Introduction to ADS microwave CAD software
- Types of transmission lines and their properties; coaxial lines, rectangular waveguides, microstrip.
- Network analysis; scattering matrix, transmission matrix formulations. Flow graphs, Mason's rule.
- Matching networks: lumped element designs and limitations, single and double-stub tuned designs. Quarter-wavelength transformers, multisection matching transformers.
- Active microwave circuit design, characteristics of microwave diodes and transistors. Linear and nonlinear behavior and models.
- Amplifier design; gain and stability, design for noise figure.
- Noise in microwave circuits; dynamic range and noise sources, equivalent noise temperature, system noise figure considerations.

Laboratory and Design Project: (approx. 11 laboratory sessions)

1. High frequency performance of circuit components
2. Measurement basics; reflectometry, spectrum analysis
3. Scalar network analyzer measurements
4. Vector network analyzer operation and error correction
5. Scattering parameter measurements of active devices
6. Matching network design, fabrication, and characterization
7. Project design, characterization, and analysis
8. Nonlinear and noise characterization of active circuits

Homework:

Homework will be assigned and collected (approximately) weekly.

Examinations:

1 in-class midterm examination, cumulative final exam

Grading:

Homework	20 %
Mid-term exam	25 %
Laboratory (includes design project)	25 %
Final exam	30 %