ECE 684 Microwave Metrology

Spring

Instructor: P. Siqueira, 113E KEB

The course website can be found on Moodle

Goal: Because of the importance of phase and impedance matching, making measurements at microwave frequencies (300 MHz and above) is a challenging task. In this lab-oriented course, we will be exploring the architectures of some of the basic tools behind making measurements of S-parameters, spectra, RF power, and other measures that are used to numerically characterize the behavior of microwave components and systems.

Labs: Room 6, Marcus (Microwave Instruction Lab). There are 6 to 9 labs that will begin in February. Labs include: i.) Gain measurement, ii.) Calibration using CPW and probes, iii.) Thermal noise measurements, iv.) Distortion characteristics of amplifiers, v.) Phase noise, vi.) IQ modulation and demodulation, vii.) Defining calibration standards, viii.) Use of a digital oscilloscope, and ix.) build your own amplifier.

Grading: 25% homework, 50% labs, 25% final project†

† the final project will be an extension of the "build your own" lab and will consist of the construction and characterization of a microwave circuit.

Topics:

1. Introduction
    a. Probability & Averaging
    b. Types of measurement errors
    c. Connectors and Test Equipment
    d. Microwave simulation tools
    e. Lab report note taking and formats
2. Noise & Distortion
    a. Types of noise (thermal, shot, flicker, quantization & phase)
    b. Measurement of thermal noise
        i. ENR
        ii. Y-factor
    c. Measurement of phase noise
    d. Distortion (P1dB; OIP3, Cascading)
    e. Dynamic range
    f. Effects of noise on communication signals
3. Network Analyzer
    a. Architecture
    b. Calibration standards
    c. Calibration methods
    d. S-, T-, and R-matrices
4. Spectrum Analyzer
    a. Architecture
5. Digital Oscilloscopes and RF Power measurement