ECE 332: Electronics Principles

**In:**
- Analysis and design procedures using models
  - Can express diode, MOSFET and BJT regions of operation by function and bias
- Device behavior in circuit configurations
  - Can determine region of operation, bias points
  - Can determine equivalent circuits
- Linear Signal amplification, transfer functions, frequency response
  - Can depict common gate, drain, & source configs
  - Can analyze configurations for transfer functions of voltage, current and transconductance
- Parasitic and secondary effects on signal processing
  - Can derive full expression for CS or CE configuration frequency response
  - Can show relationship to open-circuit time constant and Miller effect approximation
- SPICE simulation
  - Can simulate circuits
  - Can use simulation to confirm hand calculations for single stage amplifiers
  - Able to edit SPICE models so that models match measurements
- Laboratory procedures
  - Can connect devices and evaluate bias circuits and time-varying behavior
  - Can analyze measurements and display results in Bode plots for transfer functions
  - Can extract device properties (e.g. threshold voltage) from measured data
  - Can use LabView to derive I-V characteristics of devices and customize VI’s
- Pre-requisites:
  - ECE 331

**Out:**
- Linear Amplifier Operation and Design
  - Can design bias circuits in single and multi-stage amplifiers using active loads for achieving operational specifications
  - Can analyze and optimize design for achieving fundamental specifications such as gain, bandwidth, and output swing
  - Can calculate and articulate tradeoffs in amplifier configurations relative to performance
  - Can show first-order effects and sources of parasitic elements as related to performance of linear amplifiers
- Feedback in Linear and Non-Linear Circuits
  - Can identify and describe the basic topologies for feedback in linear amplifications
  - Can determine loop gain and understand the effect on stability described in terms of effects on poles for the circuit and phase margin
  - Can employ Bode plots to illustrate behavior
- Noise and Perturbations on Signal Integrity
  - Can describe the common sources and characteristics of noise in linear and non-linear systems
  - Can use first-order models of circuits
- Waveform Generation and Shaping
  - Can analyze common topologies for sinusoid, pulse and triangular waveform generation
  - Can design waveform generators to basic, first order specifications
- Engineering Procedures and Tools
  - Display lab notebook that meets industrial needs for documentation and intellectual property instantiation
  - Can employ SPICE as a routine tool to further understand calculations and measurements
  - Can extract parameters from measurements to modify model parameters for better matching of simulation to experiment
  - Can use LabView for data acquisition and analysis and extract parameters using math functions

**Concepts:**
- MOS transistors are used as linear devices for signal amplification and conditioning
- MOS transistors are used as non-linear devices for power amplification.
- Design tradeoffs among gain, bandwidth, output swing, stability, and noise are provided.
- Feedback allows another degree of freedom to achieve design goals.
- Design requires drawing from model information, making compromises and analyzing results relative to desired specifications

**Applications:**
- Single stage linear amplifiers
- Multi-stage linear amplifiers
- Class A, Class B, and Class AB amplifiers

**Tools:**
- Cadence schematic and simulation tools.

As of 12/9/08