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:

- ECE331

As of 12/9/08

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.

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