ECE 332: Electronics Principles II

IN

Analysis and Design Using Models

- Express diode, MOSFET and BJT regions of operation by function and bias

Device Behavior in Circuit Configurations

- Determine region of operation, bias points
- Determine equivalent circuits

Linear Signal Amplification, Transfer Functions

- Depict common gate, drain, & source configs
- Analyze configurations for transfer functions of voltage, current and transconductance

Thevenin and Norton Equivalent Circuits

- Transform sources and impedances to equivalent forms to analyze circuit behavior

SPICE Simulation

- Simulate circuits
- Use simulation to confirm hand calculations for single-transistor amplifiers

Laboratory Procedures

- Connect devices and evaluate bias circuits and time-varying behavior
- Analyze measurements and display results in Bode plots for transfer functions
- Extract device properties (e.g. threshold voltage) from measured data
- Use Analog Discovery to derive I-V characteristics of devices and customize Vi's

Pre-requisites

- ECE 331 with a minimum grade of C

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
- Noise in transistor-based circuits

Applications:

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

Tools:

- SPICE
- Electronic circuit editor
- Cadence schematic and simulation tools

OUT

Linear Amplifier Operation and Design

- Design bias circuits in single and multi-stage amplifiers using active loads for achieving operational specifications
- Analyze and optimize design for achieving fundamental specifications such as gain, bandwidth, and output swing
- Calculate and articulate tradeoffs in amplifier configurations relative to performance
- Show first-order effects and sources of parasitic elements as related to performance of linear amplifiers

Device Behavior in Circuits

- Determine region of operation, bias points
- Determine equivalent circuits for any region

Noise and Perturbations on Signal Integrity

- Depict common gate, drain, and source configurations
- Analyze circuits for transfer functions of voltage, current and transconductance

Waveform Generation and Shaping

- Analyze common topologies for sinusoid, pulse and triangular waveform generation
- 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
- Employ SPICE as a routine tool to further understand calculations and measurements
- Extract parameters from measurements to modify model parameters for better matching of simulation to experiment
- Use Analog Discovery for data acquisition and analysis and extract parameters using math functions

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