### 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 LabView to derive I-V characteristics of devices and customize Vi’s

**Pre-requisites**
- ECE 331 with a C or higher

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**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 Perurbations 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 LabView for data acquisition and analysis and extract parameters using math functions

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**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