ECE 331: Electronics Principles I

**IN**

- **Differential and Integral Calculus**
  - Integrate and differentiate sinusoidal, exponential and logarithmic functions
  - Compute terms of a series expansion
  - Evaluate functions at limiting values

- **Phasors, Impedance**
  - Convert complex numbers from Cartesian-to-polar coordinates
  - Convert linear, time-invariant system from differential

- **Kirchhoff’s Law**
  - Analyze circuits with reactive and resistive elements
  - Use mesh and node analysis to analyze circuits with independent and dependent sources

- **Thevenin and Norton Equivalent Circuits**
  - Transform sources and impedances to equivalent forms to analyze circuit behavior

- **Intro Lab and Measurement Procedures**
  - Use instruments
  - Measure voltage, current and frequency response in RLC circuits
  - Maintain a lab notebook

- **Bode Plot Nomenclature and Conventions**
  - Express transfer functions of single and multiple time constant circuits in Bode format

- **Pre-requisites**
  - ECE 202 with a C or higher; MATH 340 with a C or higher; ECE 311, may be taken concurrently; ECE 341, may be taken concurrently or ECE 451, may be taken concurrently

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**CONCEPTS:**
- Basic semiconductor physics concepts for transistor operations
- Asymmetric, non-linear devices are modeled in terms of region of operation, and parasitic properties:
  - pn junction diodes
  - Zener diodes
  - MOSFETs
- Bipolar junction transistors
- Region of operation and bias for best performance
- Transfer functions
- Equivalent circuits
- Single transistor circuit configurations

**APPLICATIONS:**
- Voltage, current and power supply design
- Large-signal processing (clamps, logic inverters)
- Linear signal processing (linear amplifiers, filters)

**TOOLS:**
- SPICE
- Electronic circuit editor
- Cadence schematic and simulation tools

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**OUT**

- **Analysis and Design Using Models**
  - Express diode, MOSFET and BJT regions of operation

- **Device Behavior in Circuits**
  - Determine region of operation, bias points
  - Determine equivalent circuits for any region

- **Linear Signal Amplification, Transfer Functions**
  - Depict common gate, drain, and source configurations
  - Analyze circuits for transfer functions of voltage, current and transconductance

- **Parasitic and Secondary Effects on Signal Processing**
  - Derive full expression for single-transistor circuit configurations frequency response
  - Show relationship to open-circuit time constant and Miller

- **SPICE Simulation**
  - Analyze systems in time and frequency domain using MATLAB and/or Simulink tools

- **Laboratory Procedures: Measurement, Analysis, and Reporting**
  - 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 for processing laboratory information

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