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

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)
- Single-stage, single-transistor amplifier circuits

Tools:

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

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

Reviewed 1/2020