

## **ECE 3424 – Intermediate Electronic Circuits**

Textbooks: Giorgio Rizzoni, Principles and Applications of Electrical Engineering, 4th Edition, McGraw-Hill 2004

Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits, 5th Edition, Oxford 2004

### **I. Semiconductors and Diodes**

- A. Electrical Conduction in Semiconductor Devices
- B. The  $pn$  Junction and the Semiconductor
- C. Circuit Models for the Semiconductor Diode
  - a. Large-Signal Diode Models
  - b. Small-Signal Diode Models
  - c. Piecewise Linear Diode Model
- D. Rectifier Circuits
  - a. The Full-Wave Rectifier
  - b. The Bridge Rectifier
- E. DC Power Supplies, Zener Diodes, and Voltage Regulation

### **II. Field-Effect Transistors: Operation, Circuit Models, and Applications**

- A. Classification of Field-Effect Transistors
- B. Overview of Enhancement-Mode MOSFETs
  - a. Operation of the  $n$ -Channel Enhancement-Mode MOSFET
  - b. Biasing MOSFET Circuits
  - c. Operation of the  $p$ -Channel Enhancement-Mode MOSFET
- C. MOSFET Amplifiers
- D. MOSFET Switches
  - a. Digital Switches and Gates
  - b. Analog Switches

### **III. Bipolar Junction Transistors: Operation, Circuit Models, and Applications**

- A. Transistors as Amplifiers and Switches
- B. Operation of the Bipolar Junction Transistor
  - a. Determining the Operating Region of a BJT
  - b. Selecting an Operating Point for a BJT
- C. BJT Switches and Gates

### **IV. AC Transistor Equivalent-Circuit Models**

- A. MOSFET High-Frequency Models
- B. MOSFET Amplifier Analysis
- C. The CMOS Digital Logic Inverter

### **V. Electronic Instrumentation and Measurements**

- A. Measurement Systems and Transducers
  - a. Measurement Systems
  - b. Sensor Classification
  - c. Motion and Dimensional Measurements
  - d. Force, Torque, and Pressure Measurements
  - e. Flow Measurements
  - f. Temperature Measurements
- B. Wiring, Grounding, and Noise
  - a. Signal Sources and Measurement System Configurations

- b. Noise Sources and Coupling Mechanisms
  - c. Noise Reduction
- C. Signal Conditioning
  - a. Instrumentation Amplifiers
  - b. Active Filters
- D. Analog-to-Digital and Digital-to-Analog Conversion
  - a. Digital-to-Analog Converters
  - b. Analog-to-Digital Converters
  - c. Data Acquisition Systems
- E. Comparator and Timing Circuits
  - a. The Op-Amp Comparator
  - b. The Schmitt Trigger
  - c. Multivibrators
  - d. Timer ICs: The NE555
- F. Other Instrumentation Integrated Circuits Amplifiers
  - a. DACs and ADCs
  - b. Frequency-to-Voltage, Voltage-to-Frequency Converters, and Phase-Locked Loops
  - c. Converters, and Phase-Locked Loops
  - d. Other Sensor and Signal Conditioning Circuits
- G. Data Transmission in Digital Instruments
  - a. The IEEE Bus
  - b. The RS- Standard
  - c. Other Communication Network Standards

## **VI. Communication Systems**

- A. Introduction to Communication Systems
  - a. Information, Modulation and Carriers
  - b. Classification of Communication Systems
  - c. Communication Channels
- B. Spectral Analysis
  - a. Signal spectra
  - b. Periodic Signals: Fourier Series
  - c. Non-periodic Signals, Fourier Transform
  - d. Bandwidth
- C. Amplitude Modulation and Demodulation
  - a. Basic Principle of AM
  - b. AM Demodulation; Integrated Circuit Receivers
- D. Frequency Modulation and Demodulation
  - a. Basic Principle of FM
  - b. FM Demodulation
- E. Examples of Communication Systems
  - a. Global Positioning System (GPS)
  - b. Radar
  - c. Sonar
  - d. Computer Networks
  - e. Wireless Networks and Personal Communication Systems
  - f. The Internet