

Course Description

This course presents an overview, applications, fundamentals and design flow of the state-of-the-art integrated circuits (IC) and systems. Course contents include fabrication process; diodes, bipolar transistors and MOS transistors and modes of operations; and fundamental of analog, digital and mixed-signal IC design. *Prerequisite(s)*: ELEC 2400 or ELEC 2420.

List of Topics

Lecture Outline

- Week 1 Introduction to Integrated Circuits and Systems, analog vs. digital signals
Review on op amp circuits and their applications: Filters, ADCs, DACs,
- Week 2 Basics of semiconductor properties, solid-state devices, and IC fabrication;
- Week 3 PN junction properties and diode-based circuits
- Week 4 Bipolar Junction Transistor (BJT) operation, IV Characteristics & biasing
- Week 5 BJT small-signal model and 1-transistor amplifier design
- Week 6 Metal-Oxide-Semiconductor Field Effect Transistor (MOSFET) operation, IV Characteristics & biasing
- Week 7 MOSFET small-signal model and 1-transistor amplifier design
- Week 8 Common-emitter amplifier, Common-base amplifier, Emitter Follower
- Week 9 Common-source amplifier, Common-source amplifier, Source Follower
- Week 10 Differential amplifier design and introduction to op amp design
- Week 11 Current mirrors, active load, two-stage op amp design
- Week 12 Introduction to digital circuits and CMOS logic
- Week 13 MOS memory storage circuits

Laboratory Outline

1. AM Radio Receiver (Week 3-4)
2. MOSFET Characterization (Week 6-7)
3. MOS Single Transistor Amplifier (Week 10-11)
4. CMOS Logic Characterization (Week 12-13)

Statement of Objectives/Outcomes:

On successful completion of this course, students will be able to:

CO1 - recognize the operations of diodes and transistors in integrated circuit functional blocks and systems.

CO2 - distinguish and employ large-signal analysis and small-signal analysis in analyzing a circuit.

CO3 - analyze and design basic CMOS analog and digital building blocks and simple mixed-signal systems.

CO4 - analyze, design and debug analog and digital circuit building blocks.

CO5 - apply software tool, such as Pspice, to design, simulate and analyze integrated circuit functional blocks.

Textbook(s):

R. Jaeger and T. Blalock, *Microelectronic Circuit Design*, 4th Edition, McGraw Hill, 2011

Reference Books/Materials:

A.S. Sedra and K.C. Smith, *Microelectronic Circuits*, 5th ed., New York, Oxford University Press, 2004.

Relationship of Course to Program Outcomes:

Please refer to the Report Section 4.3.2 (iii).

Grading Scheme:

Homework	20%
Laboratory	20%
Mid-Term Examination	25%
Final Examination	35%

*Lab. Assessment weighting: Pre lab 30% Lab performance 20% Lab report 50%