ELEC3400 Introduction to Integrated Circuits and Systems (Spring 2024) Credit: 4

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 Cascade amplifier design
Week 12 Current mirrors, active load
Week 13 Cascode amplifier design

Laboratory Outline

1. AM Radio Receiver (Week 6)
2. MOSFET Characterization (Week 9)
3. MOS Single Transistor Amplifier (Week 11)

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*, 6th Edition, McGraw Hill, 2023

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	15%
Laboratory	20%
Mid-Term Examination	25%
Final Examination	40%

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