ELEG 3224 – ELECTRONICS II

Credits and Contact Hours
Four credit hours, 37.5 hours of instructor contact

Instructor's Name
Homer Alan Mantooth

Textbook:
Microelectronic Circuits, 6th Edition, Adel S. Sedra and Kenneth C. Smith, Oxford University Press, New York, NY, 2010.

Specific Course Information

a. Catalog description
   Transistor amplifier design, frequency response, feedback principles, stability, analog integrated circuits, electronics circuit design, and applications.

b. Pre-requisites or co-requisites
   Corequisite: Prerequisites: ELEG 2114 – Electric Circuits II, MATH 3404 –Differential Equations, and ELEG 3214 – Electronics I.

c. Required

Specific Goals for the Course:

1. **Specific Outcomes of Instruction**
   The basic objective of this course is to provide students with the understanding and skills so that they are able to analyze and design transistor circuits for amplifiers and other applications. Students are introduced to the concepts of small-signal modeling, active loads, biasing with current mirrors, frequency response of open-loop and feedback amplifiers, and stability and compensation. Examples are used to demonstrate various techniques for the analysis of transistor circuits and students are required to demonstrate their understanding of these techniques by applying them in other circuits and applications.

   Upon completion of Electronics II students should be able to design a two-stage transistor amplifier with feedback that is stable, has no systematic offset voltage, and achieves the desired gain and bandwidth with the limits of the technology. They should also be adept at applying hand analysis to large and small-signal circuits and be able to create small-signal circuits through the substitution of small-signal models.

2. Student Outcomes Listed in Criterion 3 Addressed by the Course

OUTCOME	HOW IT WAS ADDRESSED
(a)	Students are required to demonstrate ability to apply mathematics through differential equations, calculus based physics of transistors and diodes, and electrical engineering principles and theorems to analog microelectronic circuits.
(b)	The associated laboratory requires students to conduct experiments and analyze and interpret data. Students are given the task for the final laboratory assignment and are required to design an experiment to acquire specified information and data.
(c)	Design problems are assigned, collected and graded throughout the course
(d)	Students work in teams of two or more for the laboratory experiments
(e)	Students are required to apply principles covered in lecture to new problems (i.e. identify, formulate and solve problems using techniques covered in class).

(f)	Professional and Ethical responsibility are discussed as appropriate in projects and homework. Honors students research and make presentations to the class on ethical issues involving contemporary issues in electronics covering item (f) and (j).
(g)	The instructor requires class discussions and questions. Students are required to speak in a manner and to state their questions so that all students in the class can hear and understand.
(h)	not applicable
(i)	The instructor informs the students how technology and techniques have changed during his career and emphasizes to need for continued and life-long learning
(j)	Contemporary issues facing microelectronics, analog and mixed signal electronics, and integrated circuit technology are discussed in the context of material being covered in lectures. Further, honors students make presentations concerning with contemporary issues in electronics.
(k)	PSPICE, an industry standard for integrated circuit simulation is required and used throughout the course. Also, students are required to use the internet to find and collect information and data for devices and applications.

List of Topics Covered in Class (class time: 75 minutes)

1. Single-stage transistor amplifiers (common-source, cascode, folded-cascode)
2. Simple Current Mirror, Cascode, Widlar, and Wilson Current Mirrors.
3. Active Loads
4. Differential amplifiers (BJT and MOSFET)
5. Common-mode and Differential mode signals
6. Differential and common-mode voltage gain for double-ended and single-ended outputs
7. Differential and common-mode input and output resistances
8. Multistage amplifiers
9. Open-circuit and Short-Circuit time constant methods for estimating upper and lower – 3dB frequencies
10. Miller's Theorem and the Miller capacitance
11. Bode plots
12. Frequency response of the common-emitter and common-source Amplifiers
13. Frequency response of the common-base and common-gate amplifiers
14. Frequency response of the common-collector and common-drain amplifiers
15. Frequency response of the differential pair amplifier
16. Basic feedback theory
17. The four feedback topologies
18. Effect of feedback on gain and bandwidth
19. Effect of feedback on input and output impedances
20. Compensation of feedback amplifiers.

List of Labs (Lab time: 170 minutes)

Experiment #1: Analog Circuit Design Project - Design of Simple Amplitude Detector
Experiment #2: Operational Amplifiers
Experiment #3: Current Mirrors
Experiment #4: Common Source Amplifiers
Experiment #5: MOS Differential Pair Amplifier