ELEG 3223 – ELECTRONICS II

Catalog Description: Transistor amplifier design, frequency response, feedback amplifiers, stability, analog integrated circuits, active filters, oscillators, electronics circuit design, and applications. Corequisite: ELEG 3221L, Prerequisites: ELEG 2113-Electric Circuits II, MATH 3404-Differential Equations, and ELEG 3212-Electronics I.

Textbook: Sedra, Adel S., and Smith, Kenneth C., Microelectronic Circuits, 4th Edition, Oxford University Press, New York, NY, 1998.

(optional) Roberts, Gordon W., and Sedra, Adel S., Spice, 2nd Edition, Oxford University Press, New York, NY, 1997.

Course Objective: 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.

Perquisites by Topic:
1. mathematics through calculus and differential equations
2. electric circuit theory and theorems
3. PSPICE circuit simulation software
4. Semiconductor PN junction theory
5. Bipolar and MOSFET transistors
6. Single transistor amplifiers
7. Opamp circuits

Topics Covered: (1 period = 50 minutes)
1. Emitter coupled differential pair amplifier
2. Common-mode and Differential mode signals
3. Differential and common-mode voltage gain for double-ended and single-ended outputs
4. Differential and common-mode input and output resistances
5. Simple Current Mirror, Widlar Current Mirror, and Wilson Current Mirror.
6. Active Loads
7. Multistage amplifiers
8. PSPICE simulation
9. Bode plots
10. Open-circuit and Short-Circuit time constant methods for estimating upper and lower –3dB frequencies
11. Miller's Theorem and the Miller capacitance
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. PSPICE Simulation
17. Basic feedback theory
18. The four feedback topologies
19. Effect of feedback on gain and bandwidth
20. Effect of feedback on input and output impedances
21. Burkhausen Condition and stability
22. Compensation of feedback amplifiers.

Class/Laboratory Schedule:	The class meets 3 times per week for 15 weeks. Each meeting is 50 minutes. There is a one credit hour laboratory associated with the course. The laboratory administratively is a separate course (ELEG 3221L). There are four required experiments in the laboratory course and each experiment requires a pre-laboratory exercise, experiment, and report.
Computer Usage	PSPICE simulations and design verifications are required for 3-5 projects each semester.

Relationship of course to program outcomes:

(a)(l)(m) 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 and 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 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.
(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 covered explicitly
(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.
(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.
(l)(m)(n)(p) Students are required to analyze and design complex analog microelectronic circuits and applications using mathematics through differential equations and integral calculus, and electric circuits science.
(l)(m)(n)Students demonstrate knowledge of linear algebra through the use of Kirchoff's current and voltage equations applied to multi-node and multi-loop circuits.
(l)(p) Students demonstrate knowledge of complex variables in solving for the gain magnitude and phase of various amplifier configurations as a function of frequency.

Prepared by: _____ Date: _____