**ELEN 3030: Analog Electronics**

**Class Schedule:** 3 Credit course, meeting the equivalent of three 50 minute class periods per week.

**Course Coordinator:** Susan Schneider

**Course Materials:**

**Required:**

Microelectronics: Circuit Analysis and Design, 4th Edition by Donald A. Neamen

**Course Description:**

Analysis and design of analog electric circuits. Low and high frequency models for both bipolar and field effect transistors. Design features and operating characteristics of integrated linear circuits with emphasis on operational amplifiers and op-amp circuits.

**Prerequisites:** EECE 3010 and ELEN 2020.

**Required** in the Electrical Engineering program and for the Bioelectronics major in the Biomedical Engineering program

**Elective in** COEN Hardware area (depth only)

**Contribution to Professional Component:** Engineering Science 75 %

Engineering Design 25 %

**Course Goals:**

* Extend knowledge of the theory and applications of transistors and transistor amplifier design
* Extend student knowledge of the theory and applications of operational amplifier integrated circuits
* Introduce students to the concepts and use of feedback and feedback (amplifier) design
* Provide sufficient knowledge and experience so that students will be able to make meaningful design choices when asked to design a (simple) amplifier to meet or exceed design specifications
* Provide sufficient knowledge and experience so that students will be able to make meaningful design choices when asked to design a (simple) analog oscillator to meet or exceed design specifications
* Continue to develop and practice oral and written communication skills specifically directed to the practice of electrical engineering
* Introduce students to the use of a variety of analog electronic components

**Course Objectives:**

*By the end of this course, you should....*

1. Understand the use of the appropriate small signal models for linear applications
2. Master the tools of analog electronics, including (but not limited to)
   * 1. Bode plot approximation techniques
     2. time constant analysis techniques
     3. negative feedback concepts, and
     4. positive feedback concepts
3. For Basic Amplifiers
   * 1. Be able to IDENTIFY basic amplifier topologies (BJT, FET, op-amp)
     2. Be able to ANALYZE basic amplifier topologies for gains and resistances
     3. Be able to DISCUSS the relative properties of various amplifier topologies
     4. Be able to DESIGN basic amplifiers to meet or exceed stated specifications
4. For Feedback Amplifiers
   * 1. Be able to IDENTIFY feedback amplifier topologies
     2. Be able to ANALYZE feedback amplifier topologies
     3. Be able to DISCUSS the relative benefits and possible drawbacks of feedback amplifier topologies with respect to basic amplifier topologies
     4. Be able to APPLY the concepts of feedback analysis to the DESIGN of analog amplifiers to meet or exceed stated specifications
5. For Large Signal Amplifiers
   * 1. Be able to IDENTIFY large signal amplifiers
     2. Be able to ANALYZE large signal amplifiers
     3. Be able to DISCUSS the relative properties of various large signal amplifier topologies
     4. Be able to APPLY large signal amplifiers to meet or exceed stated specifications
6. For Oscillators
   * 1. Be able to IDENTIFY oscillator topologies
     2. Be able to ANALYZE oscillator topologies
     3. Be able to DISCUSS the relative properties of various oscillator topologies
     4. Be able to DESIGN oscillators to meet or exceed stated specifications
7. For Operational Amplifier and Op-Amp Circuits
   * 1. Be able to discuss the non-ideal characteristics of op-amps based on their internal circuitry
     2. Be able to IDENTIFY op-amp circuit topologies
     3. Be able to ANALYZE op-amp circuits
     4. Be able to DISCUSS the relative properties of op-amp circuits

**Contribution to Program Objectives:** partial fulfillment of Criterion 3 objectives A, B, C, E, G, K

**Analog Electronics Topics: In the Text**

1. Review of Transistor Characteristics, DC Biasing, Chapter 1 – 3, 5
2. Small Signal Models
   1. BJT Chapter 5, sections 1 thru 6
   2. FET Chapter 4, sections 1 thru 6
3. Basic Amplifier Stages at Midband
4. Universal Amplifier Stage
5. BJT: CE, CE with RE, CC, CB Chapter 5, section 7
6. FET: CS, CS with RS, CD, CG Chapter 4, section 7
7. Differential Amplifiers Chapter 7, sec. 1 – 5
8. Frequency Response of Amplifiers Chapter 4.8-4.9, 5.8-5.9
   1. Low Frequency response
   2. High Frequency response
9. Operational Amplifier
   1. Op-Amp Basics Chapter 2
   2. Op-Amp Characteristics Chapter 9.1-9.6
10. IC Biasing, DAs (ch. 10, 11)
11. Feedback (ch. 12)
12. Review

If time permits

1. Op-Amps: Non-idealities (ch. 13-15)