ECE/CS 1250: Electrical & Computer Engineering Design

Credits and Contact Hours: 4.0 Credit Hours

15 weeks: Three 50-minute lectures + one 3-hour lab per week

Instructor's Name: Neil Cotter

Text Book(s) and/or Required Material:
- F.T. Ulaby and M. M. Maharbiz, *Circuits*, Second Edition, NTS Press, 2012
- H. Moore, *MATLAB for Engineers*, Fourth Edition, Prentice Hall, 2014

Catalog Description: System design using electrical and computer engineering concepts. Basic concepts of electrical circuit design, sensors, signal processing, communications, control and embedded system programming are used to design sensor/actuator systems to accomplish engineering design tasks. Topics also include Matlab programming and laboratory instrumentation.

Prerequisites: P
- Full major status in Computer Science or Computer Engineering; and
- C- or better in:
- MATH 1210: Calculus I; or
- MATH 1310: Engineering Calculus I; or
- MATH 1311: Accelerated Engineering Calculus I

Designation: Required

Contribution of Course to Meeting the Requirements of ABET Criterion 5: This course teaches electrical engineering science and electrical engineering design.

Specific Outcomes of Instruction:
At the conclusion of ECE 1250 students should be able to:
1. Design, evaluate (with theory/math and simulation), build, test, and debug simple electrical/computer engineering circuits using voltage and current sources, resistors and capacitors, op amps, and diodes to accomplish specific engineering tasks
2. Explain applications in electrical and computer engineering including: electrical circuit design, sensors, signal processing, communications, electromagnetics, control and embedded systems
3. Program MATLAB for applications in electrical & computer engineering

Relationship of the Course to the Program Outcomes:
(a) *An ability to apply knowledge of mathematics, science, and engineering.* Students apply tools such as Ohm's Law, Kirchhoff's Laws, exponential solutions to RL and RC circuits, phasors (i.e., complex numbers), and impedance of R, L, C components to solve circuit problems. Students apply this knowledge to solve homework, exam, and lab problems.

(b) *An ability to design and conduct experiments, to analyze and interpret data, and to debug and analyze software.* (1) Final project (3 weeks at end of semester) students 'invent', design, test, and build a sensor system of their own choosing. This requires them to design an experiment to show how their system is working. (2) Students program and debug Matlab software in 6 assignments throughout the semester.

NOTE: Students use the NI MyDAQ hardware that provides basic lab tools on their computers (DMM, scope, function generator, power supplies, digital analysis, etc.) They also have a personal copy of Multisim circuit analysis software. These two tools are used extensively in the lab and also in the homework to conduct experiments and analyze if the measured/simulated/predicted values all agree.

(c) An ability to design a system, component, process or software package to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. Each lab requires that students derive component values for a given circuit. Students also build a final project of their own design. The project is required to involve a sensor and perform a practical function. The final project (mentioned above) they design a sensor system to meet a specific need, which they have identified.

(e) An ability to identify, formulate, and solve engineering problems. Students solve, simulate, and build basic electrical engineering circuits. Both homework and labs provide opportunities for practice designing circuits to do specific things. In lab write-ups, students write conclusions about why results and theory may have differed.

(g) An ability to communicate effectively in written and oral form. There are two formal writing assignments in the labs during the semester, where they receive edit notes from the TAs. The final project 'report' is a video (oral communication).

(h) The broad and inclusive education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context. I cover a number of engineering applications throughout the semester, and many of these cover environmental and medical applications.

(i) A recognition of the need for, and an ability to engage in life-long learning. Students view websites such as IEEE Spectrum magazine and videos on current technology applications.

(j) A knowledge of contemporary issues. I cover a number of engineering applications throughout the semester, and many of these cover environmental and medical applications.

(k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice. Students make extensive use of software and hardware: MATLAB (to analyze measurements), Benchlink (to transfer data from oscilloscopes to PC's), digital power supplies, digital multimeters, and oscilloscopes. Students use these tools to test and analyze the circuits they build in each lab.

Topics Covered in the Course:

- Circuit laws: definition of voltage, current, power; passive sign convention; Ohm's law; Kirchhoff's laws, series and parallel resistors; voltage and current dividers; op-amp ideal model and circuits.
- DC circuit analysis: power; node-voltage method; mesh current method; Thevenin and Norton equivalents.
- RC and RL circuit analysis: current-voltage relationships for capacitors and resistors; RL and RC circuits natural response and general solution; max power transfer; superposition.
- Sinusoidal-signal circuit analysis: complex numbers, Euler's formula; phasors; impedance for R, L, and C; Kirchhoff's laws for sinusoidal signals; Thevenin and Norton equivalents, node-voltage and mesh current methods, and superposition.
- Matlab & introductory programming (built in and user defined functions, plotting and data output, debugging)
- Laboratory skills for building circuits. (build, measure, test).