Number: ENGR 330 (Section 01)

Title: Microelectronics I

Credits: 5 credits

Course Format: Four one-hour lectures per week. One two-hour laboratory per week.

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Catalog Description: Microelectronics I is the first course in modeling, characterization and application of semiconductor devices and integrated circuits. Development of models for circuit-level behavior of diodes, bipolar and field effect transistors, and non-ideal op-amps. Application in analysis and design of linear amplifiers. Frequency characterization of transistor circuits.

Learning Objectives (and corresponding mapping to ABET Criteria 3): Upon completion of this course, students will be able to:
1. Explain semiconductor material properties (ABET 3a)
2. Apply the characteristics of diodes to create wave shaping circuits (rectifiers, clippers and clampers) (ABET 3a).
3. Apply the characteristics of the zener diode to the design of voltage regulator circuits (ABET 3c, 3e).
4. Discuss and develop the parameters and characteristics of the ideal OA (ABET 3a, 3b).
5. Analyze and design OA based circuits (ABET 3c, 3e).
6. Describe and analyze operation modes and characteristics of the MOSFET (ABET 3a).
7. Calculate the DC operating point of MOSFET circuits (ABET 3a).
8. Develop the small signal model of MOSFET devices (ABET 3a, 3j).
9. Analyze and design CS, CG, CD amplifier configurations (ABET 3c, 3e).
10. Use CAD tools such as SPICE to model, analyze, simulate, design and improve the functionality of basic semiconductor devices and circuits (ABET 3g, 3i, 3j, 3k).


Prerequisites: ENGR 210 (Electric Circuits II) or consent of the instructor.

Topics:
- Introduction to Electronics
- Summary of Network Theory
- Basic Semiconductors Theory
- Diodes
- Operational Amplifiers
- Field Effect Transistor
- Introduction to SPICE
Computer Usage:
1. Electronic instrumentation such as oscilloscopes, function generators, multi-meters, power supplies and extensive use of CAD tools such as SPICE.
2. Design homework and laboratory assignments involve writing technical reports using word processing and graphic software for their presentation.

Laboratory:
Laboratory experiments and design assignments require an understanding of basic semiconductor devices and circuit analysis and design, and involve the use of CAD tools, personal computers, lab instrumentation, writing skills and teamwork.

Grading:  
A = 3.5–4.0 (90–100%), B = 3.0–3.4 (80–89%), C = 2.0–2.9 (70–79%),  
D = 1.0–1.9 (60–69%), F= 0.0 (0–59%)

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
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<tr>
<td>Labs</td>
<td>20%</td>
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<tr>
<td>Midterm exam</td>
<td>40%</td>
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<tr>
<td>Final exam/project</td>
<td>30%</td>
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Course Outcomes and mapping to ABET Criteria 3:

a. *An ability to apply knowledge of mathematics, science, and engineering.*  
   Students are required to use their background in mathematics, physics and engineering to successfully finish homework, labs, and exams.

b. *An ability to design and conduct experiments, as well as to analyze and interpret data.*  
   Students are required to design and implement lab experiments for analyzing, designing, and improving circuits and systems.

c. *An ability to design a system component, or process to meet desired needs within realistic constraints.*  
   Homework, laboratory experiments, and exams require students to analyze, design, evaluate, and improve circuits and systems that must meet specified constraints.

d. *An ability to function effectively on multi-disciplinary teams.*  
   n/a

e. *An ability to identify, formulate, and solve engineering problems*  
   Homework and labs require students to identity, formulate, model and solve several engineering challenges.

f. *An understanding of professional and ethical responsibility.*  
   n/a

g. *An ability to communicate effectively.*  
   Students need to write several lab. reports.

h. *Understand impact of engineering solutions in a global, economic, environmental and societal context*  
   n/a

i. *A Recognition of the need for, and an ability to engage in life-long learning*  
   Students must self-learn the use of lab instrumentation and CAD tools.

j. *A Knowledge of contemporary issues*  
   Homework and lab. experiments are based on state of the art technologies and methodologies

k. *An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.*  
   Lab. experiments require the use of current methodologies, instrumentation and CAD tools.

Prepared by:  Claudio Talarico  
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