ECE 311 - Engineering Electronics

Physics of semiconductor devices. Diode operation and circuit applications.
Regulated power supplies. Bipolar and field-effect transistor operating
principles. Biasing techniques and stabilization. Linear equivalent circuit
analysis of bipolar and field-effect transistor amplifiers. Laboratory experiments reinforce concepts.
Prerequisite(s): [(ECE 213)]
(3-3-4) (C)

Enrollment:  Required course for EE and CPE majors.

Textbook:  A. Sedra and K. Smith, Microelectronic Circuits, Oxford University Press, 6th
ECE 311 Laboratory Manual

Coordinator:  T. Wong, Professor of ECE

Course goals:

After completing this course, the student should be able to do the following:
1. Model OP Amp operation as a black box electronic element and to apply the model to the analysis of typical op amp functional circuit blocks.
2. Apply diode device models to the analysis of diode circuits, including Zener regulating circuits.
3. Apply MOSFET device models (DC and small signal AC) to analyze the performance of MOSFET amplifying circuits.
4. Apply BJT device models (DC and small signal AC) to analyze the performance of BJT amplifying circuits.
5. Conduct laboratory experiments to confirm the analysis done in the class.
6. Prepare an informative and organized lab report that describes the methodologies employed, the results obtained, and the conclusions make in a laboratory experiment.

Prerequisites by topic:
1. Calculus including Differential Equations.
2. Circuit Analysis (AC, DC, transients, pole-zero and frequency response).
3. Familiarity with laboratory components, equipment, and software tools.

Lecture schedule:  Two 75-minute sessions per week
Laboratory schedule:  One 150-minute session per week

Topics:
1. Introduction to Electronic Amplifiers (1 week)
2. Operational Amplifier Applications (1 week)
3. Operational Amplifier Imperfections (0.5 week)
4. Ideal Diodes With Applications (1 week)
5. Small Signal Analysis (1 week)
6. Zener Diodes and Power Supplies (1.5 weeks)
7. Properties of Intrinsic and Extrinsic Semiconductors (0.5 week)
8. PN junction at Equilibrium and Under Bias (1 week)
9. MOSFET Operation (1 week)
10. DC Q-Point Analysis & Design (1 week)
11. Equivalent Circuit and AC Analysis (1 week)
12. MOSFET Small Signal Models & Small Signal Equivalent Circuits (1 week)
13. BJT Theory and DC Consideration (1 week)
14. Equivalent Circuit & Small Signal Analysis (1 weeks)
15. BJT Design Considerations (1 week)
Computer usage:
Students can use PSpice to check homework results and are required to use it in the laboratory.

Laboratory topics:
1. Operational amplifiers (2 weeks)
2. Diodes with applications (2 weeks)
3. MOSFETs (1 week)
4. BJTs (2 weeks)
5. PSpice (1 week)

Relationship of ECE 311 Course Goals to Student Outcomes:

<table>
<thead>
<tr>
<th>Student Outcomes</th>
<th>Course Goals</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Apply knowledge of math, engineering, science</td>
<td>1, 2, 3, 4</td>
</tr>
<tr>
<td>b. Design and conduct experiments / Analyze and interpret data</td>
<td>5</td>
</tr>
<tr>
<td>c. Design system, component, or process to meet needs</td>
<td></td>
</tr>
<tr>
<td>d. Function on multi-disciplinary teams</td>
<td></td>
</tr>
<tr>
<td>e. Identify, formulate, and solve engineering problems</td>
<td>1, 2, 3, 4</td>
</tr>
<tr>
<td>f. Understand professional and ethical responsibility</td>
<td></td>
</tr>
<tr>
<td>g. Communicate effectively (written / oral)</td>
<td>6</td>
</tr>
<tr>
<td>h. Broad education</td>
<td></td>
</tr>
<tr>
<td>i. Recognize need for life-long learning</td>
<td></td>
</tr>
<tr>
<td>j. Knowledge of contemporary issues</td>
<td></td>
</tr>
<tr>
<td>k. Use techniques, skills, and tools in engineering practice</td>
<td>1, 2</td>
</tr>
</tbody>
</table>

Prepared by: T. Wong                  Date: November 1, 2013