Introduction to Analog Systems and Circuits

ECE 2020

Credit Hours:
3.00

Course Coordinator:

Course Length:
14 weeks (autumn or spring)
12 weeks (summer only)

Representative Textbooks and Other Course Materials:

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuits</td>
<td>Ulaby and Maharbiz</td>
<td></td>
</tr>
</tbody>
</table>

Course Description:
Circuit theory and applications of passive components and Op amps. Introduction to analog systems using differential equations and Laplace transforms.

Prerequisites and Co-requisites:
Prereq: Math 1152, 1161.01, 1161.02, 1172, or 1181H; and Physics 1250, 1250H, or 1260, or CHEM 1210 or 1250.

Designation:
Required
Elective

Course Goals / Objectives:
Master circuit concepts such as voltage, current, charge, resistors, inductors, capacitors, etc.
Master how to analyze, design and implement circuits using Ohm's Law, Kirchhoff's laws and superposition
Be competent in Phasor Domain sinusoidal techniques
Be competent in analyzing, designing and implementing steady state and transient behavior of RC, RL, RLC circuits
Be competent in Laplace Transform techniques
Be competent in analyzing, designing and implementing simple active filters based on ideal Op Amps
Be familiar with how to use modern computer tools for analog simulation
Be competent in how to use laboratory instruments and laboratory methodology
Be competent with methodology for critical troubleshooting skills
### ABET-EAC Criterion 3 Outcomes:

<table>
<thead>
<tr>
<th>Outcome Description</th>
<th>Contribution</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Significant contribution (7+ hours)</td>
<td>1</td>
<td>an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics</td>
</tr>
<tr>
<td>Some contribution (1-2 hours)</td>
<td>5</td>
<td>an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives</td>
</tr>
<tr>
<td>Some contribution (1-2 hours)</td>
<td>6</td>
<td>an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions</td>
</tr>
<tr>
<td>Some contribution (1-2 hours)</td>
<td>7</td>
<td>an ability to acquire and apply new knowledge as needed, using appropriate learning strategies</td>
</tr>
</tbody>
</table>
Course Topics:

Fundamentals of electric circuits: Charge, Voltage, Kirchhoff’s Laws, power and sign conventions, Ohm's law, practical circuit elements

Circuit Analysis Techniques: Node Voltage / Mesh analysis, superposition, Thevenin and Norton equivalents

Ideal op amp, feedback, active filters, cascaded active filters

RC and RL first-order circuits, natural and total response, RC Op amp circuits

Initial and Final Conditions, Series and Parallel RLC, General solution of second-order circuits

Laplace transforms, properties, pole – zero diagrams and inverse Laplace transform

System transfer function – scaling, impulse response, step response, sinusoidal response, s-Domain circuit analysis

Sinusoidal signals, Phasor domain analysis, impedance transformations

RC, RL, RLC frequency response vs transient response

Bode Plots, Passive and Active Filters

Periodic Waveforms, Average and Complex Power, Maximum power Transfer

Simulated circuit analysis

Introduction to Lab Equipment, troubleshooting skills