EE-3160
Linear Systems and Control

Curricular Designation: EE: required    CpE: required

Catalog Description:
EE 3160 - Electric Circuits Introduces the mathematical analysis of signals, systems, and control. Topics include differential equations, Fourier series, Fourier transforms, Laplace transforms, frequency response, Bode plots, state models, and an introduction to control systems. Credits: 3.0 Lec-Rec-Lab: (3-0-0) Semesters Offered: Fall Spring Summer Restrictions: Must be enrolled in one of the following Major(s): Computer Engineering, Electrical Engineering Pre-requisites: EE 2150 and EE 2110 and (MA 2320 or MA 2321) and (MA 3520 or MA 3521 or MA 3530 or MA 3560)

Textbooks(s) and/or Other Required Materials:

Prerequisites by Topic:
1. Familiarity with sinusoids: amplitude, phase, frequency, and representation using complex exponentials
2. Familiarity with complex arithmetic: magnitude, argument, real, and imaginary components
3. Familiarity with discrete-time convolution
4. Familiarity with the mathematical modeling of circuits
5. Familiarity with the solutions to 1st and 2nd order ordinary linear differential equations
6. Familiarity with the solution of circuits using Laplace transforms
7. Familiarity with the elementary operations of linear algebra

Course Objectives:
1. Introduction to the modeling of physical systems
2. Introduction to the concepts of linearity and time-invariance
3. Introduction to the representation of common engineering signals
4. Introduction to continuous-time convolution
5. Introduction to Fourier series
6. Introduction to the Fourier transform and its properties
7. Review of the Laplace transform and its properties
8. Introduction to block diagrams and signal flow graphs
9. Introduction to continuous state models and their solutions
10. Introduction to simulation via Matlab
11. Introduction to basic control engineering considerations, to include feedback and compensation

Topics Covered:
1. Modeling concepts: Mechanical translation and rotational system modeling and the relation to circuit modeling
2. Signal representation: Time and amplitude transformations, periodicity, complex exponential signals
3. System properties: Linearity, time-invariance, causality, stability
4. Solution of differential equations: Classical, continuous-time convolution, complex exponential excitation
5. Frequency domain analysis: Fourier series, Fourier transforms, Laplace transforms
6. Introduction to state modeling
7. Electrical engineering applications: Control engineering, sampling, amplitude modulation, and filtering

**Relationship of the Course Content to Program Outcomes:**

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<thead>
<tr>
<th>Outcome</th>
<th>Topics and Level of Coverage</th>
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<tbody>
<tr>
<td></td>
<td>Important</td>
</tr>
<tr>
<td>a</td>
<td>an ability to apply knowledge of mathematics, science and engineering</td>
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<td>b</td>
<td>an ability to design and conduct experiments, as well as to analyze and interpret data</td>
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<td>c</td>
<td>the ability to design a system, component, or process to meet desired needs within realistic constraints such as...</td>
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<td>d</td>
<td>an ability to function on multi-disciplinary teams</td>
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<td>e</td>
<td>an ability to identify, formulate and solve engineering problems</td>
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<td>f</td>
<td>an understanding of professional and ethical responsibility</td>
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<td>g</td>
<td>an ability to communicate effectively</td>
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<td>h</td>
<td>the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context</td>
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<td>i</td>
<td>a recognition of the need for, and an ability to engage in life-long learning</td>
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<td>j</td>
<td>a knowledge of contemporary issues</td>
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<td>k</td>
<td>the ability to use the techniques, skills, and modern engineering tools necessary for the practice of electrical engineering</td>
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**Contribution of Course to Meeting Degree Requirements:**

2 Credit Hours – Math/Basic Science 1 Credit Hour - Engineering Topics

**Class/Laboratory Schedule** (note: 1 hour = 50 minutes):

Lecture: 42 hours = 3 hours/week for 14 weeks

**Prepared by:**

Ashok Ambardar, Associate Professor, March 5, 2010