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DEPARTMENT OF SYSTEMS ENGINEERING
CISE 302: Linear Control Systems (3-3-4)
First Semester (081)

Instructor : **Dr. Samir Hasan Al-Amer**
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Catalog Description: Linear systems, Modeling of physical systems, Ordinary Differential equations models, Laplace Transform, transfer functions, block diagram manipulation. Open loop and close loop systems, time domain analysis, response of systems to different test signals, Steady state analysis. Concept of stability, Routh-Hurwitz criteria, controller design. Laboratory activities include modeling, analysis and simulation of physical processes.

Course Learning Objectives:

1. To able to obtain mathematical models of translational and rotational mechanical systems from their idealized elements.
2. To able to obtain mathematical models of electrical systems from their idealized elements.
3. To apply their mathematical knowledge to determine the response of a linear system to various types of inputs.
4. To develop familiarity and confidence with analyzing transient and steady state responses of a linear system.
5. To apply their mathematical and knowledge to understand the concept of stability
6. To develop familiarity and confidence with controller design based on Routh-Hurwitz, Root locus and PID.
7. To develop proficiency in systems simulation using MATLAB and SIMULINK.

Course Learning Outcomes:

1. To gain basic understanding and the skills needed to modeling simple electrical, mechanical systems.
2. To be able to solve linear dynamical systems using Laplace transform.
3. To be able to find transfer functions using signal flow graph or block diagram reduction.
4. To obtain a basic understanding of feedback control systems theory.
5. To obtain the ability to perform analysis of linear feedback control systems.
6. To be able to characterize transient and steady state response of linear systems
7. To be able to analyze the stability of linear time invariant systems using Routh-Hurwitz method
8. To be able to simulate dynamical systems using MATLAB and SIMULINK
9. To gain hands on experience modeling, simulating and analyzing control systems.

Pre requisite: MATH 260, EE201
Text book: Norman S. Nice. Control Systems Engineering, John Wiley & Son, 4th Ed. 2003
Alternatives Text books: Dorf and Bishop, Modern Control Systems 10th Ed. 2005
Course Outlines:

Week	Details	# of lectures
1	**Introduction to Control Systems (Chapter 1)** Terminology Control Systems Examples The Design Process	**2**

1-4	**Laplace Transform** (Section 2.1-2.3) Review of complex variables Laplace Transform, properties inverse Laplace Transform, Solution of Ordinary Differential Equations. Transfer functions	**8**
5-6	**Modeling of Dynamical Systems:** **Modeling of** Electrical Systems (Section 2.4) **Modeling of** Translational Mechanical systems (Section 2.5) **Modeling of** Rotational Mechanical systems (Section 2.6) **Modeling of** Electromechanical systems (Section 2.7)	**7**
6-8	**Time Response of Control Systems:** Effect of pole/zeros on system response (Section 4.1-4.2) Response of first order systems (Section 4.3) Response of second order systems (Section 4.4-4.6) Response of higher order systems (Section 4.7-4.8)	**5**
8-9	**Block Diagrams and Signal Flow Graphs** Block diagrams and manipulation (Section 5.1-5.3) Signal Flow Graphs (Section 5.5)	**5**
10-11	**System Stability:** Concept of stability (Section 6.1) Routh-Hurwitz stability criteria (Section 6.2) Special cases (Section 6.3) Design Example (Section 6.4)	**5**
11-14	**Steady State Errors of Control Systems:** Test Signals: step, impulse, ramp , sinusoidal (Section 7.1) steady state error for unity feedback systems (Section 7.2) steady state error constants and system type (Section 7.3) steady state error specifications (Section 7.4) steady state error for disturbance (Section 7.5) steady state error for non-unity feedback systems (Section 7.6)	**8**
14	**Introduction to Root Locus:** Definition of root locus and their properties (Section 8.1-8.3) MATLAB programs for sketching root locus +Examples	**2**
15	**PID controller Design** (Handout+ Section 9.4) Introduction to PID Guidelines for PID design PID controller Design Example	**3**

Major Exam 1 Nov 4, 2008 15%

Major Exam 2 Dec 21, 2008 20%

Final 25%