Mechanical Engineering and Mechanics

MEM 255 Introduction to Controls

Fall 2006/Spring 2007

Designation: Required

Catalog Description: Reviews basic mechanical systems, Laplace Transforms, Linear Algebra, and state-space representations; introduces modeling of multi DOF mechanical and electrical systems, poles and zeros, sytam response and characterization, stability analysis, Routh-Hurwitz technique, Bode plots, Nyquist plots, and controllability and observability of systems.

Prerequisites: Systems I (tDec 221), and Systems II (tDec 222)

Textbook(s) and other required material:

Required: Feedback Control of Dynamic Systems, G.F.Franklin, J.D.Powell, and A.Emami-Naeini, 5th edition, Prentice Hall, ISBN 0-13-149930-0
MatLab Software

Course Objectives:

1. Generate dynamic models for mechanical and electrical systems using Mewton's law and loop and node laws.
2. Determine and characterize the systems' responses using both time and Laplace domains.
3. Dtermine the stability, and range of parameters to ensure it, using Routh-Hurwitz technique.
4. Use Bode plots and Nyquist plots to anayze the system response.
5. Evaluate the controllability and observability of systems.

Topics:

1. Laplace Transforms and state-space representations
2. Modeling of mechanical systems
3. Modeling of electrical systems
4. System response and characterization
5. Stability and Routh-Hurwitz technique
6. Bode and Nyquist plots
7. Controllability and Observability

Class Schedule: 3 hours/week lecture (3 credits); 2 hours of recitation/ week (1credit)

Contribution to Professional Component:

Contributes toward the 1 ½ year of engineering topics appropriate to developing the ability to work in the area of modeling and control of dynamic systems. Prepares students for follow-up courses in control design.

Relationship to Program Outcomes:

Outcomes a - k	Content	Explanation	Evidence
a. An ability to apply knowledge of mathematics, science and engineering	**2**	This course requires the students to develop a general understanding of dynamics of systems, and the need for control. The students learn how to apply and synthesize their knowledge of mathematics, science, and engineering.	Homework, Exams, Design Project
b. An ability to design and conduct experiments as well as to analyze and interpret data	**1**	The course requires the students to interpret experimental data in the form of mathematical models of systems.	Home work problems
c. An ability to design a system, component or process to meet desired needs	**2**	The assigned home work problems and exams force the students to design specified controllers .	Final report for the design project, and home works
d. An ability to function on multidisciplinary teams	**1**	Second exam and the final project require team work	Final report, and second exam.
e. An ability to identify, formulate and solve engineering problems	**1**	The problems and project require students to solve engineering problems.	Homework, exams, design project
f. An understanding of professional and ethical responsibility	**0**	N/A	N/A
g. An ability to communicate effectively	**1**	Written presentation of the final design problem is required.	Final report for the design project
h. The broad education necessary to understand the impact of engineering solutions in a global/societal context	**0**	N/A	N/A
i. A recognition of the need for and ar ability to engage in lifelong learning	**0**	NA	
j. A knowledge of contemporary issues	**0**	NA	
k. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice	**2**	Software package (MatLab) is required for homework and the final project	Homework; Final report for the design project

Prepared by: Dr. Ajmal Yousuff, 15 November 2006