ME 3210: System Dynamics
Fall 2013

Instructor

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http://www.cecs.wright.edu/~jslater
Helpful materials are available through the course page:
http://www.cecs.wright.edu/~jslater/classes/systemdynamics
Also see the links on the left for more general information, including using MATLAB, forwarding email, contacting me, etc.

Objectives

System Dynamics introduces students to the system level modeling of dynamic engineering systems including, but not restricted to, linear and rotational mechanical, fluid, thermal, and electrical systems. Modeling of control devices (e.g. motors, heaters and pumps) is addressed.

The course focuses on a) the development of governing equations, and b) the solution of governing equations. Development of governing equations is by methods appropriate to each subfield. The unifying system level analysis will be taught a) via time domain solutions, b) frequency (Laplace domain) solutions, and c) numerical simulation in Simulink (a modern system simulation tool).

Office Hours

Tentative: Will change depending on student schedules. Tentatively 4-5 PM, Monday and Wednesday, and by appointment. Please use email to contact me when you have questions, and to set up appointments. I check my email throughout the day. You will get a quicker response by email than by any other mode of communication. Please see my web site for more contact information.

Text

System Dynamics, William J. Palm, III.

Prerequisites

EE 2010, ME 2210, ME 3120, MTH 2350

Prerequisites By Topic (quiz: 5%)

The quiz will be the third scheduled day of class.

1. Newton's laws for a rigid body in 2-D
2. Kinematics of rigid bodies in 2-D
3. Equilibrium of rigid bodies in 2-D
4. Solution to 1st and 2nd order ordinary linear differential equations, homogeneous and particular solution (to sine, cosine, and power of t inputs)
5. Understanding of: power, energy, force, pressure, displacement, velocity, acceleration

Course Contents

1. Introduction to Modeling and Analysis, (Chapter 1)
2. Modeling of Rigid Body Dynamics, (review of Dynamics, Chapter 3)
3. Dynamic Response and the Laplace Transform Method (Chapter 2)
4. Spring-Damper Elements in Mechanical Systems (Chapter 4)
5. Block Diagrams, State-Variable Models & Simulations (Chapter 5)
6. Electric and Electro-mechanical systems (Chapter 6)
7. Fluid/Thermal Systems (Chapter 7)
8. System Analysis in the Time Domain (Chapter 8)
9. System Analysis in the Frequency Domain (Chapter 9)

Grade composition

Prerequisite quiz:	5%
Professionalism:	5%
Homework:	10%
Exams:	80%

Homework

Homework problems will be assigned on the course web page. Homework is tentative until Thursday at 5 PM. Homework problem solutions are collected at the beginning of the last lecture each week. You will be given no less than one week to do them. If there is a test scheduled on a day homework is due, the homework will be collected the following lecture. Each homework problem is worth 1 point unless otherwise noted. More difficult problems may be weighted accordingly. Your final homework score is your average total score divided by the total number of possible points. Homework grades will be curved such that the class average will be no lower than 85%. You are encouraged to work together in small groups, but keep in mind that homework is assigned in order to help you learn and keep up with the course material. Please see me if you need help with the homework. This class is a cooperative effort between you and me. You are also encouraged to do additional problems out of the text for practice on your own. Use of the solution manual, should you obtain it, is considered cheating.

Exams

There will be two tests and a final exam graded on a straight, scale ($\geq 90 = A$,$\geq 80 = B$, $\geq 70 = C$, $\geq 60 = D$, $< 59 = F$). The final exam will count for two test grades. The lowest exam grade of the four will be dropped. An 8.5 in. by 11 in. formula sheet may be used provided there are no derivations, definitions or solved problems on the sheet. It must be turned in with the exam. Tests will be graded and returned as soon as possible. Solutions will be discussed during the lecture following the exam if time permits. All grading discrepancies must be brought up in writing no later than one week after the exam is returned. A simple note describing your contentions will do.

Professionalism

Professionalism is a measure of your behavior regarding expected practice as an engineer. This includes aspects such as attendance, note taking, consistency of performance, tenacity in problem solution, leadership, legibility and organization of problem solutions, clarity of communication, etc. For details on expected behavior, please consult *The Unwritten Rules of Engineering* by W.J. King, with revision by J.G. Skakoon. This book is available at the library. However, for your own professional development, I highly recommend

that you own a personal copy. If you read an older edition of the book (prior to Skakoon), please be attentive to the fact that some of the comments, especially those regarding polishing shoes, are considered rather quaint today. Two points will be automatically be deducted from your professionalism score each time you receive less than a 70% on an exam *and* do not see me personally within one week after receiving the exam grade to clear up confusion.

Programming/Computer Usage

Programming will be done in Simulink in MATLAB. Please consult either the hand-outs, the online MATLAB help, or the documentation I supply on the course web site, and the manual in the computer lab. It is highly recommended that you learn to use Simulink on your university UNIX account as soon as possible. Run MATLAB by setting, your display environment from your X-Windows terminal and typing matlab at the UNIX prompt. Run Simulink by typing simulink at the MATLAB prompt. The best way to learn is to play around with it, and look at some of the examples provided in Simulink.

Problem Solutions

All problem solutions, whether on homework, quizzes, or exams, should be neat and orderly. They should begin with a brief problem statement and figure (Elaborate drawings are not expected).

Important Dates

September 26:	Exam 1
November 7:	Exam 2
December 10, 12:30-2:30 PM:	Final Exam