Syllabus

ENME 2540: System Dynamics
Spring 2015

University of Denver
Mechanical and Materials Engineering Department

Meets: 101 CMK, MWF 2:00-2:50
(3.0 Credit hours), Undergraduate Required MME Course

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Course Description:
This course covers modeling, analysis, and control of single and multiple degree-of freedom dynamical systems, including mechanical, electrical, thermal, fluid systems and their combinations (mixed systems). Basic concepts in system theory such as state variables and stability concepts will be introduced as well as bond graph notation and approach.

Prerequisites: ENME 2710, Engineering Thermodynamics II, ENME 2661, Fluids II/Heat Transfer I, ENME 2520, Dynamics II, ENGR 1572, Applied MATLAB Programming, ENEE 2012, Circuits I w/Lab

Textbook:
Karnopp, D.C., Margolis, D.L., Rosenberg, R.C., System Dynamics: Modeling, Simulation, and Control of Mechatronic Systems, 5th Edition, 2012, ISBN# 978-0470889084.

System Dynamics Topics: Covered in Chapters 1-6 in Required Textbook

- Overview of Systems
- Bond Graph Notation
- Multiport Systems and Bond Graphs
- System Models:
    1. Electrical
    2. Mechanical
    3. Hydraulic and Acoustic Circuits
    4. Transducers
    5. MME Related Topics in More Detail (e.g. Thermo-Fluid Systems)
- State-Space Equations and Automated Simulation
- Analysis and Control of Linear Systems

Course Objectives: The student will

- Learn bond graph notation and approach to systems
- Model various engineering systems, including mechanical, electrical, thermal and fluid systems and their combinations (mixed systems).
- Solve the model equations analytically and/or numerically using Matlab/Simulink or other numerical tools
- Relate the solution of the model equations to the physical response of the system.
- Acquire basic control concepts with working knowledge on transfer function, frequency response, system stability and steady-state error.

Grading

Quizzes: 20%
Mini-Projects: 30%
Midterm Exam: 20%
Final Exam: 30%

***Quizzes/Homework*:** Quizzes will be every Friday at the beginning of class. The quizzes will be based on problems that will be assigned from the required textbook each week and class content. The homework problems are meant for you to hone your analytical skills and broaden your conceptual knowledge of System Dynamics, and are not due for a grade. Solutions will be posted with the assignment. Your lowest Quiz will be thrown out when calculating the over-all average for your Quiz score.

Mini-Projects: Mini-projects are used to synthesize your understanding of System Dynamics and its practical applications to everyday engineering practice. These projects will require a level of analysis beyond what is required in the homework, and will involve using a computational tool such as Matlab, MS Excel, or similar. The second half of the course will involve solving problems in this way.

Late Policy : 10% penalty if not turned in during class period, 25% one calendar days late, 50% two calendar days late, no late work after three calendar days.

Exams: There will be one exam during the quarter at midterm to help chart your progress in being able to solve System Dynamics problems. These types of exams will test your analytical skills and your conceptual knowledge. The exams will be in-class and the problem types will resemble in-class examples and assigned homework. An 8.5 x 11 crib sheet and a calculator are allowed for the exam.

Final: The final exam will be given on the scheduled exam data and will be comprehensive. The final exam is scheduled for June 1 at 2:00 to 3:50 p.m. in 101 CMK. The final exam will cover 30% first exam material, 70% new material.