EME 171 – Analysis, Simulation and Design of Mechatronic Systems

TEXTBOOK: System Dynamics: Modeling, Simulation, and Control of Overview: Mechatronic Systems, 5th Edition. Dean C. Karnopp, Donald L. Margolis, and Ronald C. Rosenberg. (Available online)

EME 171 concerns the modeling of physical systems across multiple energy domains including mechanical, electrical, and hydraulic. The modeling technique utilized is Bond Graph approach. Students will learn to develop Bond Graph models of many types of engineering systems and use computer simulation as a tool to help understand dynamic behavior.

At the end of the course, students should be able to:

- Work comfortably and competently with mathematics, science, and basic engineering principles
- Work comfortably in multi-disciplinary teams
- Identify, formulate, and solve engineering problems
- Model, simulate, analyze, and design an engineering system, component, or process to meet prescribed needs and constraints
- Use the techniques, skills, and modern engineering tools necessary for engineering practice

Lab Projects:

Labs will use MATLAB for modeling and simulation of dynamic systems. Students can obtain a copy of Matlab from the COE-IT website: https://technology.engineering.ucdavis.edu/services/software-business-systems/matlab/

Each lab will have a single session that introduces the Lab and any new material needed for the lab. Later lab sessions will work like office hours, where the TA will provide help with all aspects of the lab.

The first lab will be done individually, and later labs will be done in groups of 2–3 students. Lab groups should be identified one week before the 2nd lab is due. One report will be turned in for each group. Lab reports are to follow the lab report guidelines posted on the course website. Make sure to turn in the MATLAB code with every assignment. Lab reports without the MATLAB code will code will be given an automatic 30% deduction. **Labs are due on Fridays and no late labs are accepted.**

Homework:

To receive the full credit for homework assignments, you need to attempt to solve all assigned problems. **Homework assignments are due on Fridays and no late homework assignments are accepted.** Solutions to each week's assignment will be posted on the course website after the homework is due.

The **tentative** problems for each homework assignment are given below. They may move between weeks, depending on if the lectures stick to the tentative schedule. The problems listed on the Canvas assignments shall be the definitive version of what problems are assigned each week,

Assignment	**Problems**
Homework 1	1.6, 1.7, 1.8
Homework 2	2.1, 2.2, 2.4, 2.5, 2.12
Homework 3	3.1, 3.2, 3.6, 3.12, 3.15, 3.16, 3.17
Homework 4	4.1, 4.2, 4.3, 4.4(a–c), 4.5
Homework 5	4.7, 4.12, 4.19,4.25, 4.30
Homework 6	5.1, 5.4, 5.8, 5.11

Homework 7	5.3, 5.16, 5.18, 5.19
Homework 8	6.1, 6.2, 6.3, 6.5
Homework 9	6.7, 6.11, 6.12, 6.18, 8.1

Week Of	**Topic**	**Reading**	**Due**
	Introduction	Chapters 1–2;	
	Power variables, Multiport Systems, Bond Graph Elements	Sections 3.1-3.3	
	Bond Graph Elements and Causality	Sections 3.4–3.6	
	Systems Models: Electrical and Mechanical	Sections 4.1–4.2	
	System Models: Mechanical, Planar Motion	Sections 4.3–4.4	
	System Models: Hydraulic and Other Causality Assignment	Sections 5.1–5.3	
	State-Space Equations, Equation Formulation	Review	
	Extended formulation: Algebraic Loop and Derivative Causality **Midterm Exam: Tues. 05-Mar in-class**	Sections 5.4–5.6	
	Linear Systems: Intro, Zero Input/Zero State Responses, Transfer Functions	Sections 6.1-6.2	
	Linear Systems, Frequency Response	Sections 6.3-6.5, 8.1	
	Final Exam		