ME 4012 Modeling and Control of Motion Systems (Elective)

Catalog Description: ME 4012 Modeling and Control of Motion Systems (2-3-3)
Prerequisite: ME 3015 System Dynamics and Control
Motion systems consisting of mechanical, fluid and electrical components are
Analyzed, modeled and controlled. Alternatives are considered for system optimization. Laboratory reinforces lectures.

Textbook: Ogata, K., System Dynamics, 4th Edition, Prentice-Hall, 2004.

Topics Covered:

Lecture

1. Modeling of drive components and systems based on power variables
2. Design issues surrounding selection of technologies and optimization of components
3. Prediction of response based on linear and nonlinear effects
4. Sensors and actuators in common use and their characteristics
5. Control algorithms and how to implement them in digital controllers.

Lab

1. Electrohydraulic servo systems
2. Industrial electrical drives
3. Sensors applicable to industrial automation (encoders, accelerometers, etc.)
4. Industrial motion control components (PLC and servo) and custom components (PC)
5. Practical systems for coupling actuators to loads

Course Outcomes:

Outcome 1: Students will be able to model the components of engineering motion systems and their interactions and use these models for engineering purposes.

1.1 Students can derive dynamic models of actuators based on pressurized fluid and electromagnetic energy domains from first principles in the context of a motion system.
1.2 Students can obtain parameters for these actuators from experiments and the system model can be verified or obtained from system identification techniques such as frequency and time responses.
1.3 Students can express the models in transfer function and state space form.
1.4 Students can use these models for simulation and control system design.

Outcome 2: Students will be able to design and implement appropriate systems and control algorithms for motion systems.

2.1 Students will be able to incorporate limitations imposed by kinematics, energetics, material properties and structural design into a conceptual design of a motion system.
2.2 Students will be able to design successful and frequently used algorithms (e.g. PID, filters) for feedback control and structure motion profiles to achieve specifications within the limitations of the design and implement them in real-time digital control prototyping software (e.g. Simulink, LabVIEW).
2.3 Students will be able to conceptualize and implement simple supervisory algorithms in industrial hardware (e.g. Programmable Logic Controllers).

Outcome 3: Students will be able to formulate solutions to systems requiring controlled motion.

3.1 Students will understand the rationale for approaches taken in some example applications

3.2 Students will be able to apply engineering principles to realistic problems proposed.

3.3 Students will be able to evaluate and explain the strengths and weaknesses of motion system designs.

Correlation between Course Outcomes and Program Educational Outcomes:

ME 4012												
	Mechanical Engineering Program Educational Outcomes											
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k	l
Course Outcome 1.1	X											X
Course Outcome 1.2	X	X									X	X
Course Outcome 1.3												X
Course Outcome 1.4	X		X		X						X	X
Course Outcome 2.1	X		X		X							X
Course Outcome 2.2	X	X	X		X						X	X
Course Outcome 2.3	X	X			X						X	X
Course Outcome 3.1			X		X							X
Course Outcome 3.2	X		X		X							X
Course Outcome 3.3	X	X	X		X		X				X	X

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