AMERICAN UNIVERSITY OF BEIRUT
Mechanical Engineering Department

MECH 436: Control Systems

Credit hours: 3 credits, two 50 min. lectures, one 50 min. solving session, and one 170 min. lab session per week.

Instructor's Name: Naseem Daher, Email: nd38@aub.edu.lb, Phone: Ext. 3542

Textbook

Modern Control Systems, Richard C. Dorf, and Robert H. Bishop, 12th Ed. Pearson Education, 2011

Specific Course Information

A lecture and lab course that teaches the fundamentals about analysis of dynamic systems and design appropriate feedback control. The course includes a project and is taught in conjunction with the lab. *Prerequisites: EECE 210, MECH 430 and MECH 432*. (Required course)

Course learning outcomes

1. Students are able to analyze the transient response and steady state behavior of linear systems. (Analyze)
2. Students can apply the root locus method to analyze and design linear feedback systems. (Analyze and Design)
3. Students can apply the frequency response method to analyze and design linear feedback systems. (Analyze and Design)
4. Students are able to design P, PI, PD, PID-, lead-, lag- and lead-lag control feedback of systems to meet time-domain specifications using root locus and frequency response approaches as well as analytical methods. (Design)
5. Students are able to subdivide a project into relevant sub-problems and solve it in a given time frame as a team. (Teamwork)
6. Students are able to present project results to a technical audience. (Communication)
7. (Lab) Ability to use appropriate software analysis tools (e.g. MATLAB/Simulink) to implement mathematical models and analyze their dynamics.
8. (Lab) Ability to use data acquisition to measure the response of a physical system (open loop) and compare it to the response of a simulation.
9. (Lab) Students are able to interface hardware (sensors, actuators) with control software (e.g. LabVIEW) to conduct control experiments (feedback control).
10. (Lab) Students appreciate the costs and benefits of using feedback in control systems and are aware of practical issues such as measurement noise and modeling uncertainty.
11. (Lab) Ability to design a controller to meet certain specifications.
12. (Lab) Ability to tune a PID controller using Ziegler and Nichols tuning rules.

The course can be used to evaluate several KPIs of select student outcomes according to the following schedule, where `i` stands for introduce, `s' stands for strengthen, and `d' for demonstrate.

Course	Student Outcomes																						
MECH 436	a				b				c				d						e				f
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	5	6	1	2	3	4	1

	s	s		d	d	i	i	i	i	i			s						s	s	d	i	

Student Outcomes														
g				h		i			j	k				
1	2	3	4	1	2	1	2	3	1	1	2	3	4	5
s	s	s		s		i			s		d		d	

Based on this information, MECH 436 can be used to demonstrate KPIs a.4, b.1, e.3, k.2, and k.4, which are:

- Ability to recognize plausible solutions to engineering problems
- Ability to Execute Experimental Procedures
- Ability to execute the solution strategy
- Ability to compose a solution based upon the inputs of the individual components of the system
- Ability to use computer software to analyze and to solve problems
- Ability to interface software and hardware

Entry	Weight	Note
Drop Quizzes	10%	Unannounced
Assignments	-	Ungraded
Lab	25%	See instructor Must pass the lab component to pass the course
Midterm	15%	Closed-book
Final	25%	Closed-book
Project	25% 3% per report (15%) 10% presentation	Detailed later

Topics

Topics of the course include: Transient response analysis, stability and damping. Frequency domain techniques for analysis and design of dynamic systems: root locus and frequency response analysis. PID control.

1. Introduction to control
2. Transient and steady state response analyses
3. Root locus analysis and design (Lead/Lag)
4. Frequency response analysis and design (Lead/Lag)
5. PID controls and two-degrees-of-freedom control systems

Note

If you have documented special needs and anticipate difficulties with the content or format of the course due to a physical or learning disability, please contact me and/or your academic advisor, as well as the Counseling Center in the Office of Student Affairs (Ext. 3196), as soon as possible to discuss options for accommodations. Those seeking accommodations must submit the Special Needs Support Request Form along with the required documentation.