MEEG 311: Vibration and Control
Fall 2018

Lectures: Tues. and Thurs. 11:00AM - 12:15PM, Willard Hall, Rm 319.
Discussions: Wed. 5:45 - 6:35PM, Gore Hall, Rm 117 (TA: Indrajeet Yadav)
Fr. 5:45 - 6:35PM, Sharp Lab, Rm 109 (TA: Justice Calderon)

Instructor: Prof. Ioannis Poulakakis
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Office Hours: Wed. 10:30 AM – 12:00 PM

TAs:

Indrajeet Yadav (Indra)
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Justice Calderon
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Office Hours: Mon. 11:30-1:30pm

Textbook: The course textbook is:
K. Ogata , *Modern Control Engineering*, Prentice Hall, fifth edition, 2010
Note: Additional course material, announcements, and assignment grades will be available electronically through Canvas.

Description: The course requires students to apply principles of engineering, basic science, and mathematics (particularly differential equations), to analyze and design control systems. The main part of the course deals with single-input-single-output (SISO) dynamical systems expressed by linear differential equations with constant coefficients. The course (i) introduces basic concepts for modeling such systems, (ii) reviews first- and second-order systems and (iii) discusses ways to modify their dynamical behavior through the use of feedback control designs. We discuss the concepts of stability, steady-state and transient performance, and we introduce frequency-based analysis tools such as the root locus and Bode diagrams.

Grading:

Class participation	10%
Weekly Homework (collected **before** the lecture begins)	20%
In-class Mid-Term Exam (tentatively scheduled at the **end of Oct.**)	30%
Final Exam (day/time fixed by the University)	40%

Note: Late homework is accepted no later than one day after the deadline and at the expense of a 20% penalty. HW solutions will be given soon after the due date. You are encouraged to discuss HW problems with other students to gain a better understanding into the subject material.

Email Policy: I will make every effort to reply to your emails within 24 hours. As a result, if you email me less than 24 hours before a problem set is due, I may not be able to respond in time. If you have a complicated question, it is better to arrange to meet me. Also, the TAs will be happy to answer questions.

Website: Registered students can reach the course web page at canvas.

Schedule: ***The schedule is tentative—changes will probably occur as we progress.***

Week 1: 8/28, 8/30	Introduction, basic concepts - ODEs, states variables, general solution of ODEs
Week 2: 9/4, 9/6	Laplace transform, application to ODEs, transfer functions, 2DOF mechanical systems
Week 3: 9/11, 9/13	Linearization, electrical systems – principles of electromechanical energy conversion
Week 4: 9/18, 9/20	Overview of DC motors, modeling armature-controlled DC motors – block diagrams and simplifications
Week 5: 9/25, 9/27	Liquid-level systems, review of modeling part and model representations – fundamental system properties, impulse response
Week 6[1]: 10/2, 10/4	Test signals, response of 1st order systems – response of 2nd order systems
Week 7: 10/9, 10/11	Transient response specifications - open vs. closed loop, feedback control principles and examples
Week 8: 10/16, 10/18	Examples of P and PD controllers, effects of P, I, D control action - stability and Routh's criterion
Week 9: 10/23, 10/25	Steady-state errors and classification of control systems – examples and review
Week 10: **10/30**, 11/1	**Midterm exam (?)** - root locus method
Week 11: 11/6, 11/8	Root locus method examples - frequency response, signals in the frequency domain,
Week 12: 11/13, 11/15	Bode diagrams and examples
Week 13: 11/27, 11/29	Controller design in the frequency domain, phase and gain margins, lead-lag compensation, examples
Week 14: 12/4, 12/6	PID controller design in the frequency domain and examples, course review
Week 15: TBD	**Final Exam - Comprehensive**

[1] On 10/2 and 10/4 (Week 6) and on 10/9, the instructor will be travelling for conferences and workshops.

Course Details:

(i) The course integrates a number of classes such as Dynamics, Differential Equations, and Numerical Analysis. You are encouraged to review the material taught in these classes.

(ii) MATLAB is a commercial program for control systems analysis and design. Some assignments will require the use of this program. You are strongly urged to develop familiarity with the program using tutorials.