MC 300/400
Feedback and Control Systems
Spring 2016 Syllabus
Fairfield University School of Engineering

Course Number: MC 300/400	Course Name: Feedback and Control Systems
Course Time: **Mon/Wed 5:00-6:15**	Course Location: **BNW TBD**
Schedule: **1/20/16-5/2/16**	Final Exam: **Laboratory Project**
Instructor: **Jeffrey Denenberg**	Office: **BNW 301C**
Office Phone: **203-254-4000x3330**	Hours: **M/W/R 2:00-4:00 or by appt.**
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Course Description:

This course emphasizes analysis and synthesis of closed-loop control systems using classical and state-space approaches with an emphasis on electro-mechanical systems. The mathematical requirements include the Laplace transform methods of solving differential equations, matrix algebra, and basic complex variables. Discussion of classical control-system design includes modeling of dynamic systems, block diagram representation, time and frequency domain methods, transient and steady state response, stability criteria, controller action (proportional; proportional and integral; proportional, integral, and derivative; and pseudo-derivatives feedback), root locus methods, the methods of Nyquist and Bode, and dynamics compensation techniques. Discussion of state-space methods includes formulation and solution (analytical and computer-based) of state equations, and pole-placement design. The course integrates computer-aided analysis and design tools (MATLAB and Simulink) to ensure relevance to the design of real-world controlled electro-mechanical systems. The course also includes lab (hardware-based) exercises.

Prerequisites: MA 321, MC290 or EE301

Textbook:

Nise, Norman S., Control Systems Engineering, 7th ed., Wiley, 2011, ISBN: 978-1-118-17051-9

References:

Feedback and Control Systems, Schaum's Outlines, McGraw-Hill 1990, ISBN 0-07-017052-5
Control System Video Lectures, Benjamin Drew, UWE Bristol
Control System MatLab Tutorials, Bill Messner, - CMU (now at Tuffs), Dawn Tilbury - UMich

Required Software:

1. MatLab and Simulink (download directly from www.mathworks.com following instructions posted on Blackboard).
2. Recommended general computer requirements – PC running Windows 10 or later, Adobe reader, high-speed internet access, Internet Explorer or Firefox browser. You may encounter difficulties with the lectures, simulation software, or internet testing software if you use Mac OS or Linux. Please check all software compatibilities for your system promptly.

MatLab Tutorials: Mathworks **Tutorials,** Prof. Aliane **Tutorial**

Signals and Systems References:

U. of Washington Interactive Notes (Phillips and Parr), **EE235** (analog) and **EE341** **(**Discrete).

Objectives and Outcomes:

No.	Objective	Outcome
1	Understand the fundamental concepts and principles of feedback control of dynamic systems.	Students will understand the fundamental concepts and principles of feedback control of dynamic systems. (1, a, Comprehension)
2	Understand the classical methods of control system analysis to find the system parameters and response to inputs.	Students will use the Laplace transforms to find the system parameters, and determination of the response of systems to inputs including the step, impulse, and ramp. (2, a, Application)
3	Understand the modern or State-Space representation of systems and their analysis.	Students will develop system models using block diagrams, steady state errors, system stability, and frequency response by Bode and Nyquist methods. (2, a, Synthesis)
4		Students will use the Root Locus, Bode, Nichols methods for the analysis and design of feedback control systems. (2, b,c, Analysis, Synthesis)
5		Students will develop the state space analysis and design method for the feedback control systems. (3, b,c, Analysis, Synthesis)
6		Students will demonstrate the use and application of MatLab software to the above. (2, 3, k, Application)

*Objectives, **ABET a-k** outcomes (a,b,c,k), and Bloom **Cognitive Level** in parenthesis

Grade allocation:

Quizzes (5 of 7 count)	40%
Course Exams	40%
Lab Project	20%
Total	100%

Grade Histogram TBD

Exam:

The purpose of the exams is to convey your understanding of the material; therefore, it is important that you show your work. Even if you feel that the solution to a problem is obvious; you must still explain why it is obvious. Furthermore; if you are asked to solve a problem using a given technique; then please use that technique; otherwise, I have no way to judge your understanding of the technique being tested.

Homework policy:

Homework will be assigned from the book as your primary preparation for the exams. We will review select homework problems in class and you will be asked to work them on the board for a participation grade. Homework must be completed on time or it will not help with the quizzes. We will also incorporate design problems as appropriate to the material. These problems are designed to challenge you to think beyond what the book has told you, and do real engineering. There may be more than one correct answer. Quizzes will be the primary factor in your HW grade.

If you understand how to do the homework problems you will have an easier time with the Quizes.

Academic Integrity:

Working with classmates to study, resolve problems, and learn the material is expected and encouraged during normal course work. However, during individual evaluations (e.g. quizzes, exams, individual projects, etc.) you are expected to comply with all standards of academic honesty. You will be graded fairly, and so your work should fairly represent your knowledge, abilities, and effort, not that of others. Any breach of integrity (including but not limited to: copying solutions, internet solutions, copying from peers, claiming work or designs without proper citation, etc.), will not only impact your ability to learn the material and my ability to help you through proper feedback, it will result in academic penalty. Any individual found in breach of this code will fail the afflicted assignment and will be asked to meet privately; any other offenses will be referred to the Dean for further action, and could result in penalties as severe as expulsion from the University.

Disability:

If you have a documented disability and wish to discuss academic accommodations, please contact: David Ryan-Soderlund at Academic and Disability Support Services (203) 254-4000, x2615, or email drsoderlund@mail.fairfield.edu, and notify the course instructor within the first two weeks of the semester.

Class Expectations:

TEACHER:

Distribute syllabus.
Review the material described in the syllabus.
Explain material.
Identify additional materials, Internet sites or books that clarify the material.
Relate material to "real world" situations when possible.
Answer questions.
Be available to discuss problems.
Be receptive to new ideas.
Announce business/class conflicts in advance.
Make up missed classes.
Prepare and administer exams and projects.
Grade fairly.
Assign appropriate homework problems.

STUDENT:

Be familiar with the prerequisite material
Ask questions.
Stay current.
Study the material described in the syllabus, preferably before it is covered in class.
Complete the assigned homework (all chapter problems with answers).
Obtain class notes and homework if a class is missed.
Use the library and the Internet to obtain supplemental material.
Prepare for exams.
Ask for help (tutors are available for assistance)
Follow standards of academic integrity.

Class Topics and Order of Material

Week	Date	Topic	Materials	Homework	Outcome
1	1/18	Introduction	classic control, 1	C1: Review Qs; P #2, 8 , 14, 17, 19, 23	1
2	1/23, 1/25	Modeling - Frequency Domain Review HW1	2	C2: Expl 2.1, 2.2; Rev. #4, 8, 12; P #5, 6, 14, 22, 24, 29, 30, 41, 55, 61	2
3	1/30, 2/1	Modeling - Time Domain **Q1**, Review HW2	3	C3: Expl 3.1, 3.2 ;Rev. #2, 7, 11 P #6, 13, 15, 21, 26, 32	2
4	2/6, 2/8	Time Response, **Q2**, Review HW3	4	C4: Expl 4.1, 4.2; Rev. #6, 10, 20; P #8c,d, 18c,d, 34, 37, 49, 58, 67, 75, 83	2
5	2/14, 2/15	Lab. Discussion, Establish Groups Reduction of Multiple Subsystems, **Q3**, Review HW4	**Lab Experience** 5	C5: Expl 5.1; Rev #5, 6, 12, 19; P #5, 19, 23b, 27, 71	3
6	2/21, 2/23	Lab Session **Q4**, Review HW5			3
7	2/28, 3/1	Stability **Q5**, Review HW6	6	C6: Rev # 1, 6, 16	3
8	3/6, 3/8	Steady-State Errors Review for Exam 1	7	C7: Expl 7.1; Rev #8, 15, 16; P #4, 22, 34, 53	
	3/13, 3/15	**Spring Break**			3
9	3/20, 3/22	**Exam 1 (Ch. 1-5)** Exam1 Reprise, Review HW7			
10	3/27, 3/29	Root Locus Techniques **Q6/7**, Design Via Root Locus	8 9	C8: Rev #6, 13; P # 32, 71 C9: Rev. #1, 9; P # 2, 5, 47	4
11	4/4, 4/6	Review HW8, HW9 Frequency Resp. Techniques	10[1] Dorf ch10	C10: CaseStudy 1; ReviewQs; Ps: 1-5, 8, 12, 20	4,6

12	4/11, 4/13	Design Via Frequency Response **Q8/9**	11[1] Dorf ch10	Feedback in Power Electronics (Mohan #12), Designing a "controller" (Mohan #13)	2,6
13	**4/17,** 4/18, 4/20	**Easter Break – No Class** Design Via State-Space	12[1] Dorf ch11		5,6
14	4/25, 4/27	Review for Exam 2 **Exam 2 (Ch. 6-12)**			
15	5/2	Exam 2 reprise			
	***TBD**	**Final Exam Week (5/4 – 5/11)**		**Last day to upload your Laboratory Experience**	4,6

*No Class. [1] These lectures will use notes from sources other than the Text