ELEE 5700: CONTROLS II

University of Detroit Mercy
Term I, 2012-2013

Course Description: Advanced study of root locus analysis. Frequency response analysis. Design and compensation techniques. Control system analysis and design using state-space methods.

Prerequisites: ENGR 4220/5220, Control Systems

Prerequisites by topic: Laplace transforms, differential equations, transfer functions, root locus and Bode plot construction, `MATLAB` and `Simulink`

Instructor: Rick Hill, Assistant Professor
Department of Mechanical Engineering
Room E274
hillrc@udmercy.edu

Class meetings: MW 3:40 - 4:55 pm, Room E224

Office hours: MW 2:00 - 3:30 pm, T 3:00 - 5:00 pm, TH 4:00 - 5:00 pm

Course homepage: http://knowledge.udmercy.edu

Required text:
Ogata, K., *Modern Control Engineering*. 5th Ed., Prentice Hall, 2010.

Additional References:
Messner, W., and Tilbury, D., `MATLAB` and `Simulink` tutorials [http://www.engin.umich.edu/class/ctms/]
Franklin, G., Powell, J.D., and Emami-Naeini, A., *Feedback Control of Dynamic Systems*.
Nise, Norman S., *Control Systems Engineering*.

Class Elements: Homework - Problem sets will be assigned approximately weekly over the course of the semester.

Exams - Two cumulative midterms will be given during the semester in addition to a cumulative final.

Class Policies: Late work - Homework must be turned in at the beginning of class. Late homework is not accepted. Extenuating circumstances can be discussed on a case-by-case basis.

Exams - Exams will in general be closed-book and closed-note. You may be allowed to bring in an equation sheet. Make-up exams will only be given if prior arrangements have been made with me.

Regrades - If you feel a mistake has been made in the grading of an assignment or exam, you have one week from the date of its return to submit the item for a regrade.

Academic Integrity - Any suspected cheating will be dealt with according to the College policy - see the Engineering Science Student Handbook. In the case of homework, working together is encouraged, but you must write your own solutions that reflect your own understanding of the material.

Students with Disabilities - If you need course accommodations because of a disability, if you have emergency medical information to share, or if you need special arrangements in case the building must be evacuated, please contact Emilie Gallegos, Director of University Academic Services/Disability Support Services at gallegem@udmercy.edu or (313) 578-0310 to schedule an appointment. University Academic Services is located on the 3rd Floor of the Library on the McNichols Campus. Students with special needs are urged to identify themselves to me to discuss their concerns, however, faculty cannot provide disability accommodations without official notification from the Disability Support Services office.

Grading:

	Homework	20%
	2 Midterm Exams	50% (25% each)
	Final exam	30%

Scale:

Percentage	93-100	90-92	87-89	83-86	80-82	77-79	70-76	60-69	< 60
Grade	A	A-	B+	B	B-	C+	C	D	F

Course Topics:

1. System representation in the time-domain and frequency-domain
2. Control specifications in the time-domain and frequency-domain
3. Stability and robustness
4. Root locus method for control design
5. Frequency response method for control design
6. PID controllers
7. Lead and lag compensation
8. System representation in state-space
9. State-space method for controller and estimator design
10. Computer methods for analysis and simulation of dynamic systems

Course Outcomes: After taking this course, students will be able to:

1. Apply Laplace Transform techniques to determine the time response of physical systems (solution of differential equations, initial value theorem, final value theorem).
2. Determine and describe quantitatively the time response of first and second order systems (transient and steady state).
3. Model a system of components by block diagram and determine the input/output behavior of the system based on such a model.
4. Relate system properties and behavior to closed-loop pole locations and frequency domain requirements.
5. Apply pole placement and root locus plot techniques to compensator design.
6. Apply frequency response techniques to compensator design.

7. Use state-variable techniques to design control laws and estimators for linear systems.
8. Evaluate the advantages and disadvantages of a chosen type of system representation or compensator design technique.
9. Evaluate the trade-offs inherent in the design of a given compensator (transient response, steady state response, control effort, robustness).
10. Identify which types of systems a given design technique can be applied to.
11. Identify and evaluate the simplifying assumptions made in the compensator design process.
12. Use `MATLAB/Simulink` for the analysis and design of control systems.