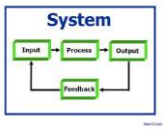


Electrical Engineering 4310/7310

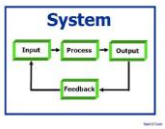
Feedback Control Systems

Prerequisite:
Math 4100, Matlab/Simulink

G. DeSouza

Spring 2016

University of Missouri - Columbia
Electrical & Computer Engineering Department
Columbia, MO 65211



Professor: G. N. DeSouza
E-mail: DeSouzaG@missouri.edu
Office: 325 EBW (stop by whenever you feel like)
Web: **http://web.missouri.edu/~desouzag/**

Lecture: 3 lectures of 50 mins each.
Lab: 2 lab hours / week in EBW 107

Lab TA: Guntu, Vinay Sandeep Kumar
Office: TBA
E-Mail: **vgv22@mail.missouri.edu**

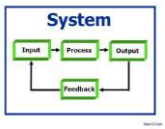
Background: "Feedback is a central feature of life. The process of feedback governs how we grow, respond to stress and challenge, and regulate factors such as body temperature, blood pressure and cholesterol level. The mechanisms operate at every level, from the interaction of proteins in cells to the interaction of organisms in complex ecologies." M. B. Hoagland and B. Dodson, The Way Life Works, 1995.

Course Description: System modeling and time and frequency response, closed loop control, stability, continuous system design, introduction to discrete time control, software and hardware experiments on compensator design and PID control.

Lab: In the lab, students will gain practical experience in writing programs to build and control simulated plants. The students will develop Matlab, Simulink, and optionally C and/or C++ code to interface with the control plants. The sequence of lab experiments build on the previous ones and, by the end of the semester, the students will be able to design, develop, and analyze a complete feedback control system.

Text: *Feedback Control of Dynamic Systems*, by Franklin, Powell and Emami-Naeini, Addison-Wesley Publishing Co., 7th Ed..
Other handouts will be provided and the following references are recommended and may be used throughout the semester:
Class notes – available from the course website.
Laboratory manual – also posted at the course website.
Control Systems Engineering, Norman Nise, John Wiley and Sons.
Feedback Control Systems, Phillips and Harbor, Prentice Hall.
Feedback Systems: An Introduction for Scientists and Engineers, by Karl J. Åström and Richard M. Murray.

Other useful Links:
http://www.cds.caltech.edu/~murray/amwiki/Main_Page
https://bblearn.missouri.edu/bbcswebdav/pid-543766-dt-content-rid-248133_1/courses/ece_4310_sn/Analysis%20of%20first%20and%20second%20order%20systems.pdf



https://bblearn.missouri.edu/bbcswebdav/pid-543767-dt-content-rid-248134_1/courses/ece_4310_sn/Laplace_Table.pdf
https://bblearn.missouri.edu/bbcswebdav/pid-543768-dt-content-rid-248135_1/courses/ece_4310_sn/Partial%20Fraction%20Expansion%20TRICKS.pdf
https://bblearn.missouri.edu/bbcswebdav/pid-543770-dt-content-rid-248137_1/courses/ece_4310_sn/PID%20without%20Math.pdf
https://bblearn.missouri.edu/webapps/blackboard/execute/content/file?cmd=view&mode=designer&content_id=_543770_1&course_id=_2045_1
http://www.williamsonic.com/BodePlot/
http://lpsa.swarthmore.edu/Bode/Bode.html
http://circuitscan.homestead.com/files/ancircp/bode1.htm
https://en.wikipedia.org/wiki/Bode_plot
https://www.math.ksu.edu/~bennett/jomacg/
http://faculty.gvsu.edu/fishbacp/complex/complex.htm
http://www.math.ucla.edu/~tao/java/Plane.html
http://demonstrations.wolfram.com/AnIllustrationOfTheArgumentPrinciple/
http://www.math.ucla.edu/~tao/java/Argument.html
http://controlcan.homestead.com/files/Frequency/controlnyquist1rp_2ccp_1rp2ccpkx800x500.htm
http://controlcan.homestead.com/files/idxpages.htm
http://ctms.engin.umich.edu/CTMS/index.php?aux=Home
http://www.facstaff.bucknell.edu/mastascu/eControlHTML/Freq/Nyquist4.html

Prerequisites: MATH 4100, Matlab/Simulink

Course Grading:

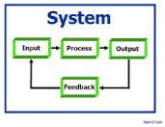
Undergrad Students:

Midterm	25 points
In-class Final Exam	35 points
Programming and Lab assignments	30 points
Continuous Assessment	10 points

Grad Students:

Midterm	15 points
In-class Final Exam	25 points
Programming and Lab assignments	25 points
Projects	25 points
Continuous Assessment	10 points

Grad Students will be assigned one large Project of their choosing. For this Project, grad students will deliver a proposal by week 8th, present their project and turn in a pre-report in week 15th and turn in a final report in week 16th.



Continuous Assessment:

1. Attendance (participation)
2. Readiness tests (preparation)
3. Tutor observation during class and group work (preparation, participation, and process)
4. Submitted group work (product)
5. Peer assessment (prep. and participation)

Grad Scale:

Undergrad students: A-to-F scale with +/-. Grad students: A, B, C, or F with +/-.

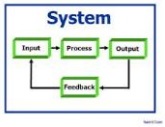
Topics:

Lectures	Topic
	Chapter 1. All sections
	Chapter 2. All sections up to 2.3, i.e., 2.4 and above are omitted
	Chapter 3. All, but omit sections 3.6 and 3.9
	Chapter 4. All, but omit section 4.4 except subsection 4.4.2
	Chapter 5. All, but omit section 5.7
	Chapter 6. All, but omit Sections 6.2, 6.5, 6.6, 6.8, 6.9, 6.10
	You are responsible for all READING ASSIGNMENTS without being notified by the instructor – this includes material from the text, Supplemental Notes, and the course website.

Total: 38 lectures, 2 reviews, 2 exams, 2 days of student presentations

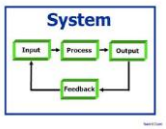
Lab Assignments:

Lab Experiment 1: TBA
Lab Experiment 2: TBA
Lab Experiment 3: TBA
Lab Experiment 4: TBA
Lab Experiment 5: TBA



Academic Dishonesty: According to University policy, instructors are required to inform students of specific guidelines regarding cheating in their courses. Instructors are required by University policy to report incidents of cheating to the Office of the Provost. In compliance with this rule, all incidents of cheating by students in this course will be reported to the Office of the Provost for determination of possible disciplinary action.
Any student found to have cheated during an *exam* will be given a 0 grade for that exam and the evidence will be sent to the Provost's Office. Students submitting the same or similar solutions to a programming homework will be given a 0 for the assignment and the evidence will be sent to the Provost's Office for determination of possible disciplinary action.
Unless an assignment is specifically structured as a group project, duplicate homework written in collaboration with others is **not** acceptable. Although it is permissible to discuss the homework with others, these discussions should be of a general nature. All work at a detailed level must be done on your own. *Students submitting the same or similar solutions to the homework will be considered as having cheated.* No statements or actions made by anyone can alter this policy.
ADA Statement: If you need accommodations because of a disability, if you have emergency medical information to share with me, or if you need special arrangements in case the building must be evacuated, please inform me immediately. Please see me privately after class, or at my office.
To request academic accommodations (for example, a notetaker), students must also register with Disability Services, AO38 Brady Commons, 882-4696. It is the campus office responsible for reviewing documentation provided by students requesting academic accommodations, and for accommodations planning in cooperation with students and instructors, as needed and consistent with course requirements.

Written Laboratory Report Format: A formal project report from each laboratory team is to be submitted to your lab instructor. Each lab team is required to submit **one team report** per lab project. The lab report flow should be logical in that each step in the lab should be documented in the order conducted. The format for written reports will be determined by the lab instructor.



LAB ORGANIZATION:

1. Each student will perform the following tasks:

a) Prelab report
b) Programming
c) Postlab report.

2. Each student should work independently and should NOT give their programs to others. Students are responsible for possible "proliferation" of their programs. Any violation will lead to penalty.

LAB TASKS:

1. Prelab Report:

a) Write pseudo code or a flow chart for the program. Pseudo code should be structured and descriptive rather than technical.
b) Other specific works assigned in the lab handout.
c) The pseudo code or the flow chart must be turned in at the beginning of the lab period.
d) The report must be typed.

2. Lab Work:

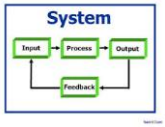
a) Your T.A. will check your program during the lab period.
b) If the program works completely following the program requirements, you will earn 50 points.
c) Partial credits will be earned upon the work progress.

3. Postlab Report:

a) Due by next lab period.
b) Lab report format:

i. Abstract
ii. Objective
iii. Background/Theory
iv. Procedures
v. Results
vi. Conclusions
vii. Appendices (e.g. programs).

c) Report must be clear and neat. Programs must be structured and commented adequately. The conclusions should contain what the overall experiment taught you, specific concepts learned from the lab and, if the lab did not work, why.
d) The report must be submitted directly to the TA. The .c and .cpp files must be included separately from the report, which may be in MS Word, or PDF format. No late reports will be accepted.



LAB GRADING:

1. Each experiment is worth 100 points including LAB 1.

2. Experiments are graded as follows:

a) Prelab 10 points
b) Program 50 points
c) Postlab 40 points (No credit for late report)

i. For the lab work (Program):

50 points, if completed during the lab period
30 points, if completed before the next lab period
No credit for labs which work after the next lab period.

ii. Postlab report grading guide lines:

Objective 5 points
Program 20 points
Conclusion 15 points.

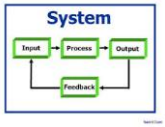
iii. There may be lab quizzes during the semester to check team participation.

COMPUTER FACILITY:

The lab sessions will be held in EBW 107, in EBE. University ID must be used to access the room after hours.

LAB REGULATIONS:

1. No food or drink in the lab.
2. Do not give lab combination to others.
3. Do not leave your own software or programs on the computers in the lab.
4. Do not put backpacks etc. on the computer keyboards or mice.



Spring 2016 (Tentative)

	Lab1	Lab2	Lab3	Lab4	Lab5
Week 1					
Week 2	Intro				
Week 3	Session (Pre)				
Week 4	Report	Session (Pre)			
Week 5		Session			
Week 6		Report	Session (Pre)		
Week 7			Session		
Mid-Term – Mar 7th					
Week 8			Session		
Week 9			Report	Session (Pre)	
Week10				Session	
Spring Break – Mar 27th to Apr 1st					
Week12				Session	
Week13				Report	Session (Pre)
Week14					Session
Week15		**Student Project Presentations (Pre-Report)**			Session
Week16					Report
FINAL EXAM: TBA (Final Project Report)					