Linear Systems Analysis
Spring 2022 Syllabus
EE5302 – CRN 29342 – Graduate Level

Monday & Wednesday 12-1:20pm – UGLC 340

Instructor: Dr. Robert C. Roberts
Engineering A310
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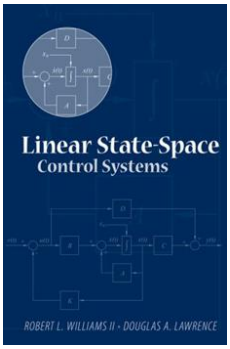
Weekly Office Hours:
W 4:00pm – 5:30pm
R 9:00am – 10:00am
or by appointment
http://teamschat.robertcroberts.com

Course Description: his course focuses on fundamental concepts of modern control theory for linear systems using the state-space approach. In a state-space representation, a mathematical model of a physical system is developed as a set of first-order differential equations. Under the correct conditions, this model can be represented in matrix form, allowing for efficient implementation on a computer. Course topics include relationships with frequency domain design, modeling of physical systems, controllability, observability, pole placement, and the design of controllers and observers.

Pre-requisites for Course: Exposure to matrix algebra and differential calculus are essential for this course. An undergraduate course of frequency domain design (such as EE 4364 Systems and Controls) is also highly beneficial.

Textbook: Robert L. Williams II and Douglas A. Lawrence, "Linear State-Space Control Systems," Wiley, 1st Edition, 2007. ISBN-13: 978-0471735557



Attendance: In order to be successful in the course, attendance is highly recommended every scheduled day, in order to keep up with the work. This means that the student should attend all lectures, and complete all work prior to the next class period. Should a situation arise when a student begins to get

behind, they should communicate with the instructor promptly to ensure they do not miss any important information and can get back on track.

Course Website: Blackboard for sharing electronic copies of presentations, course details, and handouts.

Course Grading: Students will be evaluated in the following manner:

Homework and Class Participation	40%
Midterm	25%
Final Exam	35%
TOTAL	100%

Course Drop Deadline: April 1st

Homework: There will be eight homework assignments throughout the course of the semester. A tentative schedule for the assignments and their due dates are listed on the schedule below. These will involve book problems, as well as MATLAB computer problems. Homework assignments are individual in nature, so while students can confer with one another, each student should develop their own solution. Homework is due at the beginning of class period. Work more than 24 hours late will not be graded, unless prior arrangements have been made with the instructor.

Final Exam Period: The final exam period for this course is Friday, May 13th from 1:00-3:45pm. Students should reserve this day and time for the course.

Drop Policy: Students can drop the course before April 1st with a grade of "W". Students who drop the course after April 1st will be assigned the grade earned in the course.

Additional References:

- K. Ogata, Modern Control Engineering, 5th ed., 2010
- G. F. Franklin, J. D. Powell, and A. Emami-Naeini, Feedback Control of Dynamic Systems, 7th ed., 2014
- R. C. Dorf and R. H. Bishop, Modern Control Systems, 12th ed., 2010.
- F. Golnaraghi and B. C. Kuo. Automatic Control Systems, 9th Edition. John Wiley & Sons, Inc., 2009.
- N. S. Nise, Control Systems Engineering, 6th ed., 2010
- W. Palm, Modeling, Analysis, and Control of Dynamic Systems, 2nd ed., 1999
- W. L. Brogan, Modern Control Theory, 3rd ed., 1990
- C.-T. Chen, Linear System Theory and Design, 3rd ed., 1999
- J. P. Hespanha, Linear Systems Theory, 2009
- Sinha, Linear Systems: Optimal and Robust Control, 2007
- K. J. Astrom and R. M. Murray, Feedback Systems, 2012

- (Available at: http://www.cds.caltech.edu/~murray/amwiki/Main_Page)
- Friedland, Control System Design: An Introduction to State-Space Methods, 2005
- P. R. Belanger, Control Engineering: A Modern Approach, 1995
- W. J. Rugh, Linear System Theory, 2nd ed., 1996
- Tewari, Modern Control Design with MATLAB and SIMULINK, 2002.

Tentative Course Schedule:

#	Date	Topics	Assignment
1	Jan 19	Syllabus, Intro to Control systems	
2	Jan 24	System Model Classification, Differential Equations	
3	Jan 26	Complex Variables, Laplace Transforms, Transfer Functions	HW 1
4	Jan 31	Transfer functions, solving ODEs, MATLAB	
5	Feb 2	State space realizations, block diagrams, MATLAB	
6	Feb 7	Linearization of nonlinear systems	HW1 due; HW2
7	Feb 9	Modeling of physical systems	
8	Feb 14	Modeling of physical systems	
9	Feb 16	State space fundamentals	HW2 due; HW3
10	Feb 21	State space fundamentals	
11	Feb 23	Coordinate transformations, diagonal canonical form	
12	Feb 28	Time response of LTI systems	HW3 due; HW4
13	Mar 2	Time response of LTI systems, Root locus method	
14	Mar 7	Review for midterm exam	HW4 due
15	Mar 9	**In-class midterm exam for lectures 1-14**	
	Mar 14	**No Class – Spring Break**	
	Mar 16		
16	Mar 21	Root locus, Frequency response method, Bode plots, Nyquist plots	
17	Mar 23	Bode plots and Nyquist plots, Stability margins	HW5
18	Mar 28	PID control, Controllability	
19	Mar 30	Controllability	
20	Apr 4	Controllability, Observability	HW5 due; HW6
21	Apr 6	Observability, Minimal realizations	
22	Apr 11	Internal stability analysis	
23	Apr 13	Internal stability analysis	HW6 due; HW7
24	Apr 18	BIBO stability analysis; Design of linear state feedback control laws	
25	Apr 20	Design of linear state feedback control laws	
26	Apr 25	Observers and observer-based compensators	HW7 due; HW8
27	Apr 27	Observers and observer-based compensators, Intro to linear quadratic regulator (LQR) optimal control	
28	May 2	LQR Optimal Control	
29	May 4	Review for Final Exam	HW8 due
	May 13	Final Exam	

Scholastic Integrity: As an entity of The University of Texas at El Paso, the Department of Electrical and Computer Engineering is committed to the development of its students and to the promotion of personal integrity and self-responsibility. The assumption that a student's work is a fair representation of the student's ability to perform forms the basis for departmental and institutional quality. All students within the Department are expected to observe appropriate standards of conduct. Acts of scholastic dishonesty such as cheating, plagiarism, collusion, the submission for credit of any work or material that are attributable in the whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student, or the attempt to commit such acts will not be tolerated. Any case involving academic dishonesty will be referred to the Engineering Dean's Office and the Office of the Dean of Students. The Dean of Students will assign a Student Judicial Affairs Coordinator who will investigate the charge and alert the student as to its disposition. Consequences of academic dishonesty may be as severe as dismissal from the University. See the Office of the Dean of Students' home page at www.utep.edu/dos/acadintg.htm for more information.

Policy relating to Disability / CASS: In Section 504 of the Vocational Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) of 1990, if a student needs an accommodation then the Office of Disabled Student Services located at UTEP need to be contacted. If you have a condition, which may affect your ability to perform successfully in this course, you are encouraged to discuss this in confidence with the instructor and/or the director of the Disabled Student Services. Written guidelines r/t accommodations from CASS must be submitted to the course manager PRIOR to the start of the course. If you have a disability and need classroom accommodations, please contact CASS at 747-5148, or by email to cass@utep.edu, or visit their office located in UTEP Union East, Room 106. For additional information, please visit the CASS website at www.sa.utep.edu/cass. *CASS' Staff are the only individuals who can validate and if need be, authorize accommodations for students with disabilities.*