



ENGR 6331, MECH 6300, SYSM 6307
Course Linear Systems and Signals

Professor Dr. Nicholas Gans
Term Spring Semester 2017
Meetings Monday and Wednesday 5:30PM - 6:45PM
CB3 1.302

These descriptions and timelines are subject to change at the discretion of the Professor.

Professor's Contact Information

Office Phone 972-883-4341
Other Phone N/A
Office Location ECSN 4.910 (My research lab is in ATC 1.608, so I am often there)
Email Address ngans@utdallas.edu
Office Hours Monday and Wednesday 3:00 PM - 4:00 PM or by appointment

Other Information

- An eLearning page is in place for posting lecture notes, assignments, grades, bulletin board discussions, etc.
- There is a forum in eLearning that I strongly prefer to email. Please use the forum for asking questions whenever possible.
- Email sent after 10:00 PM may not get a response until the next day.
- Course TA to be announced

General Course Information

Pre-requisites, Co-requisites, & other restrictions

Course Description

EE 6331 Linear Systems (3 semester hours) State space methods of analysis and design of linear dynamical systems. Coordinate transformations, controllability and observability. Lyapunov stability analysis. Pole assignment, stabilizability, detectability. State estimation for deterministic models, observers. Introduction to the optimal linear quadratic regulator problem.
Prerequisites: EE 2300 and EE 4310. (3-0)

MECH 6300 Systems and Control Theory (3 semester hours) State space methods of analysis and design of linear dynamical systems. Coordinate transformations, controllability and observability. Lyapunov stability analysis. Pole assignment, stabilizability, detectability. State estimation for deterministic models, observers. Introduction to the optimal linear quadratic regulator problem. .
Prerequisites: MECH 2300 and MECH 4310 or equivalents. (3-0)

SYSM 6331 - Systems & Control Theory (3 credit hours) State space methods of analysis and design of linear dynamical systems. Coordinate transformations and tools from advanced linear algebra. Controllability and observability. Lyapunov stability analysis. Pole assignment, stabilizability, detectability. State estimation for deterministic models, observers. Introduction to the optimal linear quadratic regulator problem.

Prerequisites: EE 4310 or MECH 4310 or equivalents (3-0)

Learning Outcomes	• Deriving linear system models for physical systems • Understand equivalence of linear systems • Study BIBO stability and internal stability • Find state feedback controllers and state estimators • Solve the compensator equation for pole placement and do robust tracking • Understand Advanced Linear Algebra Applications
Required Texts & Materials	Linear System Theory and Design , 4 th Edition, by Chi-Tsong Chen MATLAB Student Version
Suggested Texts, Readings, & Materials	Advanced Linear Algebra with MATLAB 3 rd Edition, by Eli Saber and Sohail Dianat Feedback Control Dynamic Systems 6 th Edition, by Franklin, Powell and Emami-Naeini

Assignments & Academic Calendar

[Topics, Reading Assignments, Due Dates, Exam Dates]

Lectures

Topic

- Linear Algebra-Linear Spaces and Linear Operators
- Linear Algebra-Linear Independence, bases, and representations
- Linear Algebra-Similarity Transform
- Linear Algebra-Functions of a Square matrix
- Linear Algebra-Some Useful Formulas
- State Space-Linear Systems
- State Space-Linearization
- State Space-Solution of LTI State Equations
- State Space-Realizations
- State-Space-Equivalent Time varying Equations
- Stability-Stability Criteria in Terms of Input-Output
- Stability-Internal Stability
- Stability – Lyapunov Stability
- Controllability and Observability-Linear Independence of Time Functions
- Controllability and Observability-Observability of Linear dynamical Systems
- Controllability and Observability of Jordan form Dynamic Equations
- Controllability After Sampling
- Minimal Realizations-Implications of Co-Primeness
- Minimal Realizations-Balanced Realization
- State Feedback-State Feedback
- State Feedback-Regulation and Tracking
- State Feedback-Connection of state Feedback and State Estimators
- State Feedback-Multivariable Case
- Pole Placement--Unity Feedback Configurations
- Pole Placement-Implementable Transfer Functions
- Pole Placement-Multivariable Unity Feedback Systems
- Optimal Control - Linear Quadratic Regulator
- Optimal Control - Linear Quadratic Gaussian
- Kalman Filters

Important dates
1/16/2016
1/25/2016
3/27/2016
03/13/2016 - 03/18/2016

MLK Day – no class
Last day to withdraw without a “W”
The last day to drop with a “W”
Spring Break

Exam dates (tentative)
3/08/2015
Final exam period, TBD

Exam 1
Exam 2 – Noncumulative

Course Policies

Grading (credit) Criteria	Homework 30%
	Exams 70% (40% for best exam score, 30% worst exam score)
Grading (credit) Criteria	Targeted grade ranges: A 90-100% A- 89% B+ 87-88% B 80-86% B- 79% C+ 77-79% C 70-76% C- 60-69% F <60%
	There will be two exams given during the semester. No makeup examinations will be offered in this course. In the event of an excused absence (illness, job-related travel, holy day absence, etc.; Proper documents should be provided.), the weight of the exam will be shifted to the remaining exam. Homework assignments will be collected graded and discussed in class (as time permits). Homework will be collected at the beginning of the class period when it is due. Homework that is not reasonably neat and readable will be marked down. <u>Late Homework will not be accepted.</u> Homework will be due about one week after it is assigned. It may not be returned to you until a week after it is due, which means you may not have it back for a problem-solving session, or to use in studying for an exam. If you want to have it available at these times, you will have to make a photocopy of it before you turn it in.
Make-up Exams	No make-up exams will be given.
Extra Credit	Bonus will be given for attending a controls seminar or reading an assigned paper. Details will be given.
Late Work	Will not be accepted
Special Assignments	At instructors discretion
Class Attendance	Students are encouraged to attend every class.
Classroom Citizenship	Professional at all times. As courtesy to classmates and instructor, electronic devices should be turned off during class, except when permitted by the instructor.
Field Trip Policies	N/A

Student Conduct and Discipline	The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained in the UTD publication, <i>A to Z Guide</i>, which is provided to all registered students each academic year. The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the <i>Rules and Regulations, Board of Regents, The University of Texas System, Part 1, Chapter VI, Section 3</i>, and in Title V, Rules on Student Services and Activities of the university's <i>Handbook of Operating Procedures</i>. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391). A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.
Academic Integrity	The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work. Scholastic dishonesty includes, but is not limited to, statements, acts or omissions related to applications for enrollment or the award of a degree, and/or the submission as one's own work or material that is not one's own. As a general rule, scholastic dishonesty involves one of the following acts: cheating, plagiarism, collusion and/or falsifying academic records. Students suspected of academic dishonesty are subject to disciplinary proceedings. Plagiarism, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details). This course will use the resources of turnitin.com, which searches the web for possible plagiarism and is over 90% effective. When noted, Matlab assignments will be tested using MOSS, which compares code files. http://www.utdallas.edu/deanofstudents/integrity/ http://www.utdallas.edu/deanofstudents/bigfour/ I take this very seriously. Any case of suspected cheating or plagiarizing will be referred to Judicial Affairs. Previous students in this course have received Fs because they cheated on take home exam questions and Judicial Affairs determined they get a 0 for the exam.
Email Use	The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a student's U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used

	in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts. Since I often receive multiple emails with the same or similar questions, I strongly prefer you use the eLearning forum to ask questions whenever possible. I have set eLearning to notify me if there is a question in the forum, so I will be able to reply as quickly as I could to email. Please note you can post anonymously if you prefer.
Withdrawal from Class	The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.
Student Grievance Procedures	Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's <i>Handbook of Operating Procedures</i>. In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called "the respondent"). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the dean will appoint and convene an Academic Appeals Panel. The decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.
Incomplete Grades	As per university policy, incomplete grades will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of F.
Disability Services	The goal of Disability Services is to provide students with disabilities educational opportunities equal to those of their non-disabled peers. Disability Services is located in room 1.610 in the Student Union. Office hours are Monday and Thursday, 8:30 a.m. to 6:30 p.m.; Tuesday and Wednesday, 8:30 a.m. to 7:30 p.m.; and Friday, 8:30 a.m. to 5:30 p.m. The contact information for the Office of Disability Services is: The University of Texas at Dallas, SU 22 PO Box 830688 Richardson, Texas 75083-0688 (972) 883-2098 (voice or TTY)

	Essentially, the law requires that colleges and universities make those reasonable adjustments necessary to eliminate discrimination on the basis of disability. For example, it may be necessary to remove classroom prohibitions against tape recorders or animals (in the case of dog guides) for students who are blind. Occasionally an assignment requirement may be substituted (for example, a research paper versus an oral presentation for a student who is hearing impaired). Classes enrolled students with mobility impairments may have to be rescheduled in accessible facilities. The college or university may need to provide special services such as registration, note-taking, or mobility assistance. It is the student's responsibility to notify his or her professors of the need for such an accommodation. Disability Services provides students with letters to present to faculty members to verify that the student has a disability and needs accommodations. Individuals requiring special accommodation should contact the professor after class or during office hours.
Religious Holy Days	The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated. The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment. If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or his or her designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.
Off-Campus Instruction and Course Activities	Off-campus, out-of-state, and foreign instruction and activities are subject to state law and University policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at http://www.utdallas.edu/BusinessAffairs/Travel_Risk_Activities.htm. Additional information is available from the office of the school dean.

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