EE635 Control System Theory

Semester 1, 2017

Schedule MW 1-2:30 PM, Room EE 404

Instructor Jitkomut Songsiri (JSS) **Email:** jitkomut.s@chula.ac.th

Course web http://jitkomut.lecturer.eng.chula.ac.th/ee635.html

Course Description review on linear algebra; linear least-squares; eigenvalue problems; mathematical models for dynamical systems; linear autonomous systems; response of linear autonomous systems; stability; controllability and observability; state and output feebacks; optimal state feedback; Lyapunov theory; Riccati equation; Applications of control systems in engineering.

Course outline

1. To write mathematical equations for a linear dynamical system and find its time-domain response.
2. To analyze the stability of autonomous linear dynamical systems.
3. To analyze the controllability and observability of linear dynamical systems.
4. To design a full state or output feedback and analyze the closed-loop stability.
5. To analyze the system stability by Lyapunov theory.
6. To analyze an optimal full state feedback and solve the associated Riccati equation.

Grading policy Homework 30%, Midterm 30%, Final 25%, Term project 15%

Exams To be announced.

Textbooks

1. C.T. Chen, *Linear System Theory and Design*, 3rd edition, 1998
2. T. Kailath, *Linear Systems*, Prentice-Hall, 1980
3. K. J. Astrom and R. Murray, *Feedback Systems*, Princeton University Press, 2010
4. G. E. Dullerud and F. Paganini, *A Course in Robust Control Theory: A Convex Approach*, Springer, 2000.
5. K. Zhou and J. C. Doyle, *Essentials of Robust Control*, Prentice Hall, 1998.

Rules & Regulations

1. A homework is due on the following week from the assignment date. There will be a penalty on late homework.
2. DO NOT copy homework from your classmates or lend it to others. Anyone who violates this regulation will be given zero for the homework.
3. Any student who is late more than 15 minutes will be not permitted to the classroom. Remember that when any student comes to class late, it can interupt the flow of a lecture or distract other students.

Course calendar

Week	Date	Outline	Homework
1	Aug 16	Review on linear algebra	
2	Aug 21,23	Linear autonomous systems, Time-domain response, Matrix exponential	HW 1
3	Aug 28,30	Eigenvalues and eigenvectors, Diagonalization, Cayley-Hamilton theorem	HW 2
4	Sep 4,6	Jordan canonical form, Linear systems with inputs and outputs	HW 3
5	Sep 11,13	Linear least-squares and least-norm problems	HW 4
6	Sep 18,20	Controllability	HW 5
7	Sep 25,27	Observability	
8	Oct 2-6	**Midterm week**	
9	Oct 9,11	Minimal realization Uncontrollable/Unobservable systems	
10	Oct 16,18	State feedback, Output feedback	HW 6
11	Oct 25	Lyapunov theory	
12	Oct 30, Nov 1	Stability of linear systems, Lyapunov equation	HW 7
13	Nov 6,8	Optimal state feedback, Algebraic Riccati equation	HW 8
14	Nov 13,15	Kalman filter, LQG controller	HW 9
15	Nov 20,22	Linear matrix inequalities in control theory	HW 10
16	Nov 27,29	Applications of control systems in engineering	
17	Dec 4-8	**Final week/Term project presentation**	