ME 627/CEE 627: Linear Systems Theory
12:00pm-1:15pm, Tuesdays and Thursdays, Online Class
Fall 2020

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Course Description: This graduate level course focuses on linear system theory in the time domain. The course introduces the fundamental mathematics of linear spaces, linear operator theory, and then proceeds with existence and uniqueness of solutions of differential equations, structural properties of linear systems, and design of linear controllers. The focus is on linear time invariant systems in continuous and discrete time. Topics covered include:

- Introduction: State-space representation, linearization, existence and uniqueness of solutions of linear differential equations
- Review: Linear spaces, eigenvalues, eigenvectors, change of basis, diagonalization, Jordan forms, Cayley-Hamilton theorem, matrix exponential
- Stability: Uniform, asymptotic, and exponential stability, Lyapunov stability theorems
- Controllability and observability: Kalman rank test, PBH test
- State feedback and estimation: Canonical forms, pole placement, observer design
- Optimal control: Riccati equation, Hamiltonian matrix, stability

Prerequisites: Basic knowledge of linear algebra, differential equations, and signals and systems. Undergraduates need permission.

Textbooks and References:
- Wilson J. Rugh. *Linear System Theory*, 2nd Edition, Prentice Hall, 1996.
- Panos J. Antsaklis and Anthony N. Michel. *A Linear Systems Primer*, 1st Edition, Birkhauser Boston, 2007.
- Joao Hespanha. *Linear Systems Theory*, Princeton University Press, 2009.
- C.T. Chen. *Linear Systems Theory and Design*, 3rd Edition, Oxford University Press, 1999.
- G. Strang. *Linear Algebra and its Applications*, 3rd edition, 1988 (Linear Algebra Reference).

Grading Policy:
Homeworks: 100%