AOE 4004: State-Space Control
Course Syllabus

Instructor: Mazen Farhood   224-10 Randolph Hall
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Time & Location: Tuesdays and Thursdays, 12:30 PM to 1:45 PM, Patton Hall, Room 305

Office Hours: Tuesdays 2:00 PM to 3:00 PM; Thursdays 2:00 PM to 3:00 PM, 5:00 PM to 6:00 PM

Description: Control design and analysis for linear, state-space system models. Properties of linear, time-invariant control systems: Input/output stability, internal stability, controllability, and observability. Performance and robustness measures. State feedback control design methods: pole placement, linear-quadratic control. State observers and output feedback control. Applications to control of mechanical systems including ocean, atmospheric, and space vehicles. Pre: 3034. (3H,3C)

Text: There is no required textbook, but detailed course notes will be provided by the instructor. While there is no required textbook, students are encouraged to purchase *Control System Design: An Introduction to State-Space Methods* by Bernard Friedland, available from Dover Publications.

Grade: 20%   Homework
25%   Exam #1: Date TBA
25%   Exam #2: Date TBA
30%   Exam #3: Date TBA

Homework Assignments:
- Assignments are to be placed in the box (with instructor name/course number on it) on the wall facing the AOE department main office (215 Randolph).
- Homework assignments are due no later than 4PM on the stated due date.
- Electronic submissions will not be accepted without prior approval.
- Late homework will not be accepted without formal documentation of extenuating circumstances.

Note: Lectures will be delivered using the chalkboard. Students are expected to put away their laptops and smart phones at the beginning of class. Tablets with pens can be used to take notes.

Course Topics:
I.   Linear System Theory
   A. Definition and properties of the state transition matrix
   B. Definitions and tests for stability
   C. Definitions and tests for controllability/stabilizability
   D. Definitions and tests for observability/detectability
   E. Realizations, transformations, and canonical forms
II.   State Feedback
   A. Pole placement
   B. Linear-quadratic control
   C. Prescribing the degree of stability
III. State Estimation and Output Feedback
   A. Full and reduced order observers
   B. The Kalman-Bucy filter
   C. Linear-quadratic Gaussian control
IV.   Robustness of feedback controllers
   A. Nyquist plots
   B. Stability (gain and phase) margins

Americans with Disabilities Act:
The Americans with Disabilities Act (ADA) is a federal antidiscrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact the Services for Students with Disabilities (SSD) Office Phone: 540/231-0858; TTY: 540/231-0853, Fax: 540/231-0848 E-mail: ssd@vt.edu, or on the web at Web: http://www.ssd.vt.edu/. If you have determined that accommodation is necessary, please feel free to meet with me during office hours during the first two weeks of class, or as soon as you become aware of the need.

Honor Code:
Students are expected to adhere to the honor system as stipulated in the University Policies for Student Life found in the Hokie Handbook (http://www.hokiehandbook.vt.edu/) and spelled out in the Virginia Tech Undergraduate Honor System constitution.
(Know your rights and obligations: http://www.honorsystem.vt.edu/constitution.html).

The Undergraduate Honor Code pledge that each member of the university community agrees to abide by states: "As a Hokie, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do."

Students enrolled in this course are responsible for abiding by the Honor Code. A student who has doubts about how the Honor Code applies to any assignment is responsible for obtaining specific guidance from the course instructor before submitting the assignment for evaluation. Ignorance of the rules does not exclude any member of the University community from the requirements and expectations of the Honor Code.