Advanced Control Systems   MEC 560   Spring 2019

Course Description:
Analytical methods applied to the design of multivariable linear control systems. Introduction to linear system theory: linearization, solution of linear matrix differential equations, stability, controllability, observability, transformations to canonical forms. Formulation of control objectives. Deterministic state observer. Full-state feedback control based on pole assignment and linear quadratic optimization theory. Linear systems with stochastic inputs and measurement noise. The response of linear systems to a random input; stochastic state estimator (Kalman filter); separation principle of stochastic control and estimation; system robustness. MatLab and relevant toolboxes will be used extensively. (3 credits)

Instructor:
Dr. Kevin Craig, Adjunct Professor of Mechanical Engineering
E-Mail: kevin.c.craig@hofstra.edu; Cell Phone: 518-858-3771; Office Phone: 516-463-6020
Class: Wednesday 4-6:50, 105 Frey Hall   Office Hours: To Be Determined

Textbooks:
- *Linear State-Space Control Systems*, R. Williams and D. Lawrence, Wiley, 2007. (Required)
- *Modern Control Engineering,* 4th Edition, K. Ogata, Prentice Hall, 2002. This text is for review of the material in a first controls course. (Optional)

References:
- *Control System Design: An Introduction to State-Space Methods*, Bernard Friedland, Dover, 1986.
- *Multivariable Feedback Control*, 2nd Edition, S. Skogestad and I. Postlethwaite, Wiley, 2005.
- *Applied Nonlinear Control,* J. Slotine and W. Li, Prentice Hall, 1991.
- *Control System Design*, G. Goodwin, S. Graebe, and M. Salgado, Prentice Hall, 2001.
- *Observers in Control Systems,* George Ellis, Academic Press, 2002.

Topics:
- Review of Linear System Theory
- Review of Physical and Mathematical Modeling of Mechanical, Electrical, and Electromechanical Systems
- Review of SISO Classical Feedback Control
- Modern State-Space Analysis and Control
- Multivariable MIMO Control
- Robust Control
- Nonlinear Control

Exams:
There will be three 90-minute in-class exams during the semester, each counting 20% of the final grade. Each exam will be a closed-book, closed-note exam.

K. Craig

Final Exam:
There will be a closed-book, closed-note cumulative final exam (25% of the final grade) given during the final exam period.

Final Assignment: A final design assignment requiring individual work and worth 15% of the final grade will be due at the final exam.

Class Attendance, Preparation, and Participation:
Attendance at all classes is mandatory and participation in class is strongly encouraged. Each session will be conducted with an interactive, applied, mentoring approach. There will be presentation of new concepts and step-by-step interactive solution of problems. Questions will be answered, and difficult concepts explained. Students are expected to participate interactively.

Student Accessibility Support Center Statement

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Student Accessibility Support Center, ECC (Educational Communications Center) Building, Room 128, (631)632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Student Accessibility Support Center. For procedures and information go to the following website: http://www.stonybrook.edu/ehs/fire/disabilities.

Academic Integrity Statement

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website athttp://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

K. Craig