# Course Syllabus

## MEC 560: Advanced Control Systems

## Fall 2021

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| **Instructor** | Amin Fakhari, Ph.D., Department of Mechanical Engineering |
| **Office** | 165 Light Engineering |
| **Office Hours** | We 11:30 AM – 1:00 PM, Th 2:00 – 3:30 PM (and, any other time by appointment)* |
| **Phone** | (631) 632-8329 |
| **Email** | amin.fakhari@stonybrook.edu |

\* I will respond to your emails as soon as possible, however, please allow 24-48 hours for a response.

## Course Detail

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| **Title** | MEC 560: Advanced Control Systems |
| **Credit** | 3 |
| **Lecture** | Tu 3:00 – 5:45 PM, Frey Hall 226 |
| **Prerequisites** | Undergraduate level control, a foundation in linear algebra and calculus, and programming in MATLAB. |

## Textbooks

- J.J. Slotine and W. Li, *Applied Nonlinear Control*, Pearson, 1991 [Publisher, Amazon].

- H. K. Khalil, *Nonlinear Control*, Pearson, 2015 [Publisher, Amazon].

## 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 random input; stochastic state estimator (Kalman filter); separation principle of stochastic control and estimation; system robustness.

## Course Main Topics

This course will cover fundamental concepts in Modern Control Theory, including

1. Linear and Nonlinear Systems,
2. Phase Plane Analysis of Linear and Nonlinear Systems,
3. Equilibrium Points and Limit Cycles,
4. Concepts of Stability for Autonomous Systems,
5. Lyapunov's Indirect and Direct Methods,
6. Linearization of Nonlinear Systems,
7. Control Design Based on Lyapunov's Direct Method,
8. Concepts of Stability for Non-Autonomous Systems,

9. Nonlinear Control Systems Design,
10. Feedback Linearization,
11. Sliding Control,
12. Adaptive Control.

## Tools

**Blackboard**: It is required that you use the [Blackboard](#) for this course. Blackboard is used for facilitation of communications between faculty and students, submission of assignments, posting of the course materials, important announcements, and grades.

**MATLAB**: It is a programming and numeric/symbolic computing environment developed by MathWorks. [MATLAB](#) allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages. An additional package, Simulink, adds graphical multi-domain simulation and model-based design for dynamical systems and embedded systems. You can [Download and Install MATLAB Software](#) using your SBU email address.

**Calculator**: Only NCEES Allowed Calculators will be permitted to be used on all quizzes, midterm, and final exams. Please see the Calculator Policy on [Stony Brook](#) and [NCEES](#) websites.

## Homework Assignments

- Homework assignments will be assigned in the class or posted on Blackboard.
- Homework must be handed in at the beginning of the class on the specified due date in order to be considered on time (unless otherwise announced).
- Late homework will receive half credit before the solutions are posted and will not be accepted after that.
- You can either hand-write your solutions to homework or type them.
- Late homework will not be accepted in any case.

## Examinations

**Midterm Exam**     Tuesday, Oct. 5, 2021 (in class, Frey Hall 226)
**Final Exam**         Tuesday, Dec. 14, 3:00 – 5:45PM (in class, Frey Hall 226)

(a) There will be no make-up exams unless provided me an official proof of the reason within three days following the exam. An unexcused exam absence will be scored as a zero.
(b) The exam dates are subject to change. Students will be notified in a timely manner of any changes in the exam dates.

## Grading Policy (Tentative)

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| **Homework and Project** | 40% |
| **Midterm Exam** | 30% |
| **Final Exam** | 30% |

(a) Any disagreement with exam grading must be settled within one week after the graded material is returned.
(b) No individual extra credit work or extra points will be offered to improve grades.

## Syllabus Disclaimer

The instructor views the course syllabus as an educational understanding between the instructor and students. Every effort will be made to avoid changing the course schedule, materials, assignments, and deadlines, but the possibility exists that unforeseen events will make syllabus changes necessary. The instructor reserves the right to make changes to the syllabus as deemed necessary. Students will be notified in a timely manner of any syllabus changes via email or in the Blackboard Announcements. Please remember to check your SBU email or Blackboard Announcements regularly.

# University Policies and Statements

## 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 at http://www.stonybrook.edu/commcms/academic_integrity/index.html.

## Student Accessibility Support Center (SASC) Statement

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations 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 the Student Accessibility Support Center (SASC). For procedures and information go to Evacuation Guide for People with Physical Disabilities and search Fire Safety and Evacuation and Disabilities.

## Critical Incident Management Statement

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and 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.

## Copyright Statement

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