Sample Syllabus

ME 450-002: Modeling of Dynamic Systems
Fall 2023

Instructor:

Dr. Satadru Dey
Office: 338A Reber Building
Email: skd5685@psu.edu
Office Hours: Wednesday 11:15 AM – 2:15 PM (at 338A Reber Building or over zoom)
Preferred contact method: Email.
If you need urgent response, please email me at skd5685@psu.edu. DO NOT SEND a Canvas message.

Class Schedule: Monday Wednesday Friday 2:30 PM – 3:20 PM

Location: Chemistry Bldg 102

Teaching Assistant:

- Alexander Sakal; Email: ams9454@psu.edu; Office Hours: Thursday 3 PM – 6 PM. This will be over zoom. Zoom link: https://psu.zoom.us/j/9303794709

Text: Palm III, William, **System Dynamics**, fourth edition.

Prerequisite courses: Prerequisite or concurrent: ME 345 or ME 348; Prerequisite ME 370

Course Description:
This course covers modeling, analysis, and control of single and multiple degree-of-freedom dynamical systems, including mechanical, electrical, thermal, fluid systems and their combinations (mixed systems). The processes of energy storage and dissipation, which are common for different kinds of dynamic systems, will be emphasized in investigating general principles for modeling various dynamic systems. Basic concepts in system theory such as state variables and stability notions will be introduced. Most of the content will be restricted to linear-time-invariant systems (LTIs); however, local linearization around nominal operating points will be taught to analyze nonlinear systems. Introduction to classical control analysis and design methods will also be given.

Course Learning Objectives: After completing this course, students should be able to:

1. Recognize energy storing elements in an engineering system including mechanical, electrical, fluid, thermal, and mixed. Choose appropriate inputs, outputs, and state variables to formulate time-domain models such as state-space and Input/Output models.
2. Analyze nonlinear systems by local linearization around nominal operating points.
3. Draw system block diagrams from the system equations and vice versa: write system equations from block diagrams. Apply the Laplace transform to linear and time-invariant ODEs and derive the transfer functions.

4. Analytically and numerically (i.e., Matlab, Simulink) obtain the response from state-space models and transfer functions.
5. Perform frequency-response analyses for linear systems such as Bode plots.
6. Determine system stability and stability limits for certain classes of systems.
7. Perform design/analysis calculations for basic linear-feedback control systems such as proportional (P), integral (I), and derivative (D) feedback.
8. Applying ethical framework to analyze control engineering problems.
9. Demonstrating awareness of global, economic, environmental, and societal issues.

Grading:

Midterm exam	10%
Final exam	10%
One computer project (Group project)	30%
Homework (five)	50%

Final score (%)	>93.00	90.00-92.99	85.00-89.99	80.00-84.99	78.00-79.99	74.00-77.99	70.00-73.99	60.00-69.99	<60.00
Letter grade	A	A-	B+	B	B-	C+	C	D	F

Note: The course will be grading using an absolute grading scale. The final grade you receive will not depend on the performance of your fellow classmates.

Class Attendance:
Attendance is required.

Website:
There is a CANVAS website for the course. All materials required for this course will be posted online. It is the responsibility of the student to regularly check for announcements, homework assignments and meet the deadlines for the course.

Homework:
Students will be given two weeks to turn in their solution from the date questions are posted. Each homework assignment is worth 8 points and will be weighed equally for the final grade. A tentative schedule of when homework problems are assigned is posted in the syllabus. The submission of the homework solutions will be done online. No late homework will be accepted unless there are some unavoidable circumstances. This is an individual effort: each student must turn his/her own solution and show independent working. Please refer to the Academic Integrity section below.

Computer Project:
Computer project will be performed using MATLAB/Simulink. For this assignment you will be required to prepare a report highlighting your work and your findings. The submission of the reports and the model will be done online. You will have one month to complete this assignment.

Midterm and Final Exams: Exams will be closed book and closed notes. You can use one double sided handwritten "cheat-sheet". Calculators are allowed. No other material (printed or written) or communication means (phone) will be allowed during the exam. No collaboration is allowed during the exam.

Conflict Exam: No makeup exam will be given except as required by University policy. See me prior to any anticipated absences, preferably at the beginning of the semester.

Assessment: You must complete these works entirely on your own. You may not assist other students or use any online sites (e.g., Course Hero or Chegg), technologies (e.g., ChatGPT, language translators), tools, or sources that are prohibited. If your instructor permits the use of ideas, images, or word phrases created by another person or by generative technology, you must identify their source. You may not share any information about, or from, this assessment with others. If you have questions about these instructions, you should discuss them with your instructor before you begin.

Note to students with disabilities:
Penn State welcomes students with disabilities into the University's educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office for Disability Services (ODS) at 814-863-1807 (V/TTY). For further information regarding ODS, please visit the Office for Disability Services Web site at http://equity.psu.edu/ods/.

In order to receive consideration for course accommodations, you must contact ODS and provide documentation. The documentation guidelines for students with disabilities are available online at http://equity.psu.edu/ods/guidelines/documentation-guidelines). If the documentation supports the need for academic adjustments, ODS will provide a letter identifying appropriate academic adjustments. Please share this letter and discuss the adjustments with your instructor as early in the course as possible. You must contact ODS and request academic adjustment letters at the beginning of each semester.

Academic Integrity (University Policy 49-20)
Definition and expectations: "Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner… a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts."

Per the University Faculty Handbook, academic dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating or falsifying information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting the work of another person or work previously used without informing the instructor, or tampering with the academic work of other students.

"There is a commitment by all members of the University community not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others." The instructor in this course will follow procedures outlined in Senate Policy 49-20, Academic Integrity, http://www.psu.edu/ufs/policies when academic dishonesty is suspected.

Please see the attached letter on academic integrity at the end for more information.
According to Penn State policy G-9: Academic Integrity, an academic integrity violation is "an intentional, unintentional, or attempted violation of course or assessment policies to gain an academic advantage or to advantage or disadvantage another student academically." Unless your instructor tells you otherwise, you must complete all course work entirely on your own, using only sources that have been permitted by your instructor, and you may not assist other students with papers, quizzes, exams, or other assessments. If your instructor allows you to use ideas, images, or word phrases created by another person (e.g., from Course Hero or Chegg) or by generative technology, such as ChatGPT, you must identify their source. You may not submit false or fabricated information, use the same academic work for credit in multiple courses, or share instructional content. Students with questions about academic integrity should ask their instructor before submitting work.

Students facing allegations of academic misconduct may not drop/withdraw from the affected course unless they are cleared of wrongdoing (see G-9: Academic Integrity). Attempted drops will be prevented or reversed, and students will be expected to complete course work and meet course deadlines. Students who are found responsible for academic integrity violations face academic outcomes, which can be severe, and put themselves at jeopardy for other outcomes which may include ineligibility for Dean's List, pass/fail elections, and grade forgiveness. Students may also face consequences from their home/major program and/or The Schreyer Honors College.

Educational Equity and Reporting Bias
Penn State takes great pride to foster a diverse and inclusive environment for students, faculty, and staff. Acts of intolerance, discrimination, or harassment due to age, ancestry, color, disability, gender, gender identity, national origin, race, religious belief, sexual orientation, or veteran status are not tolerated and can be reported through Educational Equity via the Report Bias webpage (http://equity.psu.edu/reportbias/).

Counseling and Psychological Services (CAPS)
Counseling and Psychological Services (CAPS) provides group and individual counseling, crisis intervention, and psychological and psychiatric evaluations for undergraduate and graduate students as well as prevention and consultation services for the University community.

Our professional staff includes psychologists, psychiatric providers, professional counselors, social workers, and graduate trainees. https://studentaffairs.psu.edu/counseling

Contacting CAPS
501 Student Health Center
University Park, PA 16802
Hours: Monday - Friday

8:00 a.m. - 5:00 p.m.
Phone: (814) 863-0395

Crisis Services (24/7)

Penn State Crisis Line:
1-877-229-6400
Crisis Text Line:
Text "LIONS" to 741741

Tentative Course Schedule (Subject to change)

Week	Chapter # (from Textbook)	Module and Topic	Assignments	
1	1	Module 1: Introduction to System Dynamics and Modeling		
2	3, 4	Module 2: Modeling of Mechanical Systems		
3, 4	2	Module 3: Frequency Domain Modeling Framework: Transfer Function Models [Solving differential equations, Laplace Transform, Transfer functions]	HW 1	
5, 6	5	Module 4: Time Domain Modeling Framework: State Space Models		Midterm Exam
7	5	Module 5: Simulation Methods: MATLAB and Simulink	HW 2	Computer Project
8, 9	8	Module 6: Time Domain Analysis of Systems	HW 3	
10, 11	9	Module 7: Frequency Domain Analysis of Systems	HW 4	
12	6, 7	Module 8: Electrical, Thermal, Fluid, and Mixed Systems		
13, 14, 15	10, 11, 12	Module 9: Control System Design [Idea of closed-loop control, Bode plots, Control design PID, Control design with state feedback]	HW 5	Final Exam