ME 450.3: Modeling of Dynamic Systems

Instructor:  
Dr. Stephanie Stockar  
Office: 136 Research East  
E-mail: stockar@psu.edu

Location:  
103 Leonhard

Meeting Time:  
MWF 1:25p – 2:15p

Prerequisites:  
ME 370, ME 345 (concurrent)

References:  
[1] Class Notes (uploaded online on CANVAS before each lecture)  

TA:  
Susheel Dharmadhikari  
Office: 337 Reber  
E-mail: sud85@psu.edu

Office Hours:  
Tuesday 1:30pm – 3:00pm 337 Reber  
Wednesday 2:30pm – 5:00pm 202 Leonhard  
Thursday 4:30pm – 6:00pm 337 Reber  
Come and see me if you have questions about anything or if you are concerned about your progress in the course.

Evening Exams:  
**Midterm 1:** 02/11/2019 (Monday) 1:25p – 2:15p Room 103 Leonhard  
**Midterm 2:** 04/01/2019 (Monday) 1:25p – 2:15p Room 103 Leonhard

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 bring a copy of the lecture notes (printed on in electronic form) to class and regularly check for announcements, homework assignments and meet the deadlines for the course.

Poll Everywhere:  
We will be using poll everywhere as the in-class response system. Separate instructions for registering for this course and using the system from your phone are posted on Canvas.

Grading Policy:  
The grading scheme will be as follows:  
- Homework: 20%  
- In-Class work (drop the lowest 6): 15%  
- Midterm 1: 20%  
- Midterm 2: 20%  
- Final Exam: 25%

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.
Grading Scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100 to 93</td>
</tr>
<tr>
<td>A-</td>
<td>&lt; 93 to 89</td>
</tr>
<tr>
<td>B+</td>
<td>&lt; 89 to 85</td>
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<tr>
<td>B</td>
<td>&lt; 85 to 80</td>
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<tr>
<td>B-</td>
<td>&lt; 80 to 76</td>
</tr>
<tr>
<td>C+</td>
<td>&lt; 76 to 72</td>
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<tr>
<td>C</td>
<td>&lt; 72 to 65</td>
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<tr>
<td>D</td>
<td>&lt; 65 to 60</td>
</tr>
<tr>
<td>F</td>
<td>&lt; 60 to 0</td>
</tr>
</tbody>
</table>

Homework: Students will be given a week to turn in their solution from the date questions are posted. The only exception is HW6 (see below). Each homework assignment is worth 100 points and will be weighed equally for the final grade. A detailed schedule of when homework problems are assigned is posted in the syllabus. Please plan your activities using this schedule. Homework is to be handed in class on the day it is due. No late homework will be accepted. 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 Assignment: Homework #6 is a computer assignment that will be solved 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 two weeks to complete this assignment.

In-Class Work: In-class work will be assigned in each class and the responses will be recorded using poll everywhere. In-class work will be will count towards 15% of the final grade after dropping eight (6) lowest scores. No makeup in-class work will be assigned.

Examinations: All exams (midterms and final) will be closed book and closed notes. For each Midterm, you are allowed one page (single sided) handwritten “cheat-sheet”. For the final, you can bring one double sided handwritten “cheat-sheet”. Calculators are allowed. No other material (printed or written) or communication means (phone) will be allowed during exams. 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.

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; 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 Objectives:

1. To model various engineering systems, including mechanical, electrical, fluid, thermal systems and their combinations.
2. To solve the model equations analytically and numerically using Matlab/Simulink.
3. To relate the solution of the model equations to the physical response of the system.
4. To understand basic control concepts with working knowledge of transfer functions, frequency response, system stability, and steady-state error.
5. To perform basics design/analysis of control systems.
6. To evaluate student’s understanding of engineering ethics.

Course Outcomes:

After completing this course, the student should be able to:

1. Derive equations describing the transient behavior for various engineering systems through the application and integration of physical principles.
2. Recognize energy storage elements for various engineering systems and determine the order of a system.
3. Analyze nonlinear systems by linearizing the equations around an equilibrium condition.
4. Solve the equation of motion (typically a first-order or second-order ordinary differential equation) to obtain the time-dependent response.
5. Analyze the time-dependent response of generic types of first and second order systems for various inputs.
6. Draw block diagrams representing the dynamics of complex systems (multiple ODEs) and vice versa (obtain system equations from block diagrams).
7. Use MATLAB/Simulink to analyze and simulate the response of a dynamic system.
8. Analyze the response of systems under various harmonic inputs and represent the frequency-dependent response of these systems.
9. Understand basic concept of feedback control applied to simple linear time invariant systems.

Academic Integrity:

The University defines academic integrity as the pursuit of scholarly activity in an open, honest and responsible manner. 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 (refer to Senate Policy 49-20). Dishonesty of any kind will not be tolerated in this course. Dishonesty includes, but is not limited to, cheating, plagiarizing, fabricating information or citations, facilitating acts of academic dishonesty by others, having unauthorized possession of examinations, submitting work of another person or work previously used without informing the instructor, or tampering with the academic work of other students. Students who are found to be dishonest will receive academic sanctions and will be reported to the University’s Office of Student Conduct for possible further disciplinary sanctions (refer to Senate Policy G-9). Using someone else’s computer/phone/alias for in-class assignments is academically dishonest, as is answering questions when you are not in class.

Disability Access:

Penn State welcomes students with disabilities into the University’s educational programs. Every Penn State campus has an office for students with disabilities. The Student Disability Resources Web site provides contact information for every Penn State campus: http://equity.psu.edu/student-disability-resources/disability-coordinator. For further information, please visit the Student Disability Resources Web site: http://equity.psu.edu/student-disability-resources.
In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: http://equity.psu.edu/student-disability-resources/applying-for-services. If the documentation supports your request for reasonable accommodations, your campus’s disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

Counseling & Psychological Service (CAPS):

CAPS can help students resolve personal concerns that may interfere with their academic progress, social development, and satisfaction at Penn State. Some of the more common concerns include anxiety, depression, difficulties in relationships (friends, roommates, or family); sexual identity; lack of motivation or difficulty relaxing, concentrating or studying; eating disorders; sexual assault and sexual abuse recovery; and uncertainties about personal values and beliefs. You can contact CAPS by calling the Main CAPS number/Appointment Scheduling: 814-863-0395 (Please call between the hours of 8am and 5pm, Monday-Friday to schedule an appointment) or visit us at our office location, 5th Floor Student Health Center.

Online Resources for Relaxation

It's important to take care of yourself. There are a number of valuable online resources that you can use for relaxation and stress reduction. Learn how stress impacts your health and life, as well as some self-help strategies for managing it through the PSU Student Affairs EDGE online workshop. Check out other stress management resources available, including a guided program called Stress Recess. There are also a number of relaxation, visualization, and mindfulness resources at the Mind Body Spa. You can also download mindfulness meditations here. If winter has got you down and you need an upbeat song to listen to, check this out.

Sexual Assault and Relationship Violence Hotline

A hotline has been established for victims and observers of sexual assault and relationship violence. Trained counselors on the hotline will help students access appropriate resources. Penn State students from any campus can call 1 (800) 560-1637 to access the 24 hour a day, seven day a week hotline.

Subject to Change: Please note that this Course Syllabus is subject to change. Students are responsible for abiding by such changes.