# MECH 432 Dynamic Systems Analysis

Summer 2012-13

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Office hours: Mondays 12:00 am – 2:00 pm RGB 410

## *Class Meetings*

Mondays, Tuesdays, Wednesdays, Thursdays 9:00–9:50 am, Bechtel 407

## *Textbook*

C. C. Close, D. K. Fredrick, and J.C. Newel, Modeling and analysis of dynamic systems, third edition.

## *Prerequisites*

EECE 210M: Electric Circuits and Electronics
EECE 230: Computers and Programming

## *Description*

A course that involves modeling of mechanical, electrical, electromechanical, hydraulic and pneumatic systems. By the end of the course students will be comfortable modeling any system they are subjected to and possess a deep understanding of the equivalence in the model representations between different types of systems.

## *Tentative Schedule*

| Date | Topic |
|---|---|
| Topic 1 | Translational mechanical system. |
| Topic 2 | Standard forms for mechanical systems. Computer simulations. |
| Topic 3 | Rotational mechanical systems. |
| Topic 4 | Electrical systems., |
| Topic 5 | Transform solutions of linear models. |
| Topic 6 | Developing linear models. |
| Topic 7 | Electromechanical systems |
| Topic 8 | Thermal systems. |
| Topic 9 | Fluid systems. |
| Topic 10 | Block diagrams for dynamic systems |
| Topic 11 | Modeling, analysis and design tools |

## Course Objectives

The students will:
1. Learn the basic elements of a dynamic system;
2. Generate models of integrated dynamic systems;
3. Establish mathematical models of various systems;
4. Express math models in block diagrams and signal flow diagrams;
5. Formulate models in state variable representation;
6. Develop skills in analysis and assessment of dynamic systems behavior;
7. Use LabVIEW, Matlab, and Simulink to solve dynamic problems;

## Course Outcomes

Upon completion of this course, students will have demonstrated the ability to:

1. Develop linear mathematical models for mechanical systems,
2. Use block diagrams to represent systems,
3. Determine the transient response and steady-state errors of linear systems (step-input response, etc.)
4. Work in groups on design projects and present results.
5. Effectively use Matlab and Simulink in the analysis systems.

## Performance Criteria and Measures

**Objectives 1-7 correlate to outcomes (a), (b), (c), (e), (g), (j), and (k) of ABET 2000 Criterion 3.**

1. **Objectives 1-6:** Students will present solutions to homework problems that require them to: Perform analysis of various dynamic problems.
   **Criterion:** Students should be able to attack and solve unfamiliar problems that require the use of course skills put together in a new way.
   **Measure:** 1) Quality of the analysis of the problems, as indicated by step-by-step breakdown details of plan of attack, and diagrams. 2) The correctness, completeness, and accuracy of the answers of these questions.

2. **Objective 7.** Students are required to use National Instruments' graphical programming language LABVIEW, Matlab, and SIMULINK as a platform to solve various dynamic problems.
   **Criterion:** Students should be able to effectively use the software tool to build virtual instruments and experience practical industrial automation environment.
   Measure: Ability of students in using the program.

## Grading Rubric

Students will be graded according to the following scheme.

| Entry | Weight | Note |
|---|---|---|
| Drop Quizzes & Interaction | 15% | First 15 minutes |
| Assignments | 15% | |
| Midterm | 30% | Closed-book |
| Final | 40% | Closed-book |

## Course Policy

**Class attendance and quizzes**
The class is a place for the teacher and students to interact. Therefore, I design my lectures in such a way to foster interaction. In order for the synergy to work you must bring you books

and class lecture notes with you to class and follow during the lecture. Quizzes will be held without notice during the first 15 minutes of class, so please come early to lectures. You will not be given extra time if you are late.

IMPORTANT: The frequency and timing of the quizzes vary. If you miss a quiz you will NOT be given an opportunity to make it up. Cutting classes is a risk you are willing to take. You have been warned.

**Midterm and Final**
For this course you will be required to write a midterm and final exam. I recommend you practice the assignment problems to get a flavor of typical Control and Automation problems.

**Assignments**
Assignment problems will be assigned in conjunction with lecture topics. Assignment problems are graded. You are required to do them and submit them because the knowledge acquired through the solution of these assignments will prove to be invaluable for the solution of the Midterm and Final. The grades are based on the effort you put into the assignments as well as the correctness. Assignments copied from the solution manual will get very little of any grades.

**Make-up tests and late homework policy**
NO MAKE UP TEST WILL BE GIVEN. If you miss an exam for a justified cause (*e.g.*, with a doctor's report) I will change the weight of the grade accordingly to compensate for your missed exam.

## *Resources for the Course*

Resources for the course include:

- MOODLE: Includes a forum, which acts like a center of focus for the course. Any concerns you might have or ideas you want the entire class to hear you can post on the forum. Furthermore, anything I want to relay to you such as assignments, solutions, homework will be posted on Moodle.
- The text and references for the course.
- The instructor; class notes and handouts; your teammates.
- The library, the web.