MAE 444/544: Digital Control Systems

337 Bell (MWF, 2:00 PM - 2:50 PM)
Spring 2010.

Instructor:  Dr. Puneet Singla (psingla@buffalo.edu)

Course Contact Hour: Three-hours of lecture (MWF, 2–2:50pm), and one two-hour lab every alternative week. There would be total 4 labs. You would be assigned to a group of 4 students and have to pick one of the following time for your group:

   Monday 8–10am Wednesday 5–7pm Thursday 4–6pm

Prerequisites: MAE 443/543 (Continuous Control)

Contact Hours: My office is 1010 Furnas. My planned office hours are Monday and Wednesday 3–4pm. You can see me outside my office-hours by making an appointment through email.

Course Objectives:

   Topics include characterization of discrete time systems; analysis of discrete control systems by time-domain and transform techniques; stability analysis (Jury test, bilinear transformation, Routh stability test); deadbeat controller design; root-locus based controller design; discrete state variable techniques; synthesis of discrete time controllers; engineering consideration of computer controlled systems.

At the end of this course, students will be able to:

1. Understand and use the concept of ideal sampler to model linear discrete time systems.

2. Understand time and frequency domain performance specifications.

3. Understand the concepts of stability for discrete time systems and apply Jury test, Routh-Hurwitz test or Nyquist Criterion.

4. Apply the root locus and frequency domain methods to design discrete control systems.

5. Understand the concept of controllability and Observability pertaining to multi-input control systems.

6. Apply discrete state variable techniques to design multi-input discrete control systems and test them in the lab.
Detailed Course Content:

- **Introduction to Discrete System Analysis:** Sampled Data Systems, z-Transformation, Properties of z-Transformation, Inverse z-Transformation, Mapping Between the s-plane and the z-plane. (3-4 weeks)

- **Classical Control Theory:** Stability Analysis of Closed-Loop System, Design Based Upon Root Locus and Frequency Response Methods, Digital PID, Deadbeat Controller. (4-5 weeks)

- **State-Space Analysis:** Discretization of Continuous-Time State-Space Equations, Similarity Transformations, Pole Placement and Controllability, State Observers. (4-5 weeks)

Course bibliography:


Grading and Honor Policy:

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<tr>
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- Home-work problems will involve analytical and numerical work. You will be required to write several computer programs in your favorite programming language as a part of your home-work assignments.
  - You would be assigned groups of 2 students. Each group will turn in ONE type-set report in digital box at UBLearns.
  - The report will contain answers to home-work questions with detailed analysis and discussion at par with solved example problems in your text book. I want to see the thinking that went into analysis and answering the questions.
  - You are allowed to collaborate in problem formulation, approach, code development and writing the report.
  - Each report should clearly indicate the contribution of each group member in percentage. Only group members contributing 50% or more will get full earned points on the report. x% contribution will get you 2x% of earned points on a particular home-work report.
  - You are supposed to restrict your discussion within your group.
– **There will be penalties for late home-work submissions:** 50% deduction each day.

– There will be in-class quiz based upon each home work assignment.

- There is no collaboration permitted in all exams and in-class quizzes.

- Labs will start in mid-February. You would be assigned groups of 4 students depending upon final class-size.

  – Each group will turn in **ONE** type-set report in digital box at UB Learns.

  – The report will contain detailed analysis and discussion of lab experiment. I want to see the thinking that went into analysis and answering the questions. In addition to their lab-report, each group is required to submit their working lab-view files in digital drop-box.

  – Each report should clearly indicate the contribution of each group member in percentage. Only group members contributing 50% or more will get full earned points on the report. x% contribution will get you 2x% of earned points on a particular home-work report.

  – You are supposed to restrict your discussion within your group.

  – **There will be penalties for late lab-report submissions:** 50% deduction each day.

- Graduate students select a project topic by the end of the fourth week in consultation with the instructor. The problem could be related to the student’s thesis/dissertation topic. A final project report at the end of the term is also required which will include a detailed literature review on the problem in question. Students are expected to write a project report in IEEE conference paper format.

- Failure to comply with the above may have severe impact on your final grades.

- Academic integrity is a fundamental university value. When an instance of suspected or alleged academic dishonesty by a student arises, it will be resolved according to the procedures set forth by UB. For more information on UB policies and procedures regarding academic integrity, please visit: http://academicintegrity.buffalo.edu/.

- I reserve the rights to assign final grades depending upon the over-all performance (including class attendance) of each student, especially when there is clear evidence that your scores do not reflect your understanding of the material.