Digital Process Control Design

ENGG*4280
Winter Semester 2013

1 Instructor

Dr. Julie Vale. THRN 2333, 519-824-4120 ext. 54863, jvale@uoguelph.ca

2 Teaching assistant

Tom Hummel - thummel@uoguelph.ca

3 Laboratory technician

NA – we will be working in THRN 1004

4 Meetings

Lectures: Wednesday 8:30 - 9:20am, MACK 225, Friday 8:30-10:20am, MACK 225

Laboratories: THRN 1004
Tuesday 3:30-5:30pm, Wednesday 9:30-11:30am, Thursday 3:30-5:30

Midterm: *Tentatively* scheduled for Friday Feb. 15th 8:30-10:20 MACK 225
Final exam: April 19, 19:00-21:00.

5 Materials

Textbook: No text has been specified as the material comes from a wide variety of sources. BLAH by Ogata is a good reference for some of the discrete time material that we will be covering

Web: The course has a web page on courselink.uoguelph.ca

6 Prerequisites

Topics: Success in this course requires the fundamentals of engineering mathematics for linear time-invariant systems (linear algebra, differential equations, Laplace transform), discrete time mathematics (difference equations, z-transform), and basic controls tools and approaches (PID, root locus, Bode plot etc.).

Courses: As stated in the Undergraduate Calendar.

7 Calendar Description

Design, analysis, synthesis, and simulation of process control and automation systems. Automation hardware, process compensation techniques and PID controllers, design and dynamics of final control elements, computer control and the microprocessor.

8 Learning objectives

By the end of this course you should be able to

1. Analyze a hybrid control system
2. Use multiple techniques to design a digital controller that achieves given specifications for a continuous time plant
3. Implement a digital controller (including interfaces) in a mock laboratory setting
4. Compare and contrast different controllers in the context of performance, robustness, and stability
5. Write a clear and comprehensive engineering report

9 Evaluation

Lab Reports: maximum of (interim 10% final 20%, interim 15% final 15%)
Lab demo 4%
Lab progress reports: 6%
Midterm 10%
Final Exam 50%

The laboratory reports will be graded for both their technical content and for their grammar and writing style.

10 Approach

Lectures concentrate on theory while the **lab** concentrates on application and realisation of that theory. **Assignments** will provide practice and reinforcement of the theoretical components and will not be graded.

Laboratory:
Rather than a series of short experiments, the laboratory will consist of a controller design project. The lab periods will consist of group work and informal consultation with the lab assistant, where progress and problems may be discussed. The work is to be performed in groups of at most three. Two reports are required. The lab progress reports will be due on February 15 at 4:30pm and individual final lab reports on March 29 at 4:30pm. You will also be required to demo your lab, this demo will occur somewhere in week 10 or 11.

There are no makeup reports and late submissions are not accepted for marking.

The **midterm** and the **final exam** (comprehensive) are used to determine the extent to which you have achieved the theoretical course learning objectives. The use of notes, books, programmable calculators, or other aids is not permitted at exams. Any student not taking an exam receives a grade of zero for that exam. In case you have a legitimate reason for missing an exam session, I may consider an accommodation upon presentation of a written request and suitable documentation before the time of the exam.

11 Obtaining help

You can obtain help from me during my office hours (posted on the course web page) and after lectures, from the teaching assistant during his office hours and in the lab, and from the laboratory technician during the laboratory time slots.

Please contact us if you need help or you have fallen behind in your work. We are willing to put in as much effort to help you as you are willing to put in to help yourself. We are happy to work with you on difficult concepts and hear your suggestions for improving the course. If you are busy during our office hours, then email us with some days and times you are free, and we will set an appointment that works for both you and us.

If you are ill, call the Student Health Services or a medical doctor. If you have emotional, family, or living environment problems that affect your ability to study, visit the Counselling Services or your academic advisor. If you have a disability or a temporary disability, refer to the Centre for Students with Disabilities and you are welcome to discuss with us your specific learning needs at the earliest possible time. I have made every effort to avoid conflicts with religious obligations. If there is a discrepancy, please contact me as soon as possible.

12 Scholastic integrity

The value of an academic degree depends on the integrity of the work done to earn that degree. It is imperative that you keep a high level of honour in your work. The policies on scholastic dishonesty reported in the Undergraduate Calendar will be enforced.

Academic misconduct, such as plagiarism, is a serious offence at the University of Guelph. Please consult the Undergraduate Calendar 2010-2011 and School of Engineering programs guide, for offences, penalties and procedures relating to academic misconduct.
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml
I recommend that you review the tutorial on academicintegrity.uoguelph.ca and that you discuss any questions that you may have with me or the teaching assistants.

In this course, you will be required to submit lab reports. Please note that directly copying text or figures without citing them is plagiarism, even if you found the material on the Internet or got it from a friend. Additionally, if you paraphrase information from a source (including redrawing a figure with minimal changes), you must reference it.

13 Communication

Communication is through announcements in class. Some information will be posted on the course web page or sent via email messages to your University address. It is your responsibility to keep yourself informed.

14 Copyright

The instructor reserves the right to all materials made available for this course and all interpretations presented in class, which may not be reproduced or transmitted to others without the written consent of the instructor. The electronic recording of classes is only allowed with prior consent of the instructor and solely for the use of the authorized student.

15 Disclaimer

I reserve the right to change any or all of the above in the event of appropriate circumstances, subject to the University of Guelph academic regulations.

16 Topics

Please note that these topics are subject to change as needed. This list is in no particular order.

Review of ENGG 3410: Laplace transform, Bode Plots, control topologies, continuous time (CT) specifications
Review of discrete time mathematics: Difference Equations, z-transforms
System identification: Modeling, second order systems, response characterization
CT Design methods: Cascade control, feed forward control, PID, pole placement, Lead-Lag
Emulation: CT <=> discrete time (DT) transformations, analysis, stability issues
Direct Design: DT performance specs, stability, controllers, analysis