ENGG*4280 Digital Process Control Design

01

Winter 2020
Section(s): C01

School of Engineering
Credit Weight: 0.75
Version 1.00 - January 05, 2020

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1 Course Details

1.1 Calendar Description

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

Pre-Requisites: ENGG*3410

1.2 Timetable

Lectures: Thursdays, 7:00pm to 9:50pm, MCKN116
Labs: Section 1 Mondays 12:30 - 2:20 PM, Section 2 Fridays 8:30 - 10:30 AM (RICH 2504)

1.3 Final Exam

There is no final exam in this course.

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2 Instructional Support

2.1 Instructional Support Team

Instructor: Mike Cooper-Stachowsky
Email: mstachow@uoguelph.ca
Telephone: +1-519-888-4567 x31294
Office: THRN 3102
Office Hours: Thursdays, 5:30 to 6:30

Lab Technician: Matt Saunders EIT
Email: msaund05@uoguelph.ca

Telephone: +1-519-824-4120 x53916
Office: RICH 1506

2.2 Teaching Assistants

Teaching Assistant: Reza Mohammadi Tamanani
Email: rmoham05@uoguelph.ca

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3 Learning Resources

3.1 Required Resources

Course Website (Website)
https://courselink.uoguelph.ca
Course material, news, announcements, and grades will be regularly posted to the **ENGG*4280** Courselink site. You are responsible for checking the site regularly.

Digital Process Control: Analysis and Design (Textbook)
Custom text: ***Digital Process Control: Analysis and Design*** Prentice Hall, 2014.

3.2 Additional Resources

Other Resources (Other)
Lecture Information: Some lecture notes will be posted on Courselink.

Project Information: Information for the course projects will be posted within the project section of the Courselink page.

Problem sets: Problem sets will be posted in the 'problem sets' section of courselink. Solutions to selected questions will be posted to the same section in Courselink by the instructor and the GTA. Students are encouraged to post their attempts at solutions to the remaining questions in the discussion forums; GTA and the instructor will monitor these discussions and will provide support to help students arrive at the correct solutions.

Problem sets are not graded.

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4 Learning Outcomes

This course has three main components: it explores the fundamentals of using computers and other discrete time tools to control real, continuous time, systems and it takes a deeper look at process control. The main goals of this course are to (1) teach students how to mathematically analyze and control 'hybrid systems' using a number of different methods, (2) to investigate some of the specifics of process control, and (3) to teach students to write a well structured formal report.

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Analyze a hybrid control system using a combination of Laplace transforms and z-transforms.
2. Design a digital controller that achieves given specifications for a continuous time plant via both direct and emulation design techniques.
3. Analyze and design a digital controller in the context of process control.
4. Implement a digital controller using Matlab in a laboratory setting.
5. Compare and contrast different controllers in the context of performance, robustness, and stability.
6. Write a clear and comprehensive engineering report.

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5 Teaching and Learning Activities

5.1 Lab

Week 1
Topics: TA demo of equipment, group selection, project selection
Items Due: Safety quiz

Week 2

Topics: Mini project/proposal work

Week 3
Topics: Group Meeting
Items Due: Proposal/project plan

Week 4
Topics: Open hours

Week 5
Topics: Open hours
Items Due: Mini-project report

Week 6
Topics: Open hours
Items Due: Modeling report

Week 7
Topics: Nothing :)

Week 8
Topics: Group meetings

Week 9
Topics: Open hours
Items Due: Control report

Week 10
Topics: Open hours

Week 11
Topics: Informal demos
Items Due: Informal demos

Week 12
Topics: Open hours

Week 13
Topics: Formal demos
Items Due: Formal demos

5.2 Lecture Schedule

The following is a list of topics that will be covered in this course, in no particular order

- Review of ENGG*3410 concepts
- Discrete time mathematics
- Effect of a sample and hold operation
- Delay and its effects
- Process Control and Control Topologies beyond ENGG*3410
- Discrete time systems - stability, behaviour, control specifications
- Introduction to hybrid systems
- Emulation Control
- Direct Control

5.3 Project Schedule

Beyond the scheduled lab times, you may book one 2 hour time slot per week. This slot is yours, every week, for the duration of the term. These slots will be selected during the first week's lab session. Beyond these fixed times, there will be a lab signup sheet in the shared courselink Excel file that you can use to book a maximum of two additional 2 hour slots per week. These sign up sheets will be replaced on a weekly basis and are first come, first served. The TA and the instructor will not be present in the lab during these times.

I will be available for questions about the project during my office hours. I will also be available via email and, if needed, via pre-scheduled Skype or phone calls. I try to return emails as quickly as possible, and rarely beyond 24 hours.

5.4 Other Important Dates

Monday, January 6: Classes commence

Monday, February 17 – Friday, February 21: WINTER BREAK
Friday, April 3: Last day of classes.

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6 Assessments

6.1 Marking Schemes & Distributions

Students must obtain a grade of 50% or higher on the test portion of the course in order for the project portions of the course to count towards the final grade. Similarly, students must obtain a grade of 50% or higher on the project portions of the course in order for the test portions to count towards the final grade. If a student gets below 50% on both portions of the course, then the grade will be the **lower** of the two.

Name	Scheme A (%)
Safety Quiz	0
Term Test I	15
Term Test II	25
Process Control mini-project	10
Digital Control Project	50
Total	100

6.2 Assessment Details

Safety Quiz (0%)
There is a safety quiz available online in Courselink. This is a pass/fail quiz and does not contribute to your final course grade. You must pass (80% or higher) this quiz before you are allowed to enter the lab. If you do not pass this quiz, you will not be allowed to enter the lab and you will not be allowed to demo or submit any project report.

Term Test I (15%)
Date: Thu, Feb 27
Learning Outcome: 3, 5

Term Test II (25%)
Date: Thu, Mar 26
Learning Outcome: 1, 2, 3, 4, 5

Process Control mini-project (10%)
Learning Outcome: 3, 4, 6
Friday, February 7th at 11:59pm, electronically, to the dropbox on Courselink.

Digital Control Project (50%)
Learning Outcome: 1, 2, 3, 4, 5, 6
A detailed explanation of the grading scheme of this project is in the section below.
Expectations for this project can be found on Courselink under ‘Project’.

6.3 Digital Control Project: (50%)

A detailed explanation of the expectations for this project can be found on Courselink under 'Project' . All reports and the proposal will be submitted electronically to Courselink.

Proposal: (pass/fail)
Friday, Jan 24th at 11:59pm
This is a pass/fail report and does not contribute to your final course grade. You must pass this proposal before you are allowed to demo or submit any project report.

Modeling report: (5%)
Monday, Feb 24 at 11:59pm

Control report: (5%)
Friday, Mar 6 at 11:59pm

Informal Demo: (pass/fail)
Held during all scheduled lab slots and some lecture slots week of March 19th. Sign-up sheets will be provided in courselink for students to select specific days and times. Students who do not participate in the Informal Demo will receive an automatic grade of zero on the Formal Demo

Formal Demo: (5%)
Held during all scheduled lab slots and some lecture slots week of April 2nd. Sign-up sheets will be provided in courselink for students to select specific days and times.

Final Report: (35%)
At 11:59pm on Tuesday, April 7th. Note that this due date is during the exam period - plan accordingly!

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7 Course Statements

7.1 Course Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Consideration of Religious Obligations: http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-

accomrelig.shtml

Passing grade: In order to pass the course, you must pass both the project (60%) and test (40%) portions. As per University policy, the minimum passing grade is 50%.

Missed test: There will be no makeup tests. No extra time will be given to students who arrive late.

Late Submissions: Missed attendance at the demo will yield a grade of zero. Late project reports will be penalized at a rate of 10% per hour.

8 School of Engineering Statements

8.1 Instructor's Role and Responsibility to Students

The instructor’s role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

8.2 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

8.3 Lab Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

9 University Statements

9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Graduate Calendar - Grounds for Academic Consideration
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions
https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml

Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml

Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be

noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance and not later than the 40th Class Day.

For Guelph students, information can be found on the SAS website
https://www.uoguelph.ca/sas

For Ridgetown students, information can be found on the Ridgetown SAS website
https://www.ridgetownc.com/services/accessibilityservices.cfm

9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

9.8 Resources

The Academic Calendars are the source of information about the University of Guelph’s procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars

https://www.uoguelph.ca/academics/calendars
