ENGG*4280 Digital Process Control Design

Winter 2018
Section(s): C01

School of Engineering
Credit Weight: 0.75
Version 1.00 - January 05, 2018

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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-Requisite(s): ENGG*3410

1.2 Timetable

Timetable is subject to change. Please see WebAdvisor for the latest information.

1.3 Final Exam

There is no final exam in this course.

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2 Instructional Support

2.1 Instructor(s)

Julie Vale
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Telephone: +1-519-824-4120 x54863
Office: THRN 2340

2.2 Instructional Support Team

Lab Technician: Hong Ma
Email: hongma@uoguelph.ca
Telephone: +1-519-824-4120 x53873
Office: THRN 1506

2.3 Teaching Assistant(s)

Teaching Assistant: Andrea Dinardo
Email: dinardoa@uoguelph.ca

3 Learning Resources

3.1 Required Resources(s)

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(s)

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.

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.

4.2 Engineers Canada - Graduate Attributes

Successfully completing this course will contribute to the following:

#	Outcome Set Name	Course Learning Outcome
1	Knowledge base	1
1.3	Comprehend and apply fundamental engineering concepts	1
1.4	Comprehend and apply program-specific engineering concepts	1
3	Investigation	4
3.1	Propose and test working hypotheses	4
3.2	Design and apply an investigation plan	4
3.3	Analyze and interpret experimental data	4
3.4	Assess validity of conclusions within limitations of data and methodologies	4
4	Design	2, 3, 4, 5
4.1	Describe the design process	2, 3, 4, 5
4.2	Construct design-specific problem statements	2, 3, 4, 5
4.3	Create engineering design solutions	2, 3, 4, 5
4.4	Develop engineering design solutions	2, 3, 4, 5
4.5	Assess engineering design solutions	2, 3, 4, 5
4.6	Implement engineering design solutions	2, 3, 4, 5
7	Communication skills	6
7.1	Develop and deliver clear, key concepts using methods appropriate for the intended audience	6
7.2	Critically evaluate received information	6
7.3	Demonstrate active listening and follow instructions	6
11	Economics and project management	3, 4
11.1	Apply project management techniques and manage resources within identified constraints	3, 4

5 Teaching and Learning Activities

5.1 Lab

Topic(s): TA demo of equipment, group selection, project selection
Items Due: Safety quiz

Topic(s): Group Meeting
Items Due: Proposal/project plan

Topic(s): How to write good

Topic(s): Open hours

Topic(s): Open hours
Items Due: Mini-project report

Topic(s): Open hours
Items Due: Modeling report

Topic(s): Nothing :)

Topic(s): Group meetings

Topic(s): Open hours
Items Due: Control report

Topic(s): Open hours

Topic(s): Informal demos
Items Due: Informal demos

Topic(s): Open hours

Topic(s): Formal demos
Items Due: Formal demos

5.2 Lecture Schedule

Lectures in this course address material that students require in order to be able to do the project. Topics are fluid and are driven, at least in part, by student's project related needs. The following is a list of topics that will be covered in this course (in no particular order). The depth of coverage (and therefore the number of lectures devoted to those topics) will depend on student feedback.

- Review of ENGG*3410 concepts
- Discrete time mathematics
- Effect of a sample and hold operation
- Discrete time systems - stability, behaviour, control specifications
- Introduction to hybrid systems
- Emulation Control
- Direct Control
- How to write a formal report

Time allowing (dependent on demo signups) the last lecture will be used as an open forum for students to bring project related questions and concerns to the group. No new content will be introduced during that week.

5.3 Project Schedule

I will be in the lab during all scheduled lab times starting in week 2. There are two types of

instructor related lab activities:

Group meetings: Groups will have a pre-set time to meet with me for 15 minutes; this schedule will be determined on the second day of class. We can use that time to discuss the project, group dynamics/issues, or any other course related questions that you may have. Consider these meetings to be similar to progress reports that you would give your boss if you were working on a large project in industry. Although these meetings are not mandatory, I **strongly** encourage all group members to attend as these are an important opportunity to catch lurking issues (both technical or interpersonal) early enough to remedy them.

Open hours: I will have 30 min, bookable time slots available for meetings with groups or individuals. The TA will also be available during these times. Consider this time to be similar to an office hour. Bookings must be made (on the shared Excel file in courselink) by 4:30pm on the day **before** the lab. The TA and I will not be present in the lab during any unbooked times.

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.

5.4 Other Important Dates

See Schedule of Dates for other important dates in the academic year.

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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.

Students who get higher than 50% on both the testing and project compenents of the course will get the **higher** of the two grading schemes shown below.

Name	Scheme A (%)	Scheme B (%)
Safety Quiz	0.00	0.00
Review Test	5.00	0.00
Term Test I	10.00	15.00
Term Test II	25.00	25.00
Process Control mini-project	10.00	10.00
Digital Control Project	50.00	50.00

Name	Scheme A (%)	Scheme B (%)
Total	100.00	100.00

6.2 Assessment Details

Safety Quiz (0.00%)
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.

Review Test (5.00%)
Date: Mon, Jan 15

Term Test I (10.00%)
Date: Wed, Feb 14

Term Test II (25.00%)
Date: Mon, Mar 26

Process Control mini-project (10.00%)
Friday of Week 5 (Feb 9) at 11:59pm - bonus of 10% if submitted by Monday Feb 5 at 8:30am. Maximum grade is 100%.

Digital Control Project (50.00%)
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' .

Proposal: (pass/fail)
Thursday of Week 2 (Jan 18) at noon
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 of Week 7 (Feb 26) at 11:59pm - bonus of 10% if submitted by Friday Feb 16 at 11:59pm. Max grade is 100%.

Control report: (5%)
Friday of Week 8 (Mar 9) at 11:59pm

Informal Demo: (pass/fail)
Held during all scheduled lab slots and some lecture slots in week 10 (March 19). 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 in week 12 (April 2). Sign-up sheets will be provided in courselink for students to select specific days and times.

Final Report: (35%)
At 11:59pm on day 9 of the exam period (Wed. Apr 18).

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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.

Group Grading policy - Distribution of Contribution: Failure to submit a distribution of contribution form (DOC - available on Courselink under Grading Sheets) with the final report will result in an incomplete grade for the project components of the course. Details of how these DOCs will be used to adjust individual student's final project grades are provided on courselink. DOC sheets must be submitted by every student.

Bonus mark cap: There are bonus marks available in this course; however, no assessment grade can be greater than 100%.

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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.

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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 regulations and procedures for Academic Consideration are detailed in the Undergraduate Calendar.

9.3 Drop Date

Courses that are one semester long must be dropped by the end of the fortieth class day; two-semester courses must be dropped by the last day of the add period in the second semester. The regulations and procedures for Dropping Courses are available in the Undergraduate Calendar.

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.

More information: www.uoguelph.ca/sas

9.6 Academic Misconduct

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 discourages misconduct. 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.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar.

9.7 Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate 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 which apply to undergraduate, graduate and diploma programs.

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