ENGG*4480 Advanced Mechatronic Systems Design

Winter 2019
Section(s): C01

School of Engineering
Credit Weight: 0.75
Version 1.00 - January 05, 2019

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1 Course Details

1.1 Calendar Description

The course is a follow up to the introductory mechatronics course and aims at covering advanced topics that are necessary in developing mechatronic systems. Topics include: signal conditioning and filtering for mechatronics system including advanced filters such as Kalman filters; important/advanced electronic circuits for mechatronics systems; microcontroller interfacing and programming; design and development of motion control for mechatronics systems including PLC; introduction of integrated complex mechatronics systems: concept, structure, and applications. Through a design project, students will use and apply these concepts in building a complex mechatronics system with advanced features.

Pre-Requisite(s): ENGG*3490

1.2 Course Description

The aim of this course is to design and implement a mechatronic system using the knowledge and experience you have gained from ENGG*3490, which demonstrated the basics of sensors and actuators as well as a variety of mechatronic systems. For this course, the laboratories and project will be completed in groups of three to four people. Groups will be tasked with designing, building, and running their own experimental setup based on Arduino system and control or estimation theory. Successful setups may be used in future course offerings.

1.3 Timetable

Lectures

Monday, Wednesday
10:00am - 11:20am in THRN 2313

Laboratory

Tuesday
10:30am - 1:20pm THRN 2307

1.4 Final Exam

No final exam.

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2 Instructional Support

2.1 Instructional Support Team

Instructor:	S. Andrew Gadsden PhD, PEng, PMP, FASME
Email:	gadsden@uoguelph.ca
Telephone:	+1-519-824-4120 x52431
Office:	THRN 2411
Office Hours:	By appointment

2.2 Teaching Assistants

1. Richard Bustos: rbustos@uoguelph.ca

2. Andrew (Andy) Lee: alee32@uoguelph.ca

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3 Learning Resources

3.1 Required Resource(s)

Course Website (Website)

Course material, news, announcements, and grades will be posted regularly to the ENGG*4480 Courselink site. You are responsible for checking the site regularly.

3.2 Recommended Resource(s)

Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering (Textbook)

W. Bolton, Pearson, 6th Edition, 2015.

Students are expected to attend all of the lecturers. Students are **responsible** for whatever material is taught in the class. Note that the textbook may not have all of the material taught in the class. The textbook for the course is available at the bookstore (or online).

3.3 Recommended Resources

Other recommended resources (optional) are as follows:

- Information on Arduino systems: arduino.cc
- Online electronics shop: sparkfun.com

3.3 Additional Resources

Lecture Information: **Some parts** of the lectures notes are posted on the web page. The reason that only some parts are posted is to ensure that students attend the classes to learn the material. Note that the posted lectures on the webpage **may NOT** have all of the material taught in the class. Students should attend the classes and make their own notes.

Assignments: Assignments will cover lecture material and theory taught in the class. They will be completed individually. No late assignments will be accepted.

Miscellaneous Information: Other information related to estimation theory will also be posted on the course web page.

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4 Learning Outcomes

4.1 Course Learning Outcomes

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

1. Design and implement mechanical parts on mechatronic systems
2. Address safety concerns of mechatronic systems as well as during the fabrication process
3. Sensor and actuator implementation on Arduino board and/or Raspberry PIboard
4. Use of a variety of sensors and how to use them as input devices for a mechatronics system
5. How to achieve higher accuracies by combining more than two different sensors
6. Understand the basics of estimation theory
7. Understand the basics of machine intelligence
8. Manipulate mechatronic systems and obtain relevant measurement data for engineering purposes
9. Reflect upon professional skills and prepare for post-graduation

4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

#	Outcome	Learning Outcome(s)
1	Knowledge Base	6, 7
1.4	Recall, describe and apply program-specific engineering principles and concepts	6, 7
3	Investigation	3, 4, 5
3.3	Analyze and interpret experimental data	3, 4, 5
4	Design	1, 8
4.5	Develop and refine an engineering design solution, through techniques such as iteration, simulation and/or prototyping	1, 8
9	Impact of Engineering on Society and the Environment	2
9.1	Analyze the safety, social, environmental, and legal aspects of engineering activity	2
12	Life Long Learning	9
12.1	Identify personal career goals and opportunities for professional development	9

5 Teaching and Learning Activities

5.1 Lecture

Topic(s): Check lecture schedule on CourseLink.

5.2 Lab

Topic(s): Check lab schedule on CourseLink.

5.3 Important Note

The class schedule may be subject to change. Please refer to the most recent syllabus or outline available online.

5.4 Other Important Dates

Monday, January 7: Classes commence

Monday, February 18 – Friday, February 22: WINTER BREAK

Friday, March 8: 40th Class Day. Last day to drop winter semester courses.

Friday, April 5: Last day of classes.

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6 Assessments

6.1 Assessment Details

Laboratories (Group) (25%)
Learning Outcome(s): 3,4,6,8
Lab 1: Sensor Integration (7.5%)

Lab 2: Electronic Filters (7.5%)

Lab 3: i) Self-Balancing Robot OR ii) Magnetic Balancer (10%)

Skills Inventory and Resume (5%)
Learning Outcome(s): 9

Midterm Exam (30%)
Learning Outcome(s): 1,6,7

Project (40%)
Learning Outcome(s): 1,2,3,4,5,6,7,8
1. Proposal (5%)

2. Presentation and Demonstration (5%)

3. Final Report (30%)

6.2 Important Note

While you are encouraged to discuss with other classmates on problems in the class, there is zero tolerance for plagiarism or copying. A grade of 0% will be assigned to an exam if it is copied or plagiarized by any means. Potential cases of academic misconduct will be put forward for formal investigation by the College of Engineering and Physical Sciences.

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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 at the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08 accomrelig.shtml

Passing grade: You must pass both the laboratories and midterm section, as well as the project portion, in order to pass the course. For example, obtaining 40/40 on the project but 20/60 on the rest of the course will result in an overall failure of the course. In this example, a final grade of 49/100 will be earned in the course.

Late Submissions: Late submissions without a pre approved reason will **not** be accepted.

7.2 Relationships with other Courses & Labs

Previous Courses:

ENGG*3490: Introduction to Mechatronic Systems Design (basic concepts)

ENGG*3640: Microcomputer Interfacing (data acquisition)

ENGG*4460: Robotic Systems (modeling and design of complex mechatronic systems)

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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 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

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 course registration are available in the Undergraduate and Graduate 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

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 can be found on the SAS website
https://www.uoguelph.ca/sas

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
