PHYS-4050H-A: Advanced Experimental Techniques 2021FA - Peterborough Campus

Instructor:

Instructor: Rayf Shiell
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Office Hours: Tuesdays, 12-1

Meeting Times:

Weekly classes: lab rooms behind SC317, Tuesdays, 17:00 - 18:50 pm.

Please check http://www.trentu.ca/timetable/ to confirm times and locations

Department:

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Description:

This course is hands-on and skill-based. A focus is to understand, or to scientifically 'open-box' [as opposed to 'black-box'] components such as sensors and actuators commonly found within physical systems. We will experiment with circuits, with programming, and with physical components commonly found in research laboratories and technical/industrial workplaces. You will work in groups of two (or three if necessary) on three tasks in succession. The specific tasks include an introduction to data acquisition and control, debugging and controlling a motion sensor, and programming a set of synchronized solenoid valves. The focus is on harnessing the skill of using your knowledge of physics in the real world, of experiential learning to help gain employment-related skills. Each of the three tasks will be assessed through both a final report and an individual interview, and thus technical writing and verbal communication skills are also a focus of this course.

Pre or co-requisite: PHYS-COIS 2250H Electronics

Learning Outcomes:

Upon successful completion of this course, a student should:
- be able to quantitatively describe and then predict the behaviour of different physical systems, such as motors and solenoid valves
- be able to calculate the voltage signals required to control physical systems, through open loop and feedback configurations
- be able to program an Arduino microcontroller to provide signals of a desired type
- understand and apply the information contained within electronic datasheets
- appreciate the importance of adopting patience when solving real-world problems
- communicate technical information accurately and concisely within a written report
- be able to work well within a group
- be able to orally communicate tasks and results within an interview setting
- be able to assess and take considered risks in the laboratory, and to think prospectively before interacting with equipment.

Texts:

The exploratory nature of this course requires taking initiative to find and utilize a variety of resources in the public domain. These include research papers, such as:

J. Bechhoefer, Feedback for physicists: A tutorial essay on control, Rev. Mod. Phys. 77, 783 (2005)
O. Boubaker, The Inverted Pendulum Benchmark in Nonlinear Control Theory: A Survey, International journal of advanced robotic systems, DOI: 10.5772/55058, (2013)

and textbooks which can often be found in the library:

P. Horowitz and W. Hill, The Art of Electronics, Cambridge
B. Evans, Beginning Arduino Programming, Apress

and electronic datasheets such as found on the web:

http://www.avagotech.com/docs/AV02-1132EN
http://www.excelitas.com/downloads/dts_lhi778_lhi878_pyd1388.pdf

Assessments, Assignments and Tests:

The course environment will reflect much of what is experienced within a research or industrial setting, with Task 1 comprising an introductory set of activities to become familiar with data acquisition and control. This is followed by Tasks 2 and 3, two projects exchanged between groups in week 7 if more than one group:

Project A – decipher a commercial motion detector, and vary its range of operation, then reversibly modify it to communicate with a data-storage device

Project B – control a set of solenoid sprinkler valves according to a desired, pre-programmed, schedule.

We begin with Task 1, to work on during weeks 1-4, with a group report submitted electronically by the Friday of week 4. This report should be no more than 1,500 words (typically 4 pages of text), and include equations, figures or tables as required to aid the readers' understanding. It is critical the report introduce the underlying physics, the theory of operation of components, and all observations and results. The interviewers (the Instructor and one Lab Demonstrator) will compose ten questions based on the activities and report and send five of these to each member of the group by Monday of week 5, with the other five questions remaining undisclosed. Individual interviews lasting up to 30 minutes each will then be held by Thursday of week 5, with each group having then moved onto their second task in the intervening period.
At the beginning of week 5 each group will move to their second task, and work on this during weeks 5-7 (which encompasses Reading Week). Again, a group report will be submitted electronically by Friday of week 7. This report will be no more than 2,500 words (typically 6 pages of test). Again the interviewers will compose ten questions based on the project and report and send five of these to the members of each group by Monday of week 8, with the other five questions remaining undisclosed. Individual interviews lasting up to 30 minutes each will be held by Thursday of week 8, with each group having then moved onto their third task in the intervening period.

At the beginning of week 8 each group will be given, if it is available, a copy of the report of the group preceding them, and then work on this task during weeks 8-11. A group report will be again submitted electronically by Friday of week 11. This report will be no more than 2,500 words, as above, and contain as an appendix the inherited report from the preceding group. Again the interviewers will arrive at ten questions based on the project and report and send five of these to the members of each group by Monday of week 12, with the other five questions remaining undisclosed. Individual interviews lasting up to 30 minutes each will be held by Thursday of week 12.

For all tasks, marks for assessment of progress will be determined by the interviewers based on the progress they glean from each report and the individual interviews. It is expected that this course is one of five taken during the semester, so high marks should be attainable based on productive use of the time within 1/5th of a working week. Unless extreme circumstances arise (such as long-lasting and unexplained absence of one group member), the marks for reports and assessment of progress will be shared equally by all group members. Note that as reports are intended to be sent to other groups who will then work on the same project, good communication of content is a key requirement for a good mark. The interviews themselves are mainly intended to determine how much each individual understands in depth what was done, why it was done, and how it fits into the broader landscapes of the task itself, the subfield of relevant physics, and of the relevant technical subfield. These marks may therefore vary between individual group members.

Grading:

Report due on 1st task, 5 %
Individual interviews on 1st task, worth 15% & assessment of progress made on 1st task, worth 10 %
Report due on 2nd task, worth 10 %

Individual interviews on 2nd task, worth 15% & assessment of progress made on 2nd task, worth 10 %
Report due on 3rd task, worth 10 %
Individual interviews on 3rd task, worth 15% & assessment of progress made on 3rd task, worth 10 %

Schedule:

By Friday Oct 8 (week 4), report due on 1st task
By Thursday Oct 14 (week 5), Individual interviews on 1st task & assessment of progress made on 1st task
By Friday Nov 5 (week 7), report due on 2nd task
By Thursday, Nov 11 (week 8), Individual interviews on 2nd task & assessment of progress made on 2nd task
By Friday, Dec 3 (week 11), report due on 3rd task
By Thurs, Dec 9 (week 12), Individual interviews on 3rd task, & assessment of progress made on 3rd task

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University Policies:

Academic Integrity

Academic dishonesty, which includes plagiarism and cheating, is an extremely serious academic offence and carries penalties varying from failure on an assignment to expulsion from the University. Definitions, penalties, and procedures for dealing with plagiarism and cheating are set out in Trent University's *Academic Integrity Policy*. You have a responsibility to educate yourself – unfamiliarity with the policy is not an excuse. You are strongly encouraged to visit Trent's Academic Integrity website to learn more: www.trentu.ca/academicintegrity.

Access to Instruction

It is Trent University's intent to create an inclusive learning environment. If a student has a disability and documentation from a regulated health care practitioner and feels that they may need accommodations to succeed in a course, the student should contact the Student Accessibility Services Office (SAS) at the respective campus as soon as possible.

Sharing and Distribution of Course Content

Students in this class should be aware that classroom activities (lecture, seminars, labs, etc.) may be recorded for teaching and learning purposes. Any students with concerns about being recorded in a classroom context should speak with their professor. If a student shares or distributes course content in any way that breaches copyright legislation, privacy legislation, and/or this policy, the student will be subject to disciplinary actions under the relevant Academic Integrity Policy, the Charter of Student Rights & Responsibilities, or the Policy on the Protection of Personal Information, at a minimum, and may be subject to legal consequences that are outside of the responsibility of the university.

Student Absenteeism, Missed Tests and Examinations

Students are responsible for completing all course requirements, including attending classes and meeting assignment deadlines as specified on their syllabus.

Adjustments and deferrals to dates for participation, assignment submissions, tests, midterms and final examinations are not automatic. It is the student's responsibility to email their instructor immediately if they are unable to fulfill academic requirements.

Courses delivered remotely may involve student participation in scheduled (synchronous) classes via web-based platforms, such as Zoom. Students unable to participate (i.e., by video and/or audio) should email their instructors to request alternative arrangements for participation in these scheduled (synchronous) classes.

Students are required to be available for all tests, midterms and exams that are listed in their course syllabus and scheduled by their instructor or the Office of the Registrar. Depending on their program, the instructor or the chair/director may decide on alternative arrangements for exams and tests. Normally a doctor's note or supporting documentation is not required; however, when a student's success in the course or program is in jeopardy as determined by the instructor or chair/director, documentation may be requested.

Specific SAS accommodations can be implemented for students registered with Student Accessibility Services (SAS), but it is the responsibility of the student to make these arrangements in advance as per SAS guidelines, and to discuss accommodations of due dates with their instructors.

Students can notify the Office of the Registrar of their wish to observe cultural or religious holidays during scheduled examination periods by the deadline set in the Academic Calendar. Personal travel plans are not acceptable reasons for missing tests or exams.

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