Winter 2022   ECE 7440 – Sensors, Instrumentation, and the IoT

COURSE DESCRIPTION:

The purpose of the course is to introduce students to the fundamental concepts and application of sensors and instrumentation including the Internet of Things (IoT).

COURSE OBJECTIVE:

Sensors and instrumentation have become much more widespread. The objective of this course is to introduce students to the fundamental aspects of sensors and instrumentation. Students will learn about accuracy and resolution. They will also learn about many different types of sensors and signal conditioning electronics. The course has a significant laboratory component and the students will have the opportunity to use several different types of sensors and signal conditioning. The final objective of the course is to introduce the IOT and have a simple lab utilizing IOT principles such as edge computation.

PRE-REQUISITES:

Undergraduate background in circuits and electronics.

CONTACT HOURS:

3-hours per week plus 1.5-hours of laboratory contact per week

COURSE CONTENT:

The following topics will be discussed:
- Sensor characteristics: precision, error, uncertainty, sensitivity, calibration, accuracy, linearity, and hysteresis.
- Sensors for temperature: thermoresistive, bandgap sensors and thermoelectric sensors.
- Sensors for acceleration, force, pressure and strain.
- Sensors for position, displacement and level.
- Sensors for light: sources, detectors, optical sensor circuits.
- Analog to digital conversion
- Sensor transduction: bridge circuits and capacitance
- Electronic circuits and signal conditioning: input/output characteristics, overview of amplifiers, amplifier noise, differential amplifiers, instrumentation amplifiers, signal averaging
- Instrumentation System architecture and performance: analog versus digital, quantization error, sampling frequency, aliasing frequency
- Analytics - How can we extract information from data
- Sensors instrumentation and the IOT: Edge computation and cloud based IOT issues

HOMEWORK AND PROJECTS:

There will be prelab assignments for each laboratory. In addition there will be a project that will either be student suggested or one of 2-3 set projects offered each term.

TEXTBOOK:

N/A

EVALUATION:

Your final course grade is determined by your performance in the components list below in the Evaluation Table (seminar, assignments, project, mid-term, and a final examination. Students must receive a minimum of 50% on the final examination and must complete and pass all components in the course in order to be eligible to receive a passing grade.

Each component is weighted as follows:

COMPONENT	NO	VALUE %	TOTAL VALUE	DETAILS / ADDITIONAL INFO
Labs a prelabs	1	20%	20	
Project	1	15%	15	
Mid-Term Exam	1	15%	15	
Final Examination	1	50%	50	
TOTAL			100	

GRADE SCALE:

LETTER	MARK	LETTER	MARK	LETTER	MARK	LETTER	MARK
A+	95-100	B+	80-84	C+	65-69	D	45-54
A	85-94	B	70-79	C	55-64	F	<45

INSTRUCTOR INFO:

Name: .... Douglas Thomson
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Office Hours:............. By appointment

VOLUNTARY WITHDRAW:

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REQUIREMENTS/REGULATIONS

Student Responsibilities: It is the responsibility of each student to contact the instructor if he/she is uncertain about his/her standing in the course and his/her potential for receiving a failing grade. Students should also familiarize themselves with Sections 4 and 6 of the Regulations dealing with, among others, incomplete term work, deferred examinations, attendance and withdrawal, etc..

Lectures: Attendance at lectures is essential for successful completion of this course. Students must satisfy each evaluation component in the course.

ACADEMIC INTEGRITY

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance

with the General Academic Regulations and Requirements of the University of Manitoba, Section 7.1, students are reminded that plagiarism* or any other form of cheating is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university) regardless of media

- examinations
- assignments
- laboratory reports
- term exams

A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty

Please refer any questions regarding Academic Integrity to your course instructor.

*<u>Plagiarism</u>:   to steal and pass off (the ideas or words of another) as one's own; use (another's production) without crediting the source