

**Western University
Faculty of Engineering
Mechatronics Systems Engineering Program**

MSE 3302B: Sensors and Actuators

Course Outline 2014–15

Description:

One of the key elements in the implementation of mechatronic systems is the integration of computational intelligence with sensing (measurement of environmental conditions) and actuation (affecting the surrounding environment through a controlled response). In this course, students are introduced to advanced concepts in sensing and actuation for mechatronic systems, including both traditional sensors and actuators, an introduction to advanced topics in microelectromechanical system (MEMS) sensing, and smart materials.

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Office hours: Upon request @ TEB-373

Academic Calendar Copy: In this course, students are introduced to advanced concepts in sensing and actuation for mechatronic systems, including both traditional sensors and actuators, an introduction to advanced topics in microelectromechanical system (MEMS) sensing, and smart materials.

Contact Hours: 3 lecture hours, 1.5 laboratory hours, 0.5 credit course.

Prerequisites: MSE 3301a/b, ECE 3332a/b

Co-requisite: ECE 3375A/B

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

CEAB Academic Units: Engineering Science 60%, Engineering Design 40%.

General Learning Objectives (CEAB Graduate Attributes)

Knowledge Base	3/2	Use of Engineering Tools	3/3	Impact on Society and the Environment	
Problem Analysis	3/3	Individual and Team Work	3/3	Ethics and Equity	
Investigation	3/2	Communication Skills	3/2	Economics and Project Management	
Design	3/2	Professionalism		Life-Long Learning	

Notation: x/y , where x is the cognitive level (1: Remember, 2: Understand, 3: Apply) at which the attribute is assessed and y is the academic level (1: Beginner, 2: Intermediate, 3: Advanced) at which the attribute is assessed.

Topics and Specific Learning Objectives

1. Mechatronic systems and performance criteria

At the end of this section, students will be able to determine the required sensor and actuator criteria for a mechatronic system.

2. Sensor performance criteria and selection: thermocouples, resistive sensors, inductive sensors, capacitive sensors, piezoelectric sensors, encoders and tachometers.

At the end of this section, students will be able to understand the operation of commonly employed sensors and will be able to analyze and select the most appropriate sensors for an application.

3. Actuator performance criteria and selection: fluidic actuators, solenoids and voice coil motors, stepper motors, DC motors, piezoelectric actuators, shape memory alloy actuators, MEMS sensors and actuators.

At the end of this section, students will be able to understand the operation of commonly employed actuators and will be able to analyze and select the most appropriate actuators for an application.

Evaluation

Course Component	Weight
Quizzes and Assignments	10%
Laboratory	20%
Project	20%
Final Examination	50%

To obtain a passing grade in the course, a mark of 50% or more must be achieved on the final examination as well as on the laboratory. A final examination or laboratory mark < 50% will result in a final course grade of 48% or less.

All work submitted must be of professional quality. Material that is handed in dirty, illegible, or disorganized will be returned to the student for resubmission and the late submission penalty will

take effect. An additional penalty of 10% may be deducted for poor grammar, incoherence or lack of flow in the written reports.

Quizzes and assignments: A total of two quizzes and three assignments will be given throughout the term. The format may vary between online within OWL or requiring hard copy submission.

Due dates are non-negotiable. Assignments are to be handed in during class and are due at the start of the class period on the due date.

All work submitted must be of professional quality. Material that is handed in dirty, illegible, or disorganized will be returned to the student for resubmission and the late submission penalty will take effect.

Laboratory:

The schedule for labs will be provided at the start of the term. All students will attend the six mandatory lab sessions. Absence from any session without permission will result in a zero assigned to the corresponding laboratory report.

The MSE Arduino prototyping kit is required for the laboratory exercises. Please ensure that yours is in proper working order before the labs commence. Six laboratory exercises are scheduled for the term. Students are only permitted to work on lab exercises during their registered lab section unless special permission to attend an alternate lab section is given by the instructor. Labs will be performed in small groups (usually 2 students per group), which will be assigned by the instructor after the add/drop period ends.

1. Closed loop temperature control.
2. LVDT, encoder and tachometer interface and performance.
3. Pneumatic components and closed loop system.
4. Stepper motor drive construction and closed loop linear positioning.
5. Brushless DC motor drive construction and closed loop linear positioning.
6. Shape memory alloy actuator closed loop linear positioning.

Lab reports are to be handed in during the assigned laboratory period and are due at the start of the period on the due date. All lab reports will be submitted online through the course website on OWL. As with the homework assignments, all work submitted must be of professional quality. Material that is handed in dirty, illegible, or disorganized will be returned to the student for resubmission and the late submission penalty will take effect.

Project: A group project will be completed in which students will perform a complete sensor and actuator selection process. The details of the project will be distributed in class.

Final Examination: The final examination will be take place during the regular examination period. The exam will cover all of the material covered in class and in the labs. The final exam will be three hours long, closed book, programmable calculators allowed. A total of 3 hours will be allotted for the completion of the exam.

Late Submission Policy: Late submissions will be penalized 10% per weekday (applied at the due time and cumulative on a daily basis). If applicable, assignment solutions will generally be

released within one week of the assignment due date. Any assignments received after solutions have been posted will receive a grade of zero.

Assignment Submission Locker: Locker 224 located on the second floor of TEB.

Use of English: In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Attendance: All classes, laboratories and tutorials are mandatory, unless otherwise stated. Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the department, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Absence Due to Illness or Other Circumstances: Students should immediately consult with the instructor or department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see the attached “Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled”). The student should seek advice from the instructor or department Chair regarding how best to deal with the problem. Failure to notify the instructor or department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

For more information concerning medical accommodations, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Cheating and Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Use of Electronic Devices: Turn off all sound for pagers and cell phones. Students may use laptops, tablet computers, or smart phones *only* to access the course OWL site or for taking in-class notes during lectures, labs and tutorials. Only the use of programmable calculators is permitted during examinations. No other electronic devices may be used at any time during lectures, tutorials, or examinations.

Policy on Repeating All Components of a Course: Students who are required to repeat an Engineering course must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment, or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted by the student for grading in subsequent years.

Internet and Electronic Mail: Students are responsible for regularly checking their Western e-mail and the course web site (<https://owl.uwo.ca/portal/>) and making themselves aware of any information that is posted about the course.

Accessibility: Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

Support Services: Office of the Registrar, <http://www.registrar.uwo.ca/>
Student Development Centre, <http://www.sdc.uwo.ca/>
Engineering Undergraduate Services, <http://www.eng.uwo.ca/undergraduate/>
USC Student Support Services, <http://westernusc.ca/services/>

Students who are in emotional/mental distress should refer to Mental Health @ Western, http://www.health.uwo.ca/mental_health/, for a complete list of options about how to obtain help.

Other course policies:

Please make an effort to be in the class room ready to start at the class start time. Lectures will start promptly and immediate attention will be required from the start.