

MME 4487a - Mechatronic System Design

COURSE OUTLINE 2021–2022

CALENDAR DESCRIPTION:	An overview of electrical, mechanical, optical, and control technologies for system integration. Topics include: intelligent products and processes; design methodology; system modeling; sensors and actuators; microcontrollers; knowledge-based control.
COURSE INFORMATION:	Instructor: George K. Knopf, PhD, P.Eng. Room: SEB 3087 Email: gkknopf@uwo.ca Lectures: F 12:30 – 2:30 pm (ACEB 1420) Labs: Section 003 M 2:30 – 5:30 pm (SEB 1068) Section 004 W 9:30 – 12:30 am (SEB 1068) Section 005 Th 9:30 – 12:30 pm (SEB 1068)
PREREQUISITES:	MME 2213A/B or MME 2234A/B, and (ECE 2274A/B and ECE 3374A/B), or (ECE 2233A/B and ECE 2277A/B), or (ECE 2238A/B and ECE 2277A/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.
ACCREDITATION UNITS:	Engineering Science = 40%, Engineering Design = 60%
TOPICS AND LEARNING OBJECTIVES:	<p>Mechatronic system design strives to integrate mechanical, electronic, optical and computer technologies in order to create “optimal” products and processes. Basic concepts and fundamental principles will be reviewed in this course. Students will develop the knowledge and skills necessary to adopt an interdisciplinary approach to mechatronic system design through the lectures, hands-on laboratory assignments, and term project. Specific topics and learning objectives include:</p> <p>1. Mechatronic System Design</p> <p>The concepts of mechatronic systems, their primary components, and how they are designed in a systematic manner will be introduced at the beginning and reinforced throughout the course. Upon completion of this course each student will be able to:</p> <ol style="list-style-type: none">Identify and explain the components and characteristics of a mechatronic systemExplain the role of sensors, actuators, control, and machine intelligence in product performanceApply product design and systems engineering concepts to the development of a mechatronic systemAdapt mechanical designs into mechatronic designs <p>2. Microcontrollers</p> <p>Microcontrollers are a key component of mechatronic systems, providing control and intelligence functionality. The structure of microcontrollers, how they are programmed, and how they are interfaced with external devices will be introduced and expanded upon throughout the course. Upon completion of this section each student will be able to:</p> <ol style="list-style-type: none">Understand the basic architecture of microcontrollersDiscuss how to integrate a programmable device into a smart productDemonstrate the programming skills needed to write, modify, and implement code for a PIC microcontrollerUnderstand and demonstrate how to interface a microcontroller with analog and digital peripheral devices

3. Sensors and Actuators

Sensors provide critical information to a mechatronic system and actuators allow a system to affect the environment. Upon completion of this section each student will be able to:

- Describe the basic principles of simple electrical and optical sensors
- Analyze the operational characteristics of electromechanical actuators (e.g., solenoids, dc motors, stepper motors)
- Construct and evaluate simple electronic circuits to interface with sensors and actuators

4. Communication Systems

Several methods of wireless communications will be introduced. Upon completion of this section each student will be able to:

- Explain the operating principles of wireless communication
- Assess simple wireless electronic communication systems (e.g., optical and radio-frequency)
- Implement wireless communication methods with a microcontroller

5. Machine Control and Intelligence

Microcontrollers afford the opportunity to embed human knowledge into the operation of devices and enable them to behave in an intelligent manner. Upon completion of this section each student will be able to:

- Explain how human knowledge can be represented by a digital computer
- Illustrate how human-like control and intelligence can be integrated into a mechatronic system using knowledge-based systems, fuzzy logic, and artificial neural networks

CONTACT HOURS: 2 lecture hours and 3 laboratory hours per week, half course. Note that the laboratory work includes individual self-study.

TEXT: **Optional:** W. Bolton, *Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering*, 6th Edition, Pearson Education, 2015. ISBN # 978-1292076683

Note: Students are expected to purchase a PIC microcontroller kit through Western Engineering.

REFERENCES: Assigned Readings

UNITS: SI

EVALUATION: The course grade will be determined as follows:

Individual Laboratory Assignments (Total = 4)

Assignment 1	<i>Begins week of Sept. 20, 2021</i>	10%
Assignment 2	<i>Begins week of Sept. 27, 2021</i>	10%
Assignment 3	<i>Begins week of Oct. 4, 2021</i>	10%
Assignment 4	<i>Begins week of Oct. 18, 2021</i>	10%

Term Project

Design Review #1	<i>Oct. 22, 2021</i>	5%
Design Review #2	<i>Nov. 19, 2021</i>	5%
Prototype and Demonstration	<i>Dec. 3, 2021</i>	10%
Group Design Report	<i>Due Dec. 8, 2021</i>	30%
Individual Design Reflection	<i>Due Dec. 8, 2021</i>	10%

The dates listed above are **tentative** and may be adjusted if needed. Marks will be assigned on the basis of method of analysis and presentation, correctness of solution, clarity and neatness.

CONSULTATION HOURS: Office hours: Drop in, or by appointment

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 the improper use of English. Additionally, poorly written work with the exception of final examinations 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.

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- 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 or laboratory periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.
- RELIGIOUS ACCOMMODATION:** Students should consult the University's list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the [Western Multicultural Calendar](#).
- CHEATING:** Students must write their reports 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
- ACCESSIBILITY:** Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The accommodation policy can be found here: [Academic Accommodation for Students with Disabilities](#).
- NOTE:** The above topics and outline are subject to adjustments and changes as needed. Students who have failed an Engineering course (i.e., < 50%) 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 for grading by the student in subsequent years.

August 25, 2021

INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED

If, on medical or compassionate grounds, you are unable to write term tests or final examinations or complete course work by the due date, you should follow the instructions listed below. You should understand that academic relief will not be granted automatically on request. You must demonstrate to your department (or the Undergraduate Services Office) that there are compelling medical or compassionate grounds that can be documented before academic relief will be considered. Different regulations apply to term tests, final examinations and late assignments. Please read the instructions carefully.

NEW: Requests for Academic Consideration using the Self-Reported Absence Form

If you experience an unexpected illness or injury or an extenuating circumstance (48 hours or less) that is sufficiently severe to temporarily render you unable to meet academic requirements (e.g., attending lectures or labs, writing tests or midterm exams, completing and submitting assignments, participating in presentations) you should self-declare using the online Self-Reported Absence portal. This option should be used in situations where you expect to resume academic responsibilities within 48 hours or less.

Each student will be allowed a maximum of two self-reported absences between September and April and one self-reported absence between May and August. Self-reporting may not be used for final exams or assessments (e.g. midterm exams, tests, reports, presentations, or essays) worth more than 30% of any given course.

For full instructions about the Self-Reporting System refer to the Academic Calendar link [here](#).

A. GENERAL REGULATIONS & PROCEDURES (other than self-reported absences)

1. All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.
2. If you are an upper year student and you are missing a test/assignment/lab or examination that is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If your course work is worth MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097.
3. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
4. Documentation must be provided as soon as possible. If no one is available in your department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.
5. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM/MIDTERM TESTS (other than self-reported absences)

1. If you are in first year and you are unable to write a midterm/term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.
2. If you are an upper year student and you are unable to write a midterm/term test, inform your instructor PRIOR to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office. If the test is worth LESS THAN 10% of your mark, you should report to your department office to request relief. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request relief.
3. Be prepared to provide supporting documentation to the Department Chair and/or the Undergraduate Services Office (see next page for information on documentation).
4. Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.

C. FINAL EXAMINATIONS (cannot be self-reported)

1. If you are unable to write a final examination, contact the Undergraduate Services Office **PRIOR TO THE SCHEDULED EXAMINATION TIME** to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, headache, sleeping in, misreading timetable and travel arrangements.
3. In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you must sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

PLEASE NOTE: It is the student's responsibility to check the date, time and location of the Special Examination.

D. LATE ASSIGNMENTS

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).
2. Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Assistant Dean, First Year Studies, if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4.
 - i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean, Undergraduate Studies. Documentation is mandatory.
 - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean, Undergraduate Studies.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You are strongly encouraged to seek advice from your Academic Counsellor in the Undergraduate Services Office.

G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.**

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

H. ACADEMIC CONCERNS

1. You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).
2. **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**
3. If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your Academic Counsellor.

Calendar References: Check these regulations in your 2021 Western Academic Calendar available at www.westerncalendar.uwo.ca.

[Self-Reporting Absences](#)
[Absences Due to Illness](#)
[Academic Accommodations for Students with Disabilities](#)
[Academic Accommodations for Religious or Holy Days](#)
[Course Withdrawals](#)
[Examinations](#)
[Scheduling of Term Assignments](#)
[Scholastic Offences](#)
[Student Medical Certificate](#)
[Engineering Academic Regulations](#)

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

<u>Add Deadlines:</u>	First term half course (i.e. “A” or “F”)	September 16, 2021
	Full courses and full-year half course (i.e. “E”, “Y” or no suffix)	September 16, 2021
	Second term half course (i.e. “B” or “G”)	January 11, 2022

<u>Drop Deadlines:</u>	First term half course (i.e. “A” or “F”)	November 12, 2021
	Full courses and full-year half courses (i.e. “E”, “Y” or no suffix)	November 30, 2021
	Second term half or second term full course (i.e. “B” or “G”)	March 7, 2022

Contact Information:

Undergraduate Services Office	SEB 2097 Phone: 519-661-2130	E-mail: engugrad@uwo.ca
Chemical & Green Process Engineering	TEB 477 Phone: 519-661-2131	E-mail: cbeugrad@uwo.ca
Civil Engineering:	SEB 3005 Phone: 519-661-2139	E-mail: civil@uwo.ca
Computer, Electrical, Mechatronic Systems & Software Engineering	TEB 279 Phone: 519-661-3758	E-mail: eceugrad@uwo.ca
Integrated Engineering	ACEB 2410 Phone: 519-661-6725	E-mail: engceli@uwo.ca
Mechanical Engineering	SEB 3002 Phone: 519-661-4122	E-mail: mmeundergraduate@uwo.ca

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