Western University Faculty of Engineering Mechatronic Systems Engineering Program

MSE 4499—Mechatronic Design Project

Course Outline 2023-2024

Description: In this course, students will work in small teams to tackle a comprehensive engineering design project, building upon the overall undergraduate course material offered through the Mechatronics Systems Engineering program. Throughout the course, students will be expected to complete milestones related to the design process, including problem definition, generation and evaluation of concepts, engineering analysis and testing, and preparation of design documentation. Each team will be supervised by a faculty advisor with whom they will meet regularly. An interdisciplinary committee will evaluate project deliverables such as design reviews, progress reports, presentations and a final engineering report.

Academic Calendar Copy: The aim of the course is to develop and practice the interdisciplinary skills required to solve open-ended engineering design problems from a mechatronics perspective. Students will experience all phases of the design process, including: problem definition, generation and evaluation of concepts, engineering analysis and testing, and preparation of design documentation. Project management and communications skills will also be emphasized. A faculty advisor will supervise project teams and an interdisciplinary committee comprised of Mechatronics program faculty members will assess project outcomes.

Antirequisites: <u>CBE 4497</u>, the former MME 4419, <u>CEE 4441</u>, <u>GPE 4497</u>, <u>SE 4450</u>, <u>MME 4499</u>, <u>ECE 4415</u>, <u>ECE 4416</u>, Engineering Science 4499.

Prerequisites: MSE 3302A/B, MSE 3380A/B or MME 3380A/B.

Extra Information: 6 laboratory/project hours. Restricted to students enrolled in the Mechatronic Systems Engineering program.

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: Complementary Studies 25%, Engineering Design 75%.

Required Software: Students are expected to know how to use computer software necessary to carry out their design project efficiently. This includes programming environments, CAD and relevant computational modelling software, version control, etc.

Required Textbook: None assigned. General instructions and guidelines related to the course are available on OWL.

Recommended References: A number of textbooks related to the engineering design process,

from the perspective of both general and mechatronics engineering, may be useful as references: Clive L. Dym and Patrick Little, *Engineering Design: A Project-Based Introduction*, 3rd edition, New York: John Wiley & Sons, 2009.

Kevin Otto and Kristin Wood, *Product Design: Techniques in Reverse Engineering and New Product Development*, Upper Saddle River, NJ: Prentice Hall: 2000.

George E. Dieter and Linda C. Schmidt, Engineering Design, 5th edition, New York, NY: McGraw-Hill, 2013.

David G. Alciatore and Michael B. Histand, *Introduction to Mechatronics and Measurement Systems*, 4th edition, New York: McGraw-Hill, 2012.

J. Edward Carryer, R. Matthew Ohline and Thomas W. Kenny, *Introduction to Mechatronic De-sign*, Upper Saddle River, NJ: Prentice Hall, 2011.

Klaus Pohl, *Requirements Engineering: Fundamentals, Principles and Techniques*, London: Springer-Verlag, 2010.

Pankaj Jalote, A Concise Introduction to Software Engineering, London: Springer-Verlag, 2008.

General Learning Objectives (CEAB Graduate Attributes):

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

Notation: *x* represents the content level code as defined by the CEAB. blank = not applicable; I = introduced (introductory); D = developed (intermediate) and A = applied (advanced).

Specific Learning Objectives

By the end of the course, students should be able to demonstrate:	Incorporated GA Indicators	
2. Problem Analysis An ability to use appropriate knowledge and skills to identify, formulate, analyze and solve complex engineering problems pertaining to capstone project in order to reach substantiated conclusions.	PA 1, PA 2, PA 3	

3. Inves	stigation (Y)	
a. Ap	I 1	
b. Ap	I 2	
c. Ap	roject successfully. oplied level ability to analyse and interpret data generated in the roup's capstone project to reach valid conclusions.	13
4. Desig		
a.	Applied level ability to frame a complex, open-ended design problem of capstone project in engineering terms.	D 1
b.	Applied level ability to generate a diverse set of candidate engineering design solutions for capstone project.	D 2
c.	Applied level ability to select candidate engineering design solutions of capstone project for further development. (Y)	D 3
d.	Applied level ability to advance an engineering design of capstone project to a defined end state – completion. (Y)	D 4
5. Use of	Engineering Tools (Y)	
_	plied ability to identify and select appropriate engineering tool(s) d resources for capstone project.	ET 1
	oplied ability to apply appropriate engineering tool(s) and resources capstone project.	ET 2 ET3
c. Ap	plied ability to create/develop/adapt appropriate engineering tools capstone project.	E13
6. Indivi	dual and Team Work	
		ITW 1, ITW 2, ITW3
7. Comn	nunication Skills	
	vanced level ability to follow instructions (listening and reading for mprehension).	CS 1
ma	vanced level ability to communicate orally using appropriate aterials, language, non-verbal communication and effective graphical ols.	CS 2
	vanced level ability to articulate ideas in writing using appropriate chnical language, and effective graphical tools. (Y)	CS 3

0 D., f.,	
8. Professionalism Developed level understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.	PR 1, PR 2, PR 3
9. Impact of Engineering on Society and the Environment	
a. Developed ability to analyse the interactions of engineering with economic, social, health, safety, legal and cultural aspects of society pertaining to capstone project.	IESE 1 IESE 2
b. Developed understanding of the concept of sustainable design and development pertaining to capstone project.	IESE 3
c. Developed level understanding of the concept of environmental stewardship pertaining to capstone project. (Y)	IESE 3
10. Ethics and Equity (Y)	
a. Developed level knowledge of professional ethics pertaining to capstone project.	EE 1 EE 2
b. Developed level ability to apply Ethical Behaviour pertaining to capstone project.	EE 3
c. Developed level ability to apply the principles of professional accountability pertaining to capstone project.	EE 4
d. Developed level of awareness of the principles of equity pertaining to capstone project.	
11. Economics and project management	EPM1, EPM2, EPM3
Developed level ability to appropriately incorporate economics and business practices including project, risk, and change management into the practice of engineering and to understand their limitations, to perform cost analysis and generate project budgets, and to schedule and manage a large design project.	
12. Life-long Learning	
a. Advanced level ability to assess limitations in knowledge and skills. (Y)	LL 1
b. Advanced level ability to learn independently.	LL 2

Items labelled (Y) in the above implies that the Graduate Attribute (GA) will be collected in this course.

Project Topic:

The project topic may be selected from a listing of projects suggested by faculty advisors or may be suggested by a student team. The topic must be related to some aspect of Mechatronic Systems Engineering, including significant elements of electronic and mechanical engineering in addition to some elements of other fields (e.g., software engineering), contain a significant

amount of engineering design experience and be approved by the course coordinator.

Evaluation: Over the course of the year, students will be required to deliver/meet a number of milestones. These will be evaluated on an individual and team basis as follows:

Course Component	Team Grade	Individual Grade	Due Date *
Project Selection	2%		Sep. 24, 2023
Project Proposal	7%		Oct. 8, 2023
Design Review 1 + Abstract	6%		Oct. 24, 2023**
Phase 1 Report	15%		Nov. 26, 2023
Design Review 2 + Abstract	6%		Jan. 23, 2024 ***
Detailed Design Documentation	15%		March 3, 2024
Design Showcase Presentation	10%		April 2, 2024
Final Report	35%		April 8, 2024
Reflections and Lessons Learned		4%	April 9, 2024

^{*} Deadlines are approximate and maybe slightly adjusted due to unforeseen circumstances.

Unless stated otherwise, assignments should be submitted electronically through OWL.

Grade Distribution

By default, group assignment grades earned by each team will be uniformly distributed among group members. While highly discouraged, if the contribution of a team member(s) is significantly less than others, grades of team members who contribute less may be adjusted consistently with their low contribution. Each submitted group assignment where work distribution issue is encountered should be accompanied by a grade distribution form appended to this document. While it is preferred that issues of design team dynamics be resolved within the team, such issues must be reported to the course coordinator immediately if a satisfactory resolution is not achieved shortly after lack of improvement is noticed.

Important: Submitted grade distribution forms cannot be applied retroactively.

Course Passing Minimum Requirements

In order to pass the course, the final report grade must be at least 50%. In addition, component grades below 50% may result in immediate project termination and a final course grade of 48% or less.

^{**} The design review will be held face-to-face between each team and a panel of faculty advisors. The abstract (1.5%) submission deadline: October 22, 2022

^{***} The design review will be held face-to-face between each team and a panel of faculty advisors. The abstract (1.5%) submission deadline: January 21, 2023

Late Submission Policy: Late submission of any report or deliverable will incur a penalty of 10% per day of the component mark. Any deliverables submitted more than 5 days late will not be accepted.

Attendance: 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 program, 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 program Director 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 program Director regarding how best to deal with the problem. Failure to notify the instructor or program Director 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 AI Text Generators: It is prohibited to use any AI text generator including ChatGPT. Using such tools for composing report deliverables in this course may be treated in accordance with the Cheating and Plagiarism section.

Use of Electronic Devices: During lectures and other activities (e.g., Design Review sessions) please 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 during lectures and tutorials. No other electronic devices may be used at any time during lectures, design reviews etc.

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 assignments from previous years. Previously completed assignments cannot be resubmitted by the student for grading in subsequent years.

Internet and Electronic Mail: Students are responsible for regularly checking their Western email and the course web site (https://owl.uwo.ca/portal/) and making themselves aware of any information that is posted about the course. If the student fails to act on information that has been posted on these sites and does so without a legitimate explanation (i.e., those covered under the illness/compassionate form), then there are NO grounds for an appeal.

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.

Western is committed to reducing incidents of gender-based and sexual violence and providing

compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at https://www.uwo.ca/health/student_support/survivor_support/get-help.html.

To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Grade Distribution Form for Design Team

Please complete this form and append to your assignment if the contribution of a team member(s) is significantly less than other team members

Design Team Identification:	
Team Number: ———	
Team Project Title:	
The undersigned agree to the following distribu	ution of our Team Grade:
Design Team Member Name (please print):	
Percentage of Team Member Grade:	
Signature of Design Team Member:	
Design Team Member Name (please print):	
Percentage of Team Member Grade:	
Signature of Design Team Member:	
Design Team Member Name (please print):	
Percentage of Team Member Grade:	
Signature of Design Team Member:	
Design Team Member Name (please print):	
Percentage of Team Member Grade:	
Signature of Design Team Member:	
and the second s	
Design Team Member Name (please print):	
Percentage of Team Member Grade:	
Signature of Design Team Member:	
As course Instructor, I approve the Grade Dist	ribution above.
Signature of Course Instructor:	



Western University - Faculty of

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Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced gender-based or sexual violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts, here. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

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.

A. GENERAL REGULATIONS & PROCEDURES

- 1. All first-year students will report to the Undergraduate Services Office by submitting the Academic Consideration Request Form, for all instances.
- 2. If you are an upper year student and you are missing a test/assignment/lab or examination you will report the absence by submitting <u>Academic Consideration Request Form</u>. Absences worth LESS THAN 10% of your mark, will be processed by your department office. If your course work is worth 10% OR MORE of your final grade, your request will be processed by the Undergraduate Services Office.
- 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 <u>clearly</u> 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. <u>TERM/MIDTERM TESTS</u>

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 and request relief through the Academic Consideration Request Form. 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, your request for relief will be processed by your department office. If the test is worth MORE THAN 10% of your final grade your request for relief will be processed by the Undergraduate Services Office.
- 3. Be prepared to attach supporting documentation to the Department Chair and/or the Undergraduate Services Office through the online form (see next page for information on documentation).
- 4. Discuss with the instructor if and when the test can be rescheduled. The approval of the Chair or the Undergraduate Services Office is required when rescheduling midterm/term tests.

C. FINAL EXAMINATIONS

- If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR
 TO THE SCHEDULED EXAMINATION TIME to report your absence using the <u>Academic Consideration Request Form</u> and request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message <u>clearly</u> 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 <u>must</u> obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you <u>must</u> submit an "<u>Application for a Special Exam</u>" form. 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. <u>LATE ASSIGNMENTS</u>

- 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 submit the <u>Academic Consideration Request Form</u> and 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 <u>must</u> 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.

<u>In Case of Serious Illness of a Family Member:</u> 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.

<u>Calendar References:</u> Check these regulations in your 2023 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness:

Academic Accommodations for Students with Disabilities:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1& SelectedCalendar=Live&ArchiveID=#Page 10

Academic Accommodations for Religious or Holy Days:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1& SelectedCalendar=Live&ArchiveID=#Page 16

Course Withdrawals:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=6& SelectedCalendar=Live&ArchiveID=#Page_75

Examinations:

 $\frac{http://www.westerncalendar.uwo.ca/PolicyPages.cfm?PolicyCategoryID=5\&command=showCategory\&\\SelectedCalendar=Live\&ArchiveID=$

Scheduling of Term Assignments:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=5&SelectedCalendar=Live&ArchiveID=#SubHeading_78

Scholastic Offences:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=1&SelectedCalendar=Live&ArchiveID=#Page_20

Student Medical Certificate:

https://www.eng.uwo.ca/files/undergraduate/student-medical-certificate.pdf

Engineering Academic Regulations:

http://www.westerncalendar.uwo.ca/PolicyPages.cfm?Command=showCategory&PolicyCategoryID=4&SelectedCalendar=Live&ArchiveID=#Page_86

<u>Note:</u> 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.

Add Deadlines: First term half course (i.e. "A" or "F")

September 15, 2023

Full courses and full-year half course (i.e. "E", "Y" or no suffix)

September 15, 2023

Second term half course (i.e. "B" or "G")

January 16, 2024

Drop Deadlines: First term half course without penalty (i.e. "A" or "F")

November 13, 2023

Full courses and full-year half courses without penalty (i.e. "E", "Y" or no suffix)

November 30, 2023

Second term half or second term full course without penalty (i.e. "B" or "G")

March 7, 2024

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 241	0Phone: 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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