Integrated Mechatronics & Biomedical Engineering Capstone Design Project

Fall/Winter Terms (2022-23)

Course **Outline**

Course/Calendar Description

A multidisciplinary engineering design project involving design and synthesis that reinforces concepts from both Mechatronics Engineering and Biomedical Engineering.

Students will work in **teams of 2-4** to develop and design a solution based on stakeholder needs. This course is a two-term project (Fall/Winter) carried out under the co-supervision of faculty members in biomedical engineering and mechatronics engineering. Student teams will identify a project with a significant design element that requires application of knowledge and skills in biomedical engineering and mechatronics engineering.

Teams will be expected to meet with stakeholders and/or project clients to determine a need for a problem while receiving feedback and end-use improvements throughout the design process. They will also meet with their co-supervisors to improve and refine their technical and engineering design process. Students will be exposed to the underlying key concepts required for their capstone through the tutorials and workshops.

Pre-Requisites and Anti-Requisites

Prerequisite(s): Registration in Level V of the Integrated Biomedical Engineering and Health Sciences program

Cross-list(s): CHEMBME 5P06A/B, CIVBME 5P06A/B, ELECBME 5P06A/B, EPHYSBME 5P06A/B, IBEHS 5P06A/B, MATLSBME 5P06A/B, MECHBME 5P06A/B, SFWRBME 5P06A/B

Course Schedule

Lectures: Tuesdays from 2:30 to 4:30pm.

- *Location*: BSB B136

This is an in-person lecture, and attendance is expected. The content is captured using Echo360 and available for review, however, should you have to be absent from lecture. There may be times where the lectures will be online through the IBEHS 5P06 Capstone Teams site.

Course Instructors

Lead Instructor **Dr. Ravi Selvaganapathy**
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Office: JHE 212B/ETB-406 Office Hours: By appointment via email

Co-Instructor **Dr. Spencer Smith**
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Additional Instructional Support

Chemical Engineering	**Dr. Carlos Filipe** Email: filipec@mcmaster.ca Office: JHE 250 Phone: 905-525-9140 x27278 Office Hours: By appointment via Teams
Civil Engineering	**Dr. Yiping Guo** (Fall) Email: guoy@mcmaster.ca Office: JHE 226 Phone: 905-525-9140 x24846 Office Hours: By appointment via email **Dr. Peijiun Guo** (Winter) Email: guop@mcmaster.ca Office: JHE 227 Phone: 905-525-9140 x27903 Office Hours: TBD
Electrical Engineering	**Dr. Shahram Shirani** Email: shirani@mcmaster.ca Office: ITB A225 Phone: 905-525-9140 x27943 Office Hours: Tues. @ 10:30 – 11:30 am or by appointment via email
Engineering Physics	**Dr. Adriaan Buijs** Email: buijsa@mcmaster.ca Office: JHE A325 Phone: 905-525-9140 x24925 Office Hours: By appointment via email
Materials Engineering	**Dr. Gu Xu** Email: xugu@mcmaster.ca Office: JHE 357/A Phone: 905-525-9140 x27341 Office Hours: Mon. @ 10:30 – 11:30 am or by appointment via email
Mechanical Engineering	**Dr. Colin McDonald** Email: cmcdona@mcmaster.ca Office: ETB-107 / MDCL-3510C Phone: 905-525-9140 x24131 Office Hours: By appointment via MS Teams
Software Engineering	**Dr. Spencer Smith** Email: smiths@mcmaster.ca Office: ITB 167 Phone: 905-525-9140 x27929 Office Hours: By appointment via email
Health, Engineering Science & Entrepreneurship	**Dr. Carol Walker Bassim** Email: bassimc@mcmaster.ca Office: MDCL-3510 Phone: 905-525-9140 Office Hours: By appointment via MS Teams

Teaching Assistants

Name: Mahnaz Tajik
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Course Delivery

Avenue-to-Learn will be the online management system for the course. Please check Avenue regularly for updated information and announcements.

MS Teams will be used as a virtual space for online communications, collaborations, and (as needed) virtual delivery of course content.

Course Objectives and Learning Outcomes

Upon successful completion of the course, the student should be able to:

LO.01	Formulate an engineering problem in a precise manner understanding the approximations and risks.
LO.02	Be able to select and apply appropriate materials and supplies to tackle design problem.
LO.03	Independently acquire knowledge from a variety of sources.
LO.04	Work in a team in an effective and efficient manner.
LO.05	Manage time effectively to achieve project goals.
LO.06	Clearly communicate engineering design work in both written and oral formats.
LO.07	Understand and demonstrate effective design principles and processes.
LO.08	Understand and articulate the impact of their work on society, environment, and stakeholders.
LO.09	Identify and mitigate risks to project success.

Assumed Knowledge

This capstone design course requires to students to apply knowledge gained from the program and specialization of study over the course of their academic career in Engineering.

Course Materials

Required Texts: None.

Important Dates

Date/Week*	Topic
Mid-September	Final announcement of approved groups and project.
End of September	**Justification of Disciplinary Focus*****: Following project approvals, each *team* must prepare a **1-2-page report** highlighting and outlining what each discipline teams members will be focusing on. It is expected teams go in further details than what was described as part of the project approval process.
Mid-October	**Proposal Report*****: Each *team* must prepare a report that completely describes their proposed project.
Mid/End-November	**Preliminary Design Idea Presentation**: Each *team* must present their initial design idea regarding their project topic.
Early-December	**Interim Report*****: Each *team* must prepare an interim report focusing on the design plans for the project. **Self-/Peer-Evaluation**: Each *team member* must complete a preliminary self-and peer-evaluation.
End-January	**Proof of Concept and Risk Management Report*****: Each *team* must prepare a brief report outlining progress to-date. The report should specify what project objectives have been met, including evidence to support their progress. The report should also specify objectives that are still left to be completed, including an assessment of potentials risks that may impact meeting project objectives.
Late-March	**Final Report*****: Each *team* must prepare a final report upon completion of their Capstone Project. It is expected that the final report will describe the testing and implementation process of the design.
Early-April	**Capstone Expo Presentation**: Each *team* must prepare and present a poster outlining their design and present it to their peers and the community at large. Full or partial demonstration of project operation is encouraged to aid presentation. Presentations will be evaluated **individually** *and* as a **team**.

* Specific dates will be forthcoming.
*** All **written** deliverables are to be submitted through Avenue-to-Learn.

Assessments

Component	Weight
Justification of Disciplinary Focus (*Team*)	**2%**
Proposal Report (*Team*)	**5%**
Preliminary Design Idea Presentation (*Team*)	**15%**
Interim Report (*Individual* and *Team*) Summary of design plans for the project Budget summary Preliminary self- and peer-evaluation	**23%** (20%) (2%) (1%)
Proof of Concept and Risk Management Document (*Team*)	**5%**
Final Report (*Team*)**	**35%**
Capstone Expo Presentation (*Individual* and *Team*)	**10%**
Avenue Quizzes (*Individual*)	**5%**

** Final Report grades for each team member may be adjusted based on individual contributions.

Accreditation Learning Outcomes

Note: The *Learning Outcomes* defined in this section are measured throughout the course and form part of the Department's continuous improvement process. They are a key component of the accreditation process for the program and will not be taken into consideration in determining a student's actual grade in the course. For more information on accreditation, please ask your instructor or visit: http://www.engineerscanada.ca.

Indicator	Graduate Attribute Indicator Description	Measurements
4.1	Defines the problem by identifying relevant context, constraints, and prior approaches before exploring potential design solutions.	Proposal Report
4.2	Explores a breadth of potential solutions, considering their benefits and trade-offs as they relate to the project requirements.	Proposal Report, Interim Report
4.3	Develops models or prototypes, tests, evaluates, and iterates as appropriate.	Interim Report, Final Report
4.4	Justifies and reflects on design decisions, considering limitations, assumptions, constraints, and other relevant factors.	Final Report
5.2	Successfully uses engineering tools.	Proposal Report, Interim Report, Final Report
7.3	Composes and delivers an effective oral presentation for the intended audience.	Capstone Expo Presentation
8.2	Integrates appropriate standards, codes, legal and regulatory factors into decision making.	Proposal Report, Interim Report, Final Report
9.2	Evaluates the social impact of engineering activities, including health, safety, legal, cultural, and other relevant factors, and identifies uncertainties in decisions.	Final Report, Capstone Expo Presentation

10.1	Applies ethical frameworks and reasoning, including in situations where there are possible conflicting interests among the stakeholders.	Lecture Quiz
10.2	Applies the principles of equity and universal design to ensure equitable treatment of all stakeholders.	Final Report
11.2	Plans and effectively manages a project's time, resources, and scope, following business practices as appropriate.	Proposal Report, Interim Report, Final Report
11.3	Identifies, characterizes, assesses, and manages risks to project success.	Proposal Report, Interim Report, Final Report
12.2	Seeks and acquires appropriate external information as required, including showing awareness of sources of information and ability to critically evaluate them.	Final Report, Capstone Expo Presentation

McMaster Approved Policy Statements

Conduct Expectations

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the Code of Student Rights & Responsibilities (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online**.

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g., use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

Academic Integrity

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g., the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/

The following illustrates only three forms of academic dishonesty:

- Plagiarism, e.g., submission of work not one's own or which other credit been obtained.
- Improper collaboration in group work.

- Copying or using unauthorized aids in tests and examinations.

Authenticity / Plagiarism Detection
In this course we will be using a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. Students will be expected to submit their work electronically either directly to Turnitin.com or via Avenue to Learn (A2L) plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish to submit their work through A2L and/or Turnitin.com must still submit an electronic and/or hardcopy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com or A2L. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). To see the Turnitin.com Policy, please go to the following website:
www.mcmaster.ca/academicintegrity.

Academic Accommodations for Students with Disabilities
Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's Academic Accommodation of Students with Disabilities policy.

Academic Accommodation for Religious, Indigenous, or Spiritual Observations (RISO)
Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office **normally within 10 working days** of the beginning of term in which they anticipate a need for accommodation *or* to the Registrar's Office prior to examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Academic Accommodations for Relief for Missed Academic Work: McMaster Student Absence Form (MSAF)
In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work".

Inclusive Environment Statement
We consider this classroom to be a place where you will be treated with respect, and we welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.

We will gladly honour your request to address you by an alternate name or gender pronoun. Please advise us of this preference early in the term.

Courses with an On-Line Element
In this course, we will be using **Avenue-to-Learn** and **Microsoft Teams**. Students should be aware that,

when they access the electronic components of this course, private information such as first and last names, usernames for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in this course will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure, please discuss this with the course instructor.

Online Proctoring

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

Copyright and Recording

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

Reference to Research Ethics

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to https://reo.mcmaster.ca/.

Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster email.

Notice Regarding Possible Course Modification

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.