



ENGG*4180 Biomedical Engineering Design IV

01

Fall 2023

Section(s): C01

School of Engineering

Credit Weight: 1.00

Version 1.00 - September 13, 2023

1 Course Details

1.1 Calendar Description

This is the capstone design course for the Biomedical Engineering program. Teams normally of 3-4 students apply engineering analysis and design principles to a biomedical engineering problem. A completely specified solution at the level of preliminary or final design is required, including assessment of socio-economic and environmental impact. This is a small group design that requires reports and a poster presentation to a professional standard. Ethics and legal case studies relevant to professional engineering practice are presented during the lectures. Only students currently registered in ENGG*4000 will be permitted to select this course.

Pre-Requisites: 19.75 credits towards the BENG BME major, all 1000 and 2000 level core courses, ENGG*4000.

Restrictions: Registration in the BENG program. A maximum semester credit load of 3.25 credits. Students must have a minimum cumulative average of 60% or higher in ALL ENGG courses. Restriction waiver requests are handled by the Director, School of Engineering, or designate.

1.2 Course Description

This is the capstone design course for the Engineering program. Teams of normally 3-4 students apply engineering analysis and design principles to an engineering problem in their discipline. A completely specified solution at the level of preliminary or final design is required, including assessment of socio-economic and environmental impact. This is a small group design that requires reports and a poster presentation to a professional standard. Ethics and legal case studies relevant to professional engineering practice are presented during the lectures.

1.3 Timetable

Lecture: Monday from 7:00 p.m. to 8:50 p.m. MACS 129

Poster Presentation: Engineering Design Day - Tuesday, Nov. 28, 2023

1.4 Final Exam

Friday, Dec 15, 2023 0830hr - 1030hr

Location to be determined

Students must bring their portable electronic devices (e.g., laptop computer) to write the exam.

2 Instructional Support

2.1 Instructional Support Team

| | |
|----------------------|---------------------------|
| Instructor: | John Donald Ph.D., P.Eng. |
| Email: | jrdonald@uoguelph.ca |
| Office: | THRN 2503 |
| Office Hours: | By Appointment |

2.2 Teaching Assistants

| | |
|----------------------------------|---------------------|
| Teaching Assistant (GTA): | Zeyad Ghulam |
| Email: | zghulam@uoguelph.ca |
| Office Hours: | N/A |

3 Learning Resources

3.1 Required Resources

Course Website (Website)

<https://courselink.uoguelph.ca>

Course material, news, announcements, and grades will be posted to the **ENGG*41X0** CourseLink site. You are responsible for checking the site regularly. As per University regulations, all students are required to check their <mail.uoguelph.ca> e-mail account regularly; e-mail is the official route of communication between the University and

students.

SOE Capstone Website (Website)

Students must complete all the required information on the SOE Capstone website. The website will be used for various purposes including but not limited to building project teams, selecting projects and faculty advisors, and submitting information for the Engineering Design Day.

Law for Professional Engineers (Textbook)

Marston, D.L. *Law for Professional Engineers (2019 - Fifth Edition)*. McGraw-Hill Ryerson. Toronto. ISBN 978-1-260-13590-9

Canadian Professional Engineering and Geoscience (Textbook)

Andrews, G.C., Shaw, P. and McPhee, J. (2019) *Canadian Professional Engineering and Geoscience, Practice and Ethics (Sixth Edition)*, Top Hat, ISBN 13: 978-0-17-676467-8 or ISBN for the digital textbook:9781774126059

3.2 Recommended Resources

Practical Law of Architecture, Engineering and Geoscience (Textbook)

Samuels, B. M and Sanders, D. R. (2011) *Practical Law of Architecture, Engineering and Geoscience*, Pearson, ISBN 978-0-13-700408-9

3.3 Additional Resources

Other Resources (Other)

Lecture: Notes will be provided on Courselink.

Memos: Download requirements according to the schedule given in Course Outline and posted on Courselink.

Assignments: Download requirements according to the schedule given in Course Outline and posted on Courselink.

Projects: Download the requirements according to the schedule given in Course Outline and posted on Courselink.

School: Students are encouraged to design and build components or prototypes of devices if appropriate. Facilities of the School machine shop, access to all undergraduate laboratories and associated instruments and equipment are available subject to approval. The need for, and costs of, materials, special services or use of other facilities should be foreseen. Small grants may be available to purchase materials or components which are essential to the project but cannot be sourced within the School. These requests are normally made to the ENGSOC Lab Fund. Please follow instructions for timeline. The funds available depend upon ENGSOC rules and procedures and are not guaranteed.

4 Learning Outcomes

The goal is to prepare students to deal with open-ended, multi-faceted design problems similar to those that they will encounter as working professionals.

4.1 Course Learning Outcomes

By the end of this course, you should be able to:

1. Apply academic knowledge to work on a complex engineering problem identified in ENGG*4000.
2. Collect and analyze information and synthesize solutions taking into account significant technological, commercial, social and environmental factors.
3. Apply design principles to a complex engineering problem.
4. Summarize and communicate the design solution, including project management, economic, social, and environmental factors.
5. Exhibit effective teamwork and leadership skills at all stages of the project
6. Explain the responsibilities of engineers to society and demonstrate the expectations in professional practice through class discussions, report submission and the final exam.
7. Demonstrate life long learning values consistent with what is expected of a Professional Engineer

4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

| # | Outcome | Learning Outcome |
|-----|---|------------------|
| 1 | Knowledge Base | 1 |
| 1.1 | Recall, describe and apply fundamental mathematical principles and concepts | 1 |
| 1.2 | Recall, describe and apply fundamental principles and concepts in natural science | 1 |
| 1.3 | Recall, describe and apply fundamental engineering principles and concepts | 1 |
| 1.4 | Recall, describe and apply program-specific engineering principles and concepts | 1 |
| 2 | Problem Analysis | 1, 2 |
| 2.1 | Formulate a problem statement in engineering and non-engineering terminology | 1, 2 |
| 2.2 | Identify, organize and justify appropriate information, including assumptions | 1, 2 |

| # | Outcome | Learning Outcome |
|-----|--|------------------|
| 2.3 | Construct a conceptual framework and select an appropriate solution approach | 1, 2 |
| 2.4 | Execute an engineering solution | 1, 2 |
| 2.5 | Critique and appraise solution approach and results | 1, 2 |
| 3 | Investigation | 1, 2 |
| 3.1 | Propose a working hypothesis | 1, 2 |
| 3.2 | Design and apply an experimental plan/investigative approach (for example, to characterize, test or troubleshoot a system) | 1, 2 |
| 3.3 | Analyze and interpret experimental data | 1, 2 |
| 3.4 | Assess validity of conclusions within limitations of data and methodologies | 1, 2 |
| 4 | Design | 3 |
| 4.1 | Describe design process used to develop design solution | 3 |
| 4.2 | Construct design-specific problem statements including the definition of criteria and constraints | 3 |
| 4.3 | Create a variety of engineering design solutions | 3 |
| 4.4 | Evaluate alternative design solutions based on problem definition | 3 |
| 4.5 | Develop and refine an engineering design solution, through techniques such as iteration, simulation and/or prototyping | 3 |
| 5 | Use of Engineering Tools | 1, 2 |
| 5.1 | Select appropriate engineering tools from various alternatives | 1, 2 |
| 5.2 | Demonstrate proficiency in the application of selected engineering tools | 1, 2 |
| 5.3 | Recognize limitations of selected engineering tools | 1, 2 |
| 6 | Individual & Teamwork | 5 |
| 6.1 | Describe principles of team dynamics and leadership | 5 |
| 6.2 | Understand all members' roles and responsibilities within a team | 5 |
| 6.3 | Execute and adapt individual role to promote team success through, for example, timeliness, respect, positive attitude | 5 |
| 6.4 | Apply strategies to mitigate and/or resolve conflicts | 5 |

| # | Outcome | Learning Outcome |
|-----|---|------------------|
| 6.5 | Demonstrate leadership through, for example, influencing team vision and process, promoting a positive team culture, and inspiring team members to excel | 5 |
| 7 | Communication Skills | 4 |
| 7.1 | Identify key message(s) and intended audience in verbal or written communication as both sender and receiver | 4 |
| 7.2 | Interpret technical documentation such as device specification sheets, drawings, diagrams, flowcharts, and pseudocode | 4 |
| 7.3 | Construct the finished elements using accepted norms in English, graphical standards, and engineering conventions, as appropriate for the message and audience | 4 |
| 7.4 | Substantiate claims by building evidence-based arguments and integrating effective figures, tables, equations, and/or references | 4 |
| 7.5 | Demonstrate ability to process oral and written communication by following instructions, actively listening, incorporating feedback, and formulating meaningful questions | 4 |
| 8 | Professionalism | 5, 6 |
| 8.1 | Demonstrate an understanding of what it means to be a professional engineer and distinguish between legislated and non-legislated professions | 6 |
| 8.2 | Effectively describe engineering law and its impact on professional engineering practice | 6 |
| 8.3 | Demonstrate professional behaviour | 5, 6 |
| 9 | Impact of Engineering on Society and the Environment | 2, 4 |
| 9.1 | Analyze the safety, social, environmental, and legal aspects of engineering activity | 2, 4 |
| 9.2 | Evaluate the uncertainties and risks associated with engineering activities | 4 |
| 9.3 | Anticipate the positive and negative impacts of introducing innovative technologies to solve engineering problems | 4 |
| 10 | Ethics & Equity | 6 |

| # | Outcome | Learning Outcome |
|------|--|------------------|
| 10.1 | Summarize ethical theories and equity, diversity, and inclusivity principles | 6 |
| 10.2 | Determine an ethical course of action by applying ethical theories and the PEO Code of Ethics | 6 |
| 10.3 | Demonstrate values consistent with good ethical practice, including equity, diversity, and inclusivity | 6 |
| 11 | Economics and Project Management | 4 |
| 11.1 | Apply project management techniques and manage resources within identified constraints | 4 |
| 11.2 | Identify risk and change management techniques, in the context of effective project management | 4 |
| 11.3 | Estimate economic impact and feasibility of an engineering project or design using techniques such as cost benefit analysis over the life of the project or design | 4 |
| 12 | Life Long Learning | 7 |
| 12.1 | Identify personal career goals and opportunities for professional development | 7 |
| 12.2 | Self-assess skills relative to career goals and SOE defined learning outcomes | 7 |
| 12.3 | Demonstrate capability for continuous knowledge and skill development in a changing world | 7 |

5 Teaching and Learning Activities

Course Format

Classes are scheduled for each week on Monday. In addition to classroom time, where active learning is being promoted, it is expected that each team member will spend an average of 15 to 20 h per week on the design project over the semester, as this course is equivalent to two regular senior engineering science courses.

Students work in teams of three or four persons. Smaller (or larger) groups are only considered by the course instructor under extraordinary circumstances, and approval is

conditional on availability of sufficient resources. Inter-disciplinary groups are encouraged if a particular problem has sufficient scope to provide appropriate experience to all team members. ***It is expected that the selection of the team, the project and the faculty advisor was arranged during ENGG*4000.***

Teams are encouraged to use the design studios scattered throughout the Engineering Complex. Access to these rooms can be facilitated through the faculty advisor.

Each team is advised by a School faculty member responsible for helping to delineate the terms of reference for the project, providing guidance where necessary, and evaluating all written reports. The projects are self-administered: each team must carry out planning and execution of the project on its own. Accordingly, team members are required to keep a log book on the activities each individual completes. ***Team members and their faculty advisor should discuss and record concerns about the group's progress at the interim report stage and take appropriate action.*** The respective log books will be reviewed in deciding the appropriate action.

The following is a planned series of lectures, which is subject to change.

5.1 Lecture

| | |
|----------------|---|
| Topics: | Intellectual property |
| Topics: | History of the profession - Iron Ring, Quebec Bridge, Self Regulation, the Seal |
| Topics: | Engineering Code of Ethics and definitions of Professional Misconduct |
| Topics: | Key issues in Engineering Ethics - Whistleblowing and Conflict of Interest |
| Topics: | Introduction to Canadian Law - Common Law, the Constitution, and the Charter |
| Topics: | Introduction to Tort Law - Unintentional Tort, Negligence, and Duty of Care |
| Topics: | Tort - Professional duty of care, Duty to warn |

Topics: Introduction to Contract law - Five elements, Contract A&B

Topics: Contract interpretation

Topics: Completing Contracts -Rescinding, Discharge, and Breach

Topics: Equity and Diversity

5.2 Other Important Dates

Please see the University of Guelph schedule of important dates:

<https://calendar.uoguelph.ca/undergraduate-calendar/>

6 Assessments

6.1 Assessment Details

Proposal Summary Memo (0%)

Due: Mon, Sep 18, 5:00 PM

Learning Outcome: 4, 5, 7

Summarize the details of your Engineering Design Project proposal, with a focus on the preliminary design process and the expected roles of each of the members in your group. Must be submitted before the deadline and achieve a passing grade. If passing grade is not achieved an INC will be given for the course.

Assignment 1: Intellectual Property (2.5%)

Due: Fri, Sep 29, 5:00 PM, CourseLink

Learning Outcome: 7

Structured Reflection on Intellectual Property - Individual

Assignment 2: The Profession (2.5%)

Due: Fri, Oct 13, 5:00 PM, CourseLink

Learning Outcome: 7

Structured Reflection on the Engineering Profession - Individual

Interim Report (18%)

Due: Fri, Oct 20, 5:00 PM, CourseLink

Learning Outcome: 1, 2, 3, 4, 5, 6

Design report summarizing what has been completed to date on your design project and identification of the progress toward your final design.

Interim Report Summary Memo (0%)**Due:** Fri, Oct 20, 5:00 PM, CourseLink**Learning Outcome:** 4, 5, 7

Summary of the progress you have made on your project through the Interim Report submission, an update on the on the management of the project, the progression of the roles of each team member and the state of your teamwork. Must be submitted before the deadline and achieve a passing grade. If passing grade is not achieved an INC will be given for the course.

Assignment 3: Ethics and Social Justice (2.5%)**Due:** Fri, Nov 3, 5:00 PM, CourseLink**Learning Outcome:** 7

Structured reflection on your ethical and social justice beliefs. Individual.

Assignment 4: Law (2.5%)**Due:** Fri, Nov 17, 5:00 PM, CourseLink**Learning Outcome:** 7

Structured reflection related to Law in the engineering context. Individual

Poster Presentation (10%)**Date:** Tue, Nov 28, Engineering Design Day**Learning Outcome:** 4, 5

Each team creates a poster and presents their work to members of the faculty, the University community and local engineers. The poster is also submitted to Courselink and the SOE Capstone website.

Attendance at the poster presentation is mandatory for the entire time for every group member.

Final Report (40%)**Due:** Fri, Dec 1, 5:00 PM, CourseLink**Learning Outcome:** 1, 2, 3, 4, 4, 5, 6, 7

Engineering Design Report summarizing the final project design solution.

Final Report Summary Memo (2%)**Due:** Fri, Dec 1, 5:00 PM, CourseLink**Learning Outcome:** 2, 4, 5, 6, 7

Outline the details of your final design, recommendations for improvement, and reflection on your team development over the project.

Exit Survey (0%)**Date:** Fri, Dec 1, 5:00 PM, Qualtrics Survey

A component of Life-Long Learning Graduate Attribute assessment is the School's Exit Survey. This Exit Survey provides valuable insight into student development and expectations as they enter the workforce. **Information provided to the School through the Exit Survey is confidential. Failure to complete the Exit Survey by the stated deadline will result in a zero (0) grade for the course.**

Exam (20%)

Date: Fri, Dec 15, 8:30 AM - 10:30 AM

Learning Outcome: 6

Two-hour duration. CourseLink to be used for the exam. Students must bring their own portable electronic devices (e.g., laptop computer) to write the exam.

Students not achieving 50% on the Final Exam will have their Final Grade calculated according to the following modified distribution:

1. Interim Report 10%
2. Final Report 25%
3. Final Report Memo 2%
4. Poster 5%
5. Assignments 8%
6. Final Exam 50%

7 Course Statements

7.1 Course Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. See the undergraduate calendar for information on regulations and procedures for Academic Consideration: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor at the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations: <http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml>

Passing grade: In order to pass the course, students must obtain an overall grade of 50% or higher on the aggregate of all the course work outlined in Section 6 Assessment. Please note the alternate grading scheme outlined in Section 6 in the event that a student fails the exams.

Late Reports: There will be no extension of the deadlines for submissions, except for serious health or compassionate reasons, with the appropriate documentation. Just like the consulting world where projects are not awarded if the proposals are late, a grade of zero will be given for late submissions.

Certification: Students must confirm on their submissions that the SOE Code of Ethics was adhered to. For group projects, students must also state that they contributed to the group effort in an equitable manner.

Logbook: Each student should keep a logbook detailing the activities performed that are related to the course. It should include record of all group and individual activities, lecture notes, meeting minutes, work distribution, design notes, calculations, planning, decisions, sketches and all relevant information. The logbook should be signed off by other members of the group on a regular basis. The logbook may be reviewed by the course coordinator, faculty advisor and TA from time to time.

7.2 Course Specific Lab and Machine Shop Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. ENGG*41X0 does not have a laboratory component for the lecture portion for the course. However, for the project component, some student teams may be in the shop and or in the lab to build and test their prototype or final design. When in the shop and the lab, students must adhere to the applicable safety requirements and regulations. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

7.3 Photo, Video, Media Consent

Photos and videos will be taken throughout the semester for the purpose of communicating to the public about the engineering program at UofG. These pictures and videos may include project descriptions, poster presentations and showcasing of prototypes on Engineering Design Day.

Please follow the link to the university's website to download the consent form:

<https://news.uoguelph.ca/guides/brand-guide/imagery/copyright-and-consent/>

The completed consent form should be submitted individually to the CourseLink dropbox.

8 School of Engineering Statements

8.1 Instructor's Role and Responsibility to Students

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on CourseLink but these are not intended to be stand-alone course notes. Some written lecture notes will be presented only in class. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and labs.

8.2 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during

lectures and lab sessions. Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

8.3 Lab Safety

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

9 University Statements

9.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

9.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars.

Undergraduate Calendar - Academic Consideration and Appeals

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml>

Graduate Calendar - Grounds for Academic Consideration

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

Associate Diploma Calendar - Academic Consideration, Appeals and Petitions

<https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml>

9.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.

Undergraduate Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml>

Graduate Calendar - Registration Changes

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml>

Associate Diploma Calendar - Dropping Courses

<https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml>

9.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

9.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student.

When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway.

Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not constitute a disability.

Use of the SAS Exam Centre requires students to make a booking at least 14 days in advance, and no later than November 1 (fall), March 1 (winter) or July 1 (summer). Similarly, new or changed accommodations for online quizzes, tests and exams must be approved at least a week ahead of time.

For Guelph students, information can be found on the SAS website
<https://www.uoguelph.ca/sas>

For Ridgetown students, information can be found on the Ridgetown SAS website
<https://www.ridgetownc.com/services/accessibilityservices.cfm>

9.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community—faculty, staff, and students—to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse

students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

Undergraduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml>

Graduate Calendar - Academic Misconduct

<https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml>

9.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

9.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars

<https://www.uoguelph.ca/academics/calendars>

9.9 Illness

Medical notes will not normally be required for singular instances of academic consideration, although students may be required to provide supporting documentation for multiple missed assessments or when involving a large part of a course (e.g.. final exam or major assignment).
