# ENGG*4400 Biomechanical Engineering Design

01

Winter 2022
Section(s): C01

School of Engineering
Credit Weight: 0.75
Version 1.00 - January 12, 2022

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# 1 Course Details

## 1.1 Calendar Description

This course covers concept development, design, modeling, manufacture and testing of biomechanical devices including athletic equipment, assistive devices, medical implants and tools. Other topics include the biomechanical factors influencing design, regulatory issues, current development trends, and the possible future direction of design and technology.

**Pre-Requisites:** 6.00 ENGG credits including ENGG*3150, ENGG*3170

## 1.2 Course Description

This course covers concept development, design, modeling, manufacture and testing of biomechanical devices including athletic equipment, assistive devices, medical implants and tools. Other topics include the biomechanical factors influencing design, regulatory issues, current development trends, and the possible future direction of design and technology.

## 1.3 Timetable

**LECTURES: Tuesday and Thursday -- 8:30 AM - 9:50 AM -- Synchronous**

- Week 1 until face-to-face resumes: **Virtual via Zoom** (see CourseLink for details)
  - Zoom lecture recordings will be accessible via CourseLink in case of technical difficulties
- Once (if) face-to-face resumes: **CRSC 116**

**LABS: Synchronous**

- Week 1 until face-to-face resumes: **Virtual via Zoom** (see CourseLink for details)
  - Zoom lab recordings will be accessible via CourseLink in case of technical difficulties
- Once (if) face-to-face resumes: **THRN 2135**

Lab times are as follows:

| | | |
|---|---|---|
| *0101 | Tuesday | 3:30 PM - 5:20 PM |
| *0102 | Tuesday | 12:30 PM - 2:20 PM |
| *0103 | Wednesday | 11:30 AM - 1:20 PM |
| *0104 | Wednesday | 2:30 PM - 4:20 PM |
| *0105 | Monday | 8:30 AM - 10:20 AM |

Although Zoom recordings will be made available for every virtual lecture or lab, synchronous attendance is expected. Students are responsible for all information presented, and student participation is highly encouraged. There will be certain lab periods where guests and material will be made available for assignments and/or the design project. This material and the guests may only be available on a limited basis. It is the responsibility of the students to ensure they are present during these times.

### 1.4 Final Exam

Location: TBA Saturday April 23, 11:30 AM - 1:30 PM

The examination will be in-person by default. If necessary, the exam will pivot to a Zoom-invigilated examination that may involve written (then scanned and submitted) and/or online (e.g. CourseLink quiz) components.

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# 2 Instructional Support

## 2.1 Instructional Support Team

**Instructor:** Scott Brandon PhD, P.ENG
**Email:** bscott10@uoguelph.ca
**Telephone:** +1-519-824-4120 x52875
**Office:** THRN 2415
**Office Hours:** By appointment

## 2.2 Teaching Assistants

**Teaching Assistant (GTA):** Rebecca Wendland
**Email:** rwendlan@uoguelph.ca
**Office Hours:** During scheduled lab sessions and by appointment.

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|---|---|
| **Teaching Assistant (GTA):** | Seif Ali |
| **Email:** | seif@uoguelph.ca |
| **Office Hours:** | During scheduled lab sessions and by appointment |

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# 3 Learning Resources

## 3.1 Required Resources

**Course Website (Website)**

http://courselink.uoguelph.ca

Material relevant to the course including news, announcements, and grades will be regularly posted to the ENGG*4400 Courselink site. You are responsible for checking the site regularly.

## 3.2 Additional Resources

**Lecture Information (Notes)**

Lecture notes will be posted on the course website. However, assignments and examinations will also cover additional content that is discussed and presented during lectures.

**Lab Information (Lab Manual)**

Laboratory instructions will be posted on CourseLink. The Teaching Assistant will be available in lab periods to direct activities and answer questions. The Teaching Assistant will provide resources regarding tutorials and links to related web pages.

## 3.3 Communication & Email Policy

Please use lectures and lab help sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website. **It is your responsibility to check the course website regularly.**

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# 4 Learning Outcomes

## 4.1 Course Learning Outcomes

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

1. Identify common biomechanical device problems
2. Understand the regulatory framework for biomedical devices
3. Specify suitable materials for biomechanical devices, and identify appropriate manufacturing strategies
4. Apply engineering principles to the development of novel biomechanical designs
5. Design and manage the development of biomedical devices

6. Demonstrate familiarity with various career paths within the biomechanical engineering field

## 4.2 Engineers Canada - Graduate Attributes (2018)

Successfully completing this course will contribute to the following:

| # | Outcome | Learning Outcome |
|---|---|---|
| 1 | Knowledge Base | 1, 2, 3, 4 |
| 1.4 | Recall, describe and apply program-specific engineering principles and concepts | 1, 2, 3, 4 |
| 4 | Design | 4, 5 |
| 4.1 | Describe design process used to develop design solution | 4, 5 |
| 4.2 | Construct design-specific problem statements including the definition of criteria and constraints | 4, 5 |
| 4.3 | Create a variety of engineering design solutions | 4, 5 |
| 5 | Use of Engineering Tools | 4, 5 |
| 5.2 | Demonstrate proficiency in the application of selected engineering tools | 4, 5 |
| 8 | Professionalism | 5 |
| 8.3 | Demonstrate professional behaviour | 5 |
| 11 | Economics and Project Management | 2, 4 |
| 11.2 | Identify risk and change management techniques, in the context of effective project management | 2, 4 |
| 12 | Life Long Learning | 6 |
| 12.1 | Identify personal career goals and opportunities for professional development | 6 |
| 12.2 | Self-assess skills relative to career goals and SOE defined learning outcomes | 6 |

# 5 Teaching and Learning Activities

## 5.1 Lecture

**Topics:** Tentative Lecture Schedule (Subject to change at the discretion of the instructor)

| Week (Start Date) | Lecture Topics |
|---|---|
| 1 (Jan 10) | Course Introduction<br><br>Biomedical Industry & Regulation |
| 2 (Jan 17) | Biomedical Industry & Regulation<br><br>Client Based Design: Project Introduction |
| 3 (Jan 24) | Client Based Design: Stakeholders, Standards<br><br>Engineering Design Process: Sketching, Drawing, Dimensioning, Tolerancing |
| 4 (January 31) | Engineering Design: Problem Definition, Concept Generation & Evaluation<br><br>BioMechanics in Design: Constraints, Criteria, Verification, Validation |
| 5 (Feb 7) | Guest Lecture<br><br>Engineering Design: Concept Refinement |
| 6 (Feb 14) | Biomechanical Data: Force & Motion<br><br>Biomechanical Data: Imaging |
| | WINTER BREAK |

| | |
|---|---|
| 7 (Feb 28) | Orthopaedic Case Studies: External Devices<br><br>Guest Lecture |
| 8 (Mar 7) | Orthopaedic Case Studies: Knee Arthoplasty<br><br>Guest Lecture |
| 9 (Mar 14) | Guest Lecture<br><br>Orthopaedic Case Studies: Hip Arthoplasty |
| 10 (Mar 21) | Orthopaedic Case Studies: Surgery & Surgical Tools<br><br>Report Writing |
| 11 (Mar 28) | Case Studies: Fracture fixation; heart valves<br><br>Student Presentations |
| 12 (Apr 4) | Student Presentations<br><br>Course Review |

## 5.2 Lab Schedule

| Week (Start Date) | Lab Activity | Mandatory? |
|---|---|---|
| 1 (Jan 10) | - | - |
| 2 (Jan 17) | Lab Data Distribution, Instruction | Yes |
| 3 (Jan 24) | Lab & Project Coaching | Yes |

| | | |
|---|---|---|
| 4 (Jan 31) | Lab & Project Coaching | No |
| 5 (Feb 7) | Project Coaching, Data Collection | No |
| 6 (Feb 14) | Design Review Meeting | Yes |
| | WINTER BREAK | |
| 7 (Feb 28) | Project Coaching, Data Collection | Yes |
| 8 (Mar 7) | Project Coaching, Data Collection | Yes |
| 9 (Mar 14) | Resume Coaching | Yes |
| 10 (Mar 21) | Project Coaching, Data Collection | Yes |
| 11 (Mar 28) | ---------- | - |
| 12 (Apr 4) | ---------- | - |

# 6 Assessments

## 6.1 Marking Schemes & Distributions

| Name | Scheme A (%) |
|---|---|
| Group Signup | 0 |
| Project: Letter of Introduction (Group) | 5 |
| Assignment 1 - CAD (Individual) | 5 |
| Lab Report (Group) | 10 |
| Project: Proposal Report (Group) | 10 |
| Project: Design Review | 5 |
| Assignment 2: Client Management Letter | 5 |

| Name | Scheme A (%) |
|---|---|
| Assignment 3: Resume | 5 |
| Project: Final Presentation (Group) | 15 |
| Project: Final Report (Group) | 15 |
| Final Exam | 25 |
| Total | 100 |

## 6.2 Assessment Details

**Group Signup (0%)**
**Date:** Week 1
Sign up for your Lab and Design Project Group in CourseLink

**Project: Letter of Introduction (Group) (5%)**
**Date:** Week 3
**Learning Outcome:** 5

**Assignment 1 - CAD (Individual) (5%)**
**Due:** Week 4
**Learning Outcome:** 4, 5

**Lab Report (Group) (10%)**
**Due:** Week 5
**Learning Outcome:** 1, 3, 4

**Project: Proposal Report (Group) (10%)**
**Due:** Week 6
**Learning Outcome:** 1, 2, 3, 4, 5

**Project: Design Review (5%)**
**Date:** Week 6, In Lab
**Learning Outcome:** 1, 2, 3, 4, 5
Briefly meet with your GTA or Instructor to discuss your design proposal report.

**Assignment 2: Client Management Letter (5%)**
**Due:** Week 8
**Learning Outcome:** 5

**Assignment 3: Resume (5%)**
**Due:** Week 9
**Learning Outcome:** 6
Resumés will be graded based on completion of the assignment (1%, Week 9), completion of assigned peer reviews (1%, Week 10), and peer-assessed quality of your reviews (3%, week 11).

**Project: Final Presentation (Group) (15%)**
**Due:** Week 11
**Learning Outcome:** 4, 5

**Project: Final Report (Group) (15%)**
**Due:** Week 12
**Learning Outcome:** 1, 2, 3, 4, 5

**Final Exam (25%)**
**Date:** , TBA on WebAdvisor
**Learning Outcome:** 1, 2, 3, 4, 5

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# 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 within two weeks of 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**: The passing grade for this course is 50%.

**Late Submission Penalties:**

- 10% penalty if the assignment is less than 1 hour late (as denoted by Courselink).
- 40% penalty if the assignment is between 1 hour and 24 hours late.
- 80% penalty if the assignment is between 24 and 48 hours late
- 100% penalty (i.e., zero) if the assignment is more than 48 hours late.

**The Design Project:** This project forms a major activity in the course. Teams will be asked to evaluate individual team member participation. Evidence of lack of participation by individuals will result in a modified grade assessment for those students at the instructor's discretion.

**Final Exam:** The Final Exam will be used to assess your understanding of the lecture material. The Final Exam will be closed book with no electronic aids permitted.

# 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 Disclaimer

Please note that the ongoing COVID-19 pandemic may necessitate a revision of the format of course offerings, changes in classroom protocols, and academic schedules. Any such changes will be announced via CourseLink and/or class email.

This includes on-campus scheduling during the semester, mid-terms and final examination schedules. All University-wide decisions will be posted on the COVID-19 website

(https://news.uoguelph.ca/2019-novel-coronavirus-information/) and circulated by email.

## 9.10 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).

## 9.11 Covid-19 Safety Protocols

For information on current safety protocols, follow these links:

- https://news.uoguelph.ca/return-to-campuses/how-u-of-g-is-preparing-for-your-safe-return/
- https://news.uoguelph.ca/return-to-campuses/spaces/#ClassroomSpaces

Please note, these guidelines may be updated as required in response to evolving University, Public Health or government directives.

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