ENGG*4400 Biomechanical Engineering Design

Winter 2019
Section(s): C01

School of Engineering
Credit Weight: 0.75
Version 1.00 - January 05, 2019

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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-Requisite(s): 6.00 ENGG credits including ENGG*3150, ENGG*3170

1.2 Timetable

LECTURES: MCKN 117 Tuesday & Thursday 11:30 AM -12:50 PM

LABS: THRN 2135

Lab times are as follows:

01	Tuesday	9:30 - 11:20 AM
02	Monday	2:30 - 4:20 PM
03	Thursday	1:00 - 2:50 PM
04	Tuesday	2:30 - 4:20 PM
05	Monday	10:30 - 12:20 PM

Attendance is expected for all lectures and for your assigned lab sections. Students are responsible for all information presented in the class and labs 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.

1.3 Final Exam

Location: TBA Tuesday April 16, 11:30 AM - 1:30 PM

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2 Instructional Support

2.1 Instructional Support Team

Instructor: Scott Brandon
Email: scott.brandon@uoguelph.ca
Telephone: +1-519-824-4120 x52875
Office: THRN 2415
Office Hours: By appointment

Lab Technician: Ahmed Mezil
Email: amezil@uoguelph.ca
Telephone: +1-519-824-4120 x53729
Office: THRN 2308
Office Hours: During scheduled lab sessions and by appointment.

2.2 Teaching Assistant(s)

Teaching Assistant: Samuel Salemi
Email: ssalemi@uoguelph.ca
Office Hours: During scheduled lab sessions and by appointment.

Teaching Assistant: Jessica Oreskovic
Email: joreskov@uoguelph.ca
Office Hours: During scheduled lab sessions and by appointment.

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3 Learning Resources

3.1 Required Resource(s)

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 Resource(s)

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 Assistants and Lab Technician 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(s)
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

#	Outcome	Learning Outcome(s)
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

5 Teaching and Learning Activities

5.1 Lecture

Topic(s): Tentative Lecture Schedule (Subject to change at the discretion of the instructor)

Week (Start Date)	Lecture Topics	Assessment
1 (Jan 7)	Course Introduction Client-Based Design • Project Introduction; Ethics & Consent	
2 (Jan 14)	Intellectual Property	Assignment 1: Skills Inventory

	• IP, Work Product, Invention Disclosure, Contracts and agreements Medical Device Industry • Overview; Regulation	
3 (Jan 21)	Medical Device Industry • Standards and Quality Control • Writing a professional letter Engineering Design Process • Sketching, Drawing, Dimensioning, Tolerancing	Project: Letter of Introduction
4 (Jan 28)	Engineering Design Process • Concept Generation – Morphological Analysis, Functional Decomposition • Engineering Requirements - Quality Function Deployment; Design for Manufacturability, Assembly; Failure Modes and Effects Analysis	Assignment 2 - Sketch
5 (Feb 4)	Biomechanical Data Sources • Anthropometry; Motion analysis • Internal loads, EMG, V02, Thermal, Pressure, etc.	Assignment 3 - CAD
6 (Feb 11)	Biomechanical Data Sources • Medical Imaging (XRay, CT, MRI,	Lab Report

	Ultrasound) Biomechanical Analysis • Determining Constraints and Criteria	
7 (Feb 18)	WINTER BREAK	
8 (Feb 25)	External Devices • Rehabilitation Robotics, Exoskeletons • Braces, Energy Harvesters	
9 (Mar 4)	Guest Panel: Jobs in the Biomedical Industry Internal Devices • Total Knee Arthroplasty	Project: Proposal Report
10 (Mar 11)	Internal Devices: • Total Hip Arthroplasty and Resurfacing	Assignment 4 – Client Management Letter
11 (Mar 18)	Internal Devices • Fixation; Heart valves Biomedical Device Ethics	Assignment 5 - Resume
12 (Mar 25)	Guest Lectures (TBD)	

13 (Apr 1)	Final Presentations	Presentations; Final Report

5.2 Lab Schedule

Week (Start Date)	Lab Activity	Mandatory?
1 (Jan 7)	----------	-
2 (Jan 14)	Lab Safety Orientation; Motion Capture Refresher	Yes
3 (Jan 21)	Lab Challenge Assignment; Report Guidelines; Introduction to Reference Managing Software	Yes
4 (Jan 28)	Lab Data Collection	Week 4 OR 5
5 (Feb 4)	Lab Data Collection	Week 4 OR 5
6 (Feb 11)	Lab Coaching	No
7 (Feb 18)	WINTER BREAK	
8 (Feb 25)	Project Coaching	Yes
9 (Mar 4)	Project Coaching	Yes
10 (Mar 11)	Resume Coaching	Yes
11 (Mar 18)	Project Coaching	Yes
12 (Mar 25)	----------	-

13 (Apr 1)	----------	-

6 Assessments

6.1 Marking Schemes & Distributions

Name	Scheme A (%)
Assignment 1: Skills Inventory (Individual)	5
Project: Letter of Introduction (Group)	5
Assignment 2: Concept Sketch (Individual)	5
Assignment 3 - CAD (Individual)	5
Lab Report (Group)	10
Project: Proposal Report (Group)	10
Assignment 4: Client Management Letter	5
Assignment 5: Resume	5
Project: Final Presentation (Group)	10
Project: Final Report (Group)	15
Final Exam	25
Total	100

6.2 Assessment Details

Assignment 1: Skills Inventory (Individual) (5%)
Due: Week 2
Learning Outcome(s): 6

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

Assignment 2: Concept Sketch (Individual) (5%)
Due: Week 4
Learning Outcome(s): 4,5

Assignment 3 - CAD (Individual) (5%)
Due: Week 5
Learning Outcome(s): 4,5

Lab Report (Group) (10%)

Due: Week 6
Learning Outcome(s): 1,3,4

Project: Proposal Report (Group) (10%)
Due: Week 9
Learning Outcome(s): 1,2,3,4,5

Assignment 4: Client Management Letter (5%)
Due: Week 10
Learning Outcome(s): 5

Assignment 5: Resume (5%)
Due: Week 11
Learning Outcome(s): 6

Project: Final Presentation (Group) (10%)
Due: Week 13
Learning Outcome(s): 4,5

Project: Final Report (Group) (15%)
Due: Week 13
Learning Outcome(s): 1,2,3,4,5

Final Exam (25%)
Date: Tue, Apr 16, 11:30 AM - 1:30 PM, TBA on WebAdvisor
Learning Outcome(s): 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: In order to pass the course, your overall course average must be 50% or above AND your Final Exam grade must be 50% or above. A gradeof below 50% in the Final Exam will result in that grade being assigned for the entire course.

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.

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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.

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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

9.3 Drop Date

Courses that are one semester long must be dropped by the end of the fortieth class day; two-semester courses must be dropped by the last day of the add period in the second semester. The regulations and procedures for course registration are available in the Undergraduate and Graduate 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

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 book their exams at least 7 days in advance and not later than the 40th Class Day.

More information can be found on the SAS website
https://www.uoguelph.ca/sas

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