



**ENGG\*4220: Interdisciplinary Mechanical Engineering Design**  
**Winter 2024**  
**School of Engineering**  
 Credit Weight: 0.5  
 (January 7<sup>th</sup>, 2024)

## 1. Course Details

### 1.1 Calendar Description

This is a general design course for students registered in the B. Eng. major in mechanical engineering who wish to develop a broad based mechanical engineering foundation. Students work in groups to develop a general mechanical engineering design. Special attention is paid to the sustainability of the design, its economic feasibility and overall efficiency.

Prerequisite: ENGG\*3100

### 1.2 Timetable

#### Lectures:

Sec. #	Day	Time	Location	Instructor
1, 2	Mon, Fri	2:30 – 3:50 PM	MCKN 311	Dr. Elsharqawy

Some lectures will be online on Teams

#### Labs:

Sec. #	Day	Time	Location	TA
1	Wednesday	8:30 – 11:20 AM	MCKN 311	Amin Latifi Vanjani

### 1.3 Final Exam

There is no final exam for this course.

## 2. Instructional Support

### 2.1 Instructor

Instructor: Mostafa Elsharqawy, PhD, P.Eng.  
 Office: RICH 3513  
 Email: [melsharq@uoguelph.ca](mailto:melsharq@uoguelph.ca)  
 Office Hours: By appointment

## 2.2 Teaching Assistants (TA)

TA	Email	Office Hours
Amin Latifi Vanjani	<a href="mailto:alatifiv@uoguelph.ca">alatifiv@uoguelph.ca</a>	During Lab/ by appointment

## 3. Learning Resources

### 3.1 Course website

Course material, news, announcements, and grades will be regularly posted to the ENGG\*4220 CourseLink website. You will be granted access to the website when you register for the course. You are responsible for checking the website regularly.

### 3.2 Required Resources

We will use MATLAB, Excel, and EES to solve design problems. These software are available in the school of engineering computer labs.

Tutorials and refresher material are available at:

[http://www.mathworks.com/academia/student\\_center/tutorials/launchpad.html](http://www.mathworks.com/academia/student_center/tutorials/launchpad.html)

It is recommended that students who need a refresher in MATLAB download and refer to the User Guide: [http://www.mathworks.com/help/pdf\\_doc/matlab/getstart.pdf](http://www.mathworks.com/help/pdf_doc/matlab/getstart.pdf).

### 3.3 Recommended Resources

We will utilize a series of textbooks, all of which can be accessed through the University of Guelph library website.

1. Dieter G.E., Schmidt L.C., Engineering Design 4th Ed., McGraw-Hill Inc., 2008
2. Grote, K.H., Antonsson, E.K., Handbook of Mechanical Engineering. Springer, 2009.
3. Shah R.K., Sekulić D.P., Fundamentals of Heat Exchanger Design, John Wiley & Sons, 2007.
4. Duffie and Beckman. Solar Engineering of Thermal Processes, John Wiley & Sons. 2013.
5. Wood, David. Small wind turbines: analysis, design, and application, Springer. 2011.
6. Wagner and Mathur. Introduction to Hydro Energy Systems: Basics, Technology and Operation. Springer, 2011.
7. Kutz, M. (editor). Mechanical Engineers' Handbook: Materials and Mechanical Design, Vol.1, John Wiley & Sons, 2006.
8. Norton, R. L. Machine Design: An Integrated Approach. Prentice Hall. 2011.

### 3.4 Additional Resources

**Lecture Information:** Lecture notes/presentations will be posted on CourseLink throughout the semester.

**Lab Information:** All necessary information for the lab sessions will be posted on CourseLink. Make sure you check the course website for relevant information before each session.

**Assignments:** Download the assignments posted on CourseLink. Check the due date and submit your solution to Dropbox before the due date. Late submission will not be accepted.

**Miscellaneous Information:** Lectures are the main source of material which includes important discussions and worked examples that might not be found elsewhere. Other information related to this course will be posted on CourseLink.

### 3.5 Communication and Email Policy

Please use lectures and labs as your main opportunity to ask questions about the course. Electronic communication should be limited to the **discussion forum on CourseLink**; however, topics of a personal and confidential nature should be emailed to the instructor. Emails related to labs and marks should be **sent to the TA**.

Please note that all email communication must be made through your University of Guelph email account.

## 4. Learning Outcomes

This course will provide students with practical experience in mechanical engineering system modelling and design. Students will apply theory and knowledge to the design of a complex engineered system, which students will build and test.

### 4.1 Learning Objectives

At the successful completion of this course, the student will have demonstrated the ability to:

1. Integrate prior knowledge of mechanics, materials, machine design, control systems, fluid mechanics, heat transfer, thermodynamics and engineering systems to support the design of a complex engineered system.
2. Apply engineering methods to assess the feasibility of proposed design solutions in engineering, financial and social contexts.
3. Design engineered systems to address specific needs.
4. Work as a member of a multidisciplinary design team, able to complete detailed rigorous design of system components, while communicating with the team to ensure those components are optimized within the overall system.
5. Independently identify, integrate and prioritize design criteria in the design of a solution to an identified need.
6. Concisely and articulately communicate the results of an engineering system analysis or design process to an engineering audience.

### 4.2 Engineering Canada – Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Graduate Attribute	Learning objectives	Assessment
1. Knowledge Base for Engineering	1, 2, 4, 5	Exams
2. Problem Analysis	3, 5	Projects, Exams
3. Investigation	3, 4, 5	Projects
4. Design	1, 2, 3, 4, 5, 6	Projects
5. Use of Engineering Tools	1, 2, 3	Projects
6. Communication	6	Projects
7. Individual and Teamwork	3, 4, 5	Projects
8. Professionalism	-	-
9. Impact of Eng. on Society and the Environment	2	Projects
10. Ethics and Equity	-	-
11. Env., Society, Bus., & Project Management	-	-
12. Life-Long Learning	-	-

## 5. Teaching and Learning Activities

### 5.1 Lecture Schedule

Week #	Lecture Topic
1	Intro to Mechanical Engineering Design
2	Conceptual & Detailed Design
3	Dimensional Analysis & Modeling
4	Energetic and Exergetic Analyses
5	Pumping Machinery (project-based)
6	Test 1 / Pumping Machinery cont.
7	Mechanical and Electrical Systems Control (project-based)
8	Turbomachinery (project-based)
9	Thermal Systems (project-based)
10	Measurements, Instrumentations, and Testing
11	Test 2 / Project Discussion
12	Mockup/Prototype Test Results Presentations

### 5.2 Tutorial/Lab Schedule

Week #	Lab Activity
1	Group Formations
2	Project Proposal Presentations
3	Solve Assignment #1
4	Conceptual Design Presentations
5	Solve from Assignment #2 (will be in class time on Tues 7 Feb)
6	Project Progress Presentations
7	Solve from Assignment #3
8	Simulations & Analysis (Individual Presentations)
9	Solve from Assignment #4
10	Detailed Design Presentations
11	Solve from Assignment #5
12	Project Presentations

### 5.3 Important Dates

Monday, January 8, 2024: First day of classes

Feb 19 - 23, 2024: Reading Week (no classes)

## 6. Assessment

### 6.1 Dates and Distribution

**Assignments:** 20% (to be submitted electronically through CourseLink Dropbox)

Assignment #	Due date	Weight
1	Week #3 (24 Jan 2024)	4%
2	Week #5 (7 Feb 2024)	4%
3	Week #7 (28 Feb 2024)	4%
4	Week #9 (13 Mar 2024)	4%
5	Week #11 (13 Mar 2024)	4%

**In-Class Tests:** 2 tests for a total of 40% scheduled as follows:

Description	Time	Weight
Test #1	Week # 6 (16 Feb, 2024)	20%
Test #2	Week # 11 (29 Mar, 2024)	20%

**Project:** 40%

Description	Weight	Submission	Location/Time
Group Formation & Project Selection (Week #1)	-	-	Lab time
Project Proposal (Week #2)	5%	Group	Lab time
Conceptual Design (Week #4)	10%	Group	Lab time
Project Progress (Week #6)	5%	Group	Lab time
Simulation & Analysis (Week #8)	20%	Individual	Lab time
Detailed Design (Week #10)	20%	Group	Lab time
Mock-up/Prototype Test Results (Week #12)	20%	Group	Lecture time
Project Presentation (Week #12)	10%	Group	Lab time
Final report (5 April, 2024)	10%	Group	Online

**Note:** Each of the above submissions is accompanied with an oral presentation of the group. Electronic copies are to be submitted on CourseLink Dropbox.

## 6.2 Exams

In-class exams will be open-book and will cover all material in the course up to the date of the exam, including material from lectures, tutorials and project.

## 6.3 Design Project

A central theme of the course will be a large team-based design project. Design teams will consist of approximately 5 students. This multi-stage project includes both individual and team work. The project stages are summarized in the Table above (Section 3.1) and the details of these stages are given below. Details, requirements, report templates and other supporting materials will be posted on CourseLink.

Design Project Stages:

1. **Project Proposal:** Each group will present a design project proposal during lab time in week #2. The project idea should include at least 2 interdisciplinary engineering systems (i.e. thermal, mechanical, hydraulic, electrical, control, etc.). The idea presentation should have a problem definition, criteria and constraints, and evaluation of design approaches. An emphasis should be on serving the community, innovation, energy saving/generation, water saving/quality, etc. Students will present their proposal to instructor in a PowerPoint presentation for 10 minutes.
2. **Conceptual Design:** The team will divide the overall design project into a series of components, and each team member will be assigned a specific component that will be his/her responsibility for the remainder of the project. A conceptual design and a design plan will be presented by the group members.
3. **Project Progress:** Modification and correction for the comments/feedback received on the conceptual design
4. **Simulation and Analysis:** Each student will complete an individual simulation project of 20% of the total project weight and due to week #8. This simulation will be centered on

answering one or more specific questions about one component of the complex system using a time domain simulation coded in MATLAB. The student should use appropriate models, simulation tools, or potentially mock-up or prototype testing, to ensure their component design will function as intended. The component must also be designed in active consultation with other team members, to ensure that the component will integrate properly into the overall design. For example, at locations where components meet students must agree on loads, fasteners or fastening methods, dimensions, fits and tolerances at the locations. Students must also continually ensure that individual components will contribute to the overall performance, and meet the constraints, for the overall design. The simulation deliverables are a structured report and MATLAB code. Students must follow the specified project report format, and include all required material, including flow charts and code. All code must follow consistent programming conventions and be well commented. Marks will be deducted for poorly organized or commented code. Details, requirements, report templates and other supporting materials will be posted on CourseLink.

5. **Detailed Design:** This must include detailed design calculations, specifications, criteria and constraints, drawings, economics, and a construction plan.
6. **Mock-up/Prototype Test Results:** Each group will present their mock-up/prototype and the results of its performance test.
7. **Project Presentation:** Each group will prepare a documentary video of 20 minutes about their project. The video will be posted on YouTube and will be evaluated by judges from the industry and academic members.

## 6.4 Team Work

Team work is required for several parts of this course, particularly the design project. The design project will require each team member to design their component(s) in active consultation with other team members, and integrate their component(s) into the overall design. If there is some observation or evidence that you have not been contributing appropriately to the team, then you will be asked to provide evidence of your individual efforts, contributions and results. Keeping a log book may be one effective means to help demonstrate your contributions. If it is determined that a student has not made a good-faith effort to contribute to the team, the entire course mark for the student will be reduced. In extreme cases, the student's course mark could be reduced to a below-passing level and the student could fail the course, even if the student has high marks on exams and the individual portions of the projects.

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## 7. Course Statements

### 7.1 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-accomreliq.shtml>

**Late Assignments:** Late submissions of assignments or project will not be accepted.  
*10% mark deduction will be applied for every hour late submission after the first hour.*

**Passing Grades:** The passing grade is 50%.

**Questions Concerning Grades:** If you have questions about the grade of your test/assignment received, please ask your TA within one week of the grade being released.

## 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>

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.