ENGG*4220: INTERDISCIPLINARY MECHANICAL ENGINEERING DESIGN
Winter 2017

UNIVERSITY of GUELPH

School of Engineering

(Revision 1: January 9, 2017)

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1. INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Mostafa Elsharqawy, PhD, PEng
Office: THRN 2407
Email: melsharq@uoguelph.ca
Office Hours: By appointment

1.2 Teaching Assistant

GTA	Email	Office
Pragyan Garnaik	pgarnaik@uoguelph.ca	THRN 1110

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2. LEARNING RESOURCES

2.1 Course website

Course material, news, announcements, and grades will be regularly posted to the ENGG*4220 CourseLink website. You are responsible for checking the site regularly.

2.2 Recommended Resources

We will utilize a series of textbooks, all of which can be accessed (and downloaded in PDF format) through the University of Guelph library website at no additional cost to students.

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.

The following text has been utilized in ENGG*3280 Machine Design and will be a useful reference.

8. Norton, R. L. Machine Design: An Integrated Approach. Prentice Hall. 2011.

In addition, we will be utilizing MATLAB to simulate engineering systems. Tutorials and refresher material are available at:
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.

2.3 Additional Resources

Lecture Information: Some lecture notes will be posted on the course website on CourseLink throughout the semester. You will be granted access to the website when you register for the course.

Assignments: Download the assignments according to the schedule given in the CourseLink website.

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.

2.4 Communication and Email Policy

Please use lectures and tutorials as your main opportunity to ask questions about the course. Major announcements and/or changes will be posted to the course website. It is your responsibility to check the course website regularly. Electronic communication should be limited to the course forum, however topics of a personal and confidential nature (e.g. marks) should be emailed to the instructor: melsharq@uoguelph.ca. Please note that all email communication must be made through your University of Guelph email account (i.e. username@mail.uoguelph.ca).

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3. ASSESSMENT

3.1 Dates and Distribution

Assignments: 0% (5 unmarked assignments)

In-Class Tests: 2 tests for a total of 20% scheduled as follows:

Test #1	9 Feb, 2017	10%
Test #2	28 Mar, 2017	10%

Final Exam: 20% Wednesday April 19, 2017, 7 – 9 PM, Room TBA on WebAdvisor

Project: 60%

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 (14 April, 2017)	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.

3.2 Tests and Final Exams

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

3.3 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.

3.4 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.

3.5 Course Grading Policies

Academic Consideration: 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 Consideration of Religious Obligations:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Passing Grade: The exam portion (2 Tests + Final Exam) accounts for 40% of the total mark of the course. The project portion accounts for 60% of the total mark of the course. In order to pass the course, you must meet the following two criteria:

- Score 20% or higher out of the 40% allocated to the exam portion of the course.
- Score 30% or higher out of the 60% allocated to the project portion of the course.

Failure to meet any of the two criteria will result in a failure grade (your total mark or 49%, whichever is less).

Missed Tests: If you miss a test due to grounds for granting academic consideration or religious accommodation, the weight of any missed test will be added to the final exam weight. There will be no makeup quizzes, tests, or midterm.

Questions Concerning Grades: If you have questions about the grade of your quiz or test received, please ask your TA within one week of the document being returned. However, all requests for re-marking must be made to the instructor and accompanied by a re-marking request letter. Any item that is re-marked will be re-marked entirely. Therefore it is strongly suggested that you thoroughly review your entire document before making a re-marking request. Pencil-written works will not be re-marked. Re-marking requests will not be honoured more than one week after the document has been returned.

Project Work: You must attend oral presentations and submit all project milestone reports. If you miss a project report due to grounds for granting academic consideration or religious accommodation, arrangements must be made with the teaching assistant to submit the missed report. Late submissions of reports will not be accepted.

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4. AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 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

4.2 Course Aims

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.

4.3 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.

4.4 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 Engineering on Society and the Environment	2	Projects
10. Ethics and Equity	-	-
11. Environment, Society, Business, & Project Management	-	-
12. Life-Long Learning	-	-

4.5 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. 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 assessments.

4.6 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and tutorials. 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.

4.7 Relationships with other Courses & Labs

Previous Courses:
ENG*3100: Engineering design process
Follow-on Courses:
ENGG*41XX: Capstone engineering design

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5. TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:

Day	Time	Location
Tuesday, Thursday	8:30AM - 9:50AM	MACN 202

Labs:

Section #	Day	Time	Location
0101	Friday	08:30AM - 11:20AM	THRN 1007

5.2 Lecture Schedule

Week	Lecture Topic	Learning Objectives
1	Intro to Mechanical Engineering Design	1, 2
2	Conceptual & Detailed Design	1, 2, 3
3	Dimensional Analysis & Modeling	1, 2, 3
4	Energetic and Exergetic Analyses	1, 2, 3
5	Test 1	-
6	Mechanical and Electrical Systems (project-based)	1, 2, 3
7	Pumping Machinery (project-based)	1, 2, 3

8	Turbomachinery (project-based)	1, 2, 3
9	Thermal Systems (project-based)	1, 2, 3
10	Measurements, Instrumentations, and Testing	4, 5, 6
11	Test 2	-
12	Mockup/Prototype Test Results Presentations	4, 5, 6

5.3 Lab Schedule

Week	Tutorial 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

5.4 Disclaimer

The instructor reserves the right to change any or all of the above in the event of appropriate circumstances, subject to the University of Guelph Academic Regulations.

5.5 Important Dates

Monday, January 9, 2017: First day of classes
Feb 20 - 24, 2017: Reading Week (no classes)
Friday, March 10, 2017: 40th class day, last day to drop classes
Wednesday April 19, 7:00PM – 9:00PM, Final exam of this course

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6. 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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7. ACADEMIC MISCONDUCT

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 discourages misconduct. 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.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-misconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
http://www.academicintegrity.uoguelph.ca

Please also review the section on Academic Misconduct in your Engineering Program Guide.

The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

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8. ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible.

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

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9. RECORDING OF MATERIALS

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

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10. RESOURCES

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml