ENGG*3280: MACHINE DESIGN
Fall 2016

School of Engineering

(Revision 0: August 28, 2016)

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1. INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Mostafa Elsharqawy
Office: THRN 2407
Email: melsharq@uoguelph.ca
Office Hours: Wednesday and Friday 11:30AM – 12:30PM

1.2 Teaching Assistants

GTA	Email	Office Hours
Andrew Beney	abeney@uoguelph.ca	TBA
Scott Simmons	ssimmons@mail.uoguelph.ca	TBA
Robert Zinni	rzinni@uoguelph.ca	TBA

NOTE: ALL TA OFFICE HOURS WILL BE HELD IN THRN 1425.

1.3 Lab Technicians

Technician	Email	Office
Ken Graham	kgraha06@uoguelph.ca	THRN 1021, ext. 53924
David Wright	dwrigh02@uoguelph.ca	THRN 1019, ext. 53924

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2. LEARNING RESOURCES

2.1 Course website

Course material, news, announcements, and grades will be regularly posted to the ENGG*3280 CourseLink site. You are responsible for checking the site regularly.

2.2 Required Resources

1. R.L. Norton, Machine Design: An Integrated Approach, 5th Ed. Prentice Hall, 2011

2.3 Recommended Resources

1. Shigley's Mechanical Engineering Design, 9th Ed. McGraw-Hill, 2011.
2. M.F. Spotts, Design of Machine Elements, 4th Ed., Englewood Cliffs, N.J. 1971

2.4 Additional Resources

Lecture Information: Some of the lecture notes will be posted on the course website (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. All the solutions will be posted as indicated.

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 Machine Design are also posted on the CourseLink.

2.5 Communication and Email Policy

Please use lectures and tutorials as your main opportunity to ask questions about the course. 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.

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3. ASSESSMENT

3.1 Dates and Distribution

Assignments: (9 unmarked assignments) 0%

In-class Tests: 4 tests for a total of 40% scheduled as follows:

Test #	Date	Weight	Topic
1	12 Oct, 2016	10%	Simple and combined stresses
2	14 Oct, 2016	10%	Static and dynamic failures
3	9 Nov, 2016	10%	Shafts, keys, and couplings
4	11 Nov, 2016	10%	Journal and roller bearings

Project: 30%

Description	Date	Weight	Time
Group Formation	Week #1	-	Tutorial time – last 1 hour
Project Pitch	Week #2	5%	Tutorial time – last 2 hours
Design Alternatives	Week #4	10%	Tutorial time – last 2 hours
Detailed Design	Week #6	10%	Tutorial time – last 2 hours
Project Progress I	Week #8	10%	Tutorial time – last 1 hour
Project Progress II	Week #10	15%	Tutorial time – last 2 hours
Trade Show	30 Nov, 2016	30%	4:00PM – 7:00PM (in SOE Atrium)
Final Report	2 Dec, 2016	20%	By 6 PM on CourseLink

Note: Each of the above submissions is accompanied with an oral presentation of the group. Both paper and electronic copies are to be submitted.

Final Exam: 30% Tuesday, 13th December 2016, 7:00PM – 9:00PM, Room TBA on WebAdvisor

3.2 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 (4 Tests + Final Exam) accounts for 70% of the total mark of the course. The project portion accounts for 30% of the total mark of the course. In order to pass the course, you must meet the following two criteria:

- Score 35% or higher out of the 70% allocated to the exam portion of the course.
- Score 15% or higher out of the 30% 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 completed re-marking request form (found on CourseLink). 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.

Machine Shop Safety Test: Failure to write and pass this test will result in an automatic loss of privilege to work in the machine shop area and a 0% mark for the project part of the course and failure in the final grade.

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4. AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 Calendar Description

This course provides the concepts, procedures, and analysis techniques necessary to design various mechanical elements commonly found in machines. Failure analysis such as yield criteria and fatigue are covered. Component design includes screws, fasteners, shafts, bearings and lubrication, and gears. The emphasis is on the use of readily available materials, standard component, and appropriate design approaches to achieve safe and efficient system design.
Pre-requisite(s): ENGG*2120, ENGG*2230, ENGG*2340, ENGG*2400, ENGG*2450
Co-requisite(s): None.

4.2 Course Aims

This course aims at: (1) equipping the students with an understanding of theory and practice of machine design, (2) developing the ability to integrate the knowledge that they have gained earlier in the previous two years in designing machine elements, (3) developing the ability to utilize analytical skills towards synthesis of solutions by working through the design of a mechanical device.

4.3 Learning Objectives

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

1. Formulate and analyze stresses and strains in machine elements and structures subjected to various loads.
   (a) Define the most critically stressed point in a machine component.
   (b) Analyze strains and deflections.

2. Specify appropriate tolerances for machine design applications.
   (a) Understand and to interpret tolerance on a dimension.
   (b) Acquaintance with ISO system of tolerances.
   (c) Specify an appropriate tolerance on machine components.
   (d) Specify a fit for mating parts considering functional requirements.

3. Apply multidimensional static failure criteria in the analysis and design of mechanical components.
   (a) Knowledge of various static failure criteria for different materials.
   (b) Apply static failure criteria in the design and analysis of machine components.
   (c) Analyze and design components with non-uniform cross sections.

4. Apply fatigue failure criteria in the analysis and design of mechanical components.
   (a) Knowledge of fatigue failure and load-life relation.
   (b) Knowledge of various fatigue failure criteria.
   (c) Apply fatigue failure criteria in the design and analysis of machine components under various loading conditions.

5. Analyze and design structural joints.
   (a) Acquaintance with the terminology, and types of permanent and detachable joints.
   (b) Design and analyze bolted joints.
   (c) Design and analyze power screws.

6. Analyze and design power transmission shafts carrying various elements with geometrical features.
   (a) Acquaintance with different types of shafts.
   (b) Design and analyze shafts with different geometrical features under various loading conditions.
   (c) Calculate critical speed of shafts and make the design decisions accordingly.

7. Design/select the material, thermo-mechanical condition and configuration of a variety of machine elements under a variety of environmental and service conditions. These would include: shafts, bearings, spur gears, springs, and screws.

8. The acquaintance with standards, safety, reliability, importance of dimensional parameters and manufacturing aspects in mechanical design.
   (a) Knowledge of standards for machine elements.
   (b) Understanding of safety and reliability concepts in the design of machine elements.
   (c) Minimize the characteristic dimension of a machine element.
   (d) An understanding of the influence of manufacturing processes in the design of machine elements.

9. Apply their skills to complete a major open-ended design project
   (a) Devise solutions for complex mechanical engineering problem.
   (b) Design mechanical linkage system including individual components that meet specified needs.
   (c) Utilize the basic machine shop tools such as lathe, milling, press drill, and welding.

10. Demonstrate their ability to communicate their design ideas through technical reporting and presentation.
    (a) Justify a design project in a formal report.
    (b) Perform and present design calculations in a neat and organized manner.
    (c) Present the outcomes of the design in the form of engineering drawings

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 - 7	Exams
2. Problem Analysis	4, 5, 6	Exams, Project
3. Investigation	9	Project
4. Design	9	Project
5. Use of Engineering Tools	9	Project
6. Communication	10	Project
7. Individual and Teamwork	9	Project
8. Professionalism	-	-
9. Impact of Engineering on Society and the Environment	-	-
10. Ethics and Equity	-	-
11. Environment, Society, Business, & Project Management	9	Project
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 and/or Current Courses:
ENGG*1210: Mechanical system fundamentals such as force, moments, and free body diagrams
ENGG*1500: Solving systems of linear equations, matrix algebra, and complex numbers
MATH*1200 & MATH*1210: Limits, differentiation, integration, series expansion
ENGG*2120: Mean, standard deviation, normal distribution
ENGG*2230: Viscosity, Bernoulli and continuity equation
ENGG*2340: Kinematics, Dynamics, and gear analysis
ENGG*2400: Second order system, natural frequency
ENGG*2450: Fundamental circuit theorems

Follow-on Courses:
ENGG*4160: Application of mechanical design principles
ENGG*4220: Interdisciplinary Mechanical Engineering Design

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5. TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:

	Day	Time	Location
	Monday, Wednesday, Friday	8:30AM - 9:20AM	ALEX 100

Tutorials:

Section #	Day	Time	Location
103	Tuesday	11:30AM - 02:20PM	THRN 1002
101	Tuesday	02:30PM - 05:20PM	THRN 1002
102	Wednesday	02:30PM - 05:20PM	THRN 1002
104	Thursday	11:30AM - 02:20PM	THRN 1002
105	Thursday	02:30PM - 05:20PM	THRN 1002

5.2 Lecture Schedule

Lecture #	Lecture Topic	References	Learning Objectives
1	Introduction	-	-
2 – 4	Simple and combined stresses	Chapter 4	1
5 – 7	Static theories of failure	Chapter 5	3
8 – 10	Fatigue failure	Chapter 6	4
11 – 13	Shafts, keys, and couplings	Chapter 10	6
14 – 15	Class Tests 1 & 2	-	-
16 – 18	Lubrication and journal bearings	Chapter 11	6, 7, 8
19 – 21	Rolling bearings	Chapter 11	6, 7, 8
22 – 24	Gears	Chapter 12, 13	6, 7, 8
25	Review	-	-
26 - 27	Class Tests 3 & 4	-	-
28 – 33	Screws, fasteners, and connections	Chapter 15	5, 7, 8
34	Springs	Chapter 14	7
35	Planetary gears	Notes	7
36	Fits and tolerances	Notes	2, 8

5.3 Tutorial Schedule

Week	Assignment Discussion Activity	Project Activity
0	No Tutorials	No Tutorials
1	Assignment # 1 (simple stresses)	Groups formation
2	Assignment # 2 (combined stresses)	Project pitch
3	Assignment # 3 (static failure)	Prep. for design alternatives (mechanisms)
4	Assignment # 4 (fatigue failure)	Design alternatives
5	No Tutorials	No Tutorials
6	Assignment # 5 (shafts)	Detailed design
7	Assignment # 6 (journal bearings)	Prep. for project progress I (difficulties)
8	Assignment # 7 (roller bearings)	Project progress I
9	Assignment # 8 (gears)	Prep. for project progress II (difficulties)
10	No assignment	Project progress II
11	Assignment # 9 (screws & fasteners)	Prep. For trade show
12	No Tutorials	Trade show on 30 Nov, 2016

5.4 Important Dates

Thursday, September 8, 2016: First day of classes
Monday, October 10, 2016: Thanksgiving holiday
Tuesday, October 11, 2016: Fall study day, no classes
Friday, November 4, 2016: 40th class day, last day to drop classes
Tuesday December 13, 2016: 7:00PM – 09:00PM, 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