ENGG*3280 Machine Design
Fall 2013

UNIVERSITY of GUELPH
School of Engineering

(Revision 0: August 29, 2013)

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1 Instructional Support

1.1 Instructor

Instructor:	Marwan Hassan, Ph.D., P.Eng.
Office:	THRN 2405, ext. 52429
Email:	mahassan@uoguelph.ca
Office hours:	TBA on Courselink or by appointment

1.2 Lab Technician

Technician:	Ken Graham
Office:	THRN 1021, ext. 53924
Email:	kgraha06@uoguelph.ca

Technician:	David Wright
Office:	THRN 1019, ext. 53924
Email:	dwrigh02@uoguelph.ca

1.3 Teaching Assistants

GTA	Email	Office Hours
Salim El Bouzidi	selbouzi@uoguelph.ca	Mondays 10:00AM-11:00AM - Thornbrough GTA room
Yasser Selima	yselima@uoguelph.ca	Fridays 10:00AM-11:00AM- Thornbrough GTA room

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. Robert L. Norton *Machine Design: An Integrated Approach* Prentice Hall, 2011

2.3 Recommended Resources

1. Shigley's Mechanical Engineering Design (8th Edition in SI Units)
2. Design of machine elements, M. F. Spotts

2.4 Additional Resources

Lecture Information: Some of the lecture notes are posted on the web page (week #1-#12).

Assignments: Download the assignments according to the schedule given in this handout. 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 web page.

3 Assessment

3.1 Dates and Distribution

Quizzes: 10% (best 5 of 6)
Sept 18, in class
Sept 27, in class
Oct 11, in class
Oct 25, in class
Nov 8, in class
Nov 22, in class

Project: 30%

Submission	Due	Description
1	Week 1	Project Choice
2	Week 2	Introductory Project Pitch
3	Week 4	Design Alternatives
4	Week 7	Detailed Design
5	Week 9	Project Progress I
6	Week 10	Project Progress II
7	Week 11	Trade Show
8	Week 11	Final Report

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

Midterm test 1: 20%
Wed Oct 16, 17:30-19:30, Room TBA on Courselink

Midterm test 2: 20%
Wed Nov 13, 17:30-19:30, Room TBA on Courselink

Final Exam: 20%
Thurs Dec 11, 08:30AM - 10:30AM, Room TBA on Webadvisor

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

Passing grade: In order to pass the course, you must pass exam course portion. Students must obtain a grade of 50% or higher on the exam portion of the course in order for the project portion of the course to count towards the final grade.

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

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 project. 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 area and a 0% mark for the project part of the course.

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.
Prerequisite(s): ENGG*2120, ENGG*2230, ENGG*2340, ENGG*2400, ENGG*2450
Corequisite(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 in 3-D 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:
   (a) Shafts
   (b) Bearings
   (c) Spur gears
   (d) 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	Quizzes, Exams
2. Problem Analysis	4,5,6	Quizzes, 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/D2L 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 tests and project.

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:

ENGG*1210: Mechanical system fundamentals such as force, torques, friction, moments, free body diagrams

ENGG*1500: Solving systems of linear equations, matrix algebra, 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: Application of mechanical design principles

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5 Teaching and Learning Activities

5.1 Timetable

Lectures:			
Monday		08:30AM - 09:20AM	LA, Room 204
Wednesday		08:30AM - 09:20AM	LA, Room 204
Friday		08:30AM - 09:20AM	LA, Room 204
Tutorials:			
Monday	Sec 01	02:30PM - 03:20PM	MACK, Room 226
Friday	Sec 02	02:30PM - 03:20PM	MACK, Room 227
Monday	Sec 03	02:30PM - 03:20PM	MACK, Room 226
Friday	Sec 04	02:30PM - 03:20PM	MACK, Room 227
Monday	Sec 05	02:30PM - 03:20PM	MACK, Room 226
Friday	Sec 06	02:30PM - 03:20PM	MACK, Room 227
Monday	Sec 07	02:30PM - 03:20PM	MACK, Room 226
Friday	Sec 08	02:30PM - 03:20PM	MACK, Room 227
Monday	Sec 09	02:30PM - 03:20PM	MACK, Room 226
Friday	Sec 10	02:30PM - 03:20PM	MACK, Room 227
Laboratory:			
Tuesday	Sec 01	02:30PM - 04:20PM	THRN, Room 1015
Tuesday	Sec 02	02:30PM - 04:20PM	THRN, Room 1015
Wednesday	Sec 03	09:30AM - 11:20AM	THRN, Room 1015
Wednesday	Sec 04	09:30AM - 11:20AM	THRN, Room 1015
Wednesday	Sec 05	03:30PM - 05:20PM	THRN, Room 1015
Wednesday	Sec 06	03:30PM - 05:20PM	THRN, Room 1015
Thursday	Sec 07	02:30PM - 04:20PM	THRN, Room 1015
Thursday	Sec 08	02:30PM - 04:20PM	THRN, Room 1015
Friday	Sec 09	03:30PM - 05:20PM	THRN, Room 1015
Friday	Sec 10	03:30PM - 05:20PM	THRN, Room 1015

5.2 Lecture Schedule

Lectures	Lecture Topics	References	Learning Objectives
1	Review of simple stresses	Chapter 4	1
2-3	Combined stresses	Chapter 4	1
4	Stress concentration	Chapter 4	1
5-7	Static theories of failure	Chapter 5	3
8-10	Failure Due to Variable Loading	Chapter 6	4
11-14	Shafts, Keys, and Couplings	Chapter 9	6,7,8
15-20	Screws, Fasteners, and Connections	Chapter 14	5,7,8
21-25	Lubrication and Journal Bearings	Chapter 10	7,8
26-30	Rolling Contact Bearings	Chapter 10	7,8
31-33	Fits and tolerances	Notes	2,8
34-36	Gears	Chapter 11-12	7

5.3 Design Project Schedule

Week	Topic	Location
1-3	Introduction to Lab Equipment and Safety Training	Machine Shop
1	Project Identification	Design Room
2-4	Solution alternatives	Design Room
5-6	Detailed design	Design Room
7	Machining of the mechanical parts	Machine Shop
8	Power and electrical assembly	Design Assembly Room
9	Mechanical Assembly	Design Assembly Room
10	Physical prototype Testing	Design Assembly Room
11	Trade show	Engineering Atrium

Attendance of the Safety Training is mandatory. Student who does not attend the Training is mandatory will not be allowed to work in the machine shop area.

5.4 Other Important Dates

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.

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-amisconduct.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