



Faculty of Engineering
Department of Mechanical Engineering
COURSE OUTLINE

Mech 360 – Design of Mechanical Elements

Term – FALL 2016 (201609)

Instructor	Office Hours
Dr. Curran Crawford	Days: Mon (or by appointment)
Phone: 250 721 7960	Time: 1300-1400
E-mail: curranc@uvic.ca	Location: EOW 537

List all prerequisites and co-requisites: See UVic calendar

LECTURE DATE(S)

Section: A01 / CRN12278	Days: Mon/Thurs	Time: 0830-0950	Location: ECS 125
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TUTORIAL SECTIONS

Section: T01	Days: Wed	Time: 1630-1720	Location: ECS 125
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TA Name	E-mail	Office
Pouya Amid	pamid@uvic.ca	ELW 242A
Meysam Karimi	mkarimi@uvic.ca	ELW A102
Robin Thomas	robint1@uvic.ca	
Nouman Zubair	nouman@uvic.ca	

Required Text	Optional Text
Title: Machine Design: An Integrated Approach, 5/E	Various quantitative mechanical design textbooks. Note that specific design methods, tables, etc. will yield different quantitative results to those using Norton. Students should be familiar with the methods taught in class and contained in Norton for quizzes, exams, etc.
Author: Norton, R. L.	Shigley, etc.
Publisher/Year: 2014	
Reference Materials: See course website on CourseSpaces	

COURSE OBJECTIVES:

The underlying objective of this course is to learn how to quantitatively and qualitatively design common mechanical elements such as gears, shafts, bearings and fasteners. The specific elements covered in each year vary by available time and interests. The methods of previous solid mechanics courses will be used extensively in the design analyses; students should review their notes from these courses. Unlike previous courses, however, fatigue failure will be a primary consideration. As a design course, a significant emphasis is placed on the integration of the various parts into a detailed design project, in a team environment.

The course builds primarily on the engineering stress formulas presented in MECH 220. Statics, dynamics and vibrations courses (ENGR 141, MECH 242/330) are also references when determining system input loading. Technical drawings will also be required, drawing on material from MECH 200. The engineering design approaches and management methods from MECH 350 should be used in the course project.

Syllabus

The course will open with a review of basic stress analysis and statically loaded elements. Cyclically loaded elements will be studied next with a view to accounting for fatigue failure modes. Gear drives will be covered next, followed by rolling element bearings, welds and fasteners. Methods for Life Cycle Analysis (LCA) will also be presented during the course, in order to introduce the important concept of quantitatively designing for environmental impact mitigation.

Students are expected to be familiar with and able to apply the concepts and methods in Chpts 1-4 in the textbook from previous courses. Finite element analysis (Chpt. 8) is not required in this course which focuses on standard analytic engineering methods. FEA is the subject of advanced 4th year courses.

New Topics	Book §
Static failure	Chpt. 5
Fatigue failure	Chpt. 6
Shaft & coupling design	Chpt. 10
Gearing	Chpts. 12 & 13
Bearings	Chpt. 11
Fasteners	Chpt. 15
Weldments	Chpt. 16
LCA/LCI	Notes

LEARNING OUTCOMES:

By the end of the course, students will be able to:

- Define fatigue failure and its underlying mechanisms, and contrast to static failure
- Apply appropriate advanced static failure theories to predict part failure under general loading
- Analyze parts under general loading to predict fatigue failure
- Qualitatively identify fatigue failure progression from fracture surface inspection
- Comment on key aspects of gearbox layout diagrams
- Design gearbox housings for assembleability
- Specify appropriate couplers for transmission connections
- Perform detailed design of shafting including locating features
- Identify spur, helical, bevel and worm gear variants
- Specify pinion-gear and epicyclical/planetary arrangements and speeds to satisfy given gearbox functionality requirements (speed, power, size)
- Design spur and helical gear teeth for a given set of transmission specifications
- Select and analyze rolling element bearings suitable for a given application, including locating and non-locating functionality
- Specify required fasteners and torque specifications to guard against axial and shear failure and joint separation
- Design weld details for given static and fatigue loading
- Recognize the environmental impact of mechanical design decisions

- Apply the LCI step of LCA in detail to ascertain system impacts and identify areas for improvement in the system and the analysis itself

Weight & Date(s) of Assessments:	Weight	Date
Quizzes	5%	See below section Quiz dates: Sept 28, Oct 12, Oct 26, Nov 16, Nov 30
Mid-term	15%	TBA
Final Exam	40%	TBA Note: The individual components of the course must be passed to pass the course
Project	40%	See project document

The final grade obtained from the above marking scheme for the purpose of GPA calculation will be based on the percentage-to-grade point conversion table as listed in the current Undergraduate Calendar.

Note that investing time in the quizzes and project will pay big dividends in understanding for the midterm and exam, and are therefore in reality more heavily weighted than the evaluation criteria might suggest.

Missed quizzes or midterms, without a valid excuse, will receive a zero grade; with a valid excuse the percentage of that component will be transferred to the final.

Quizzes will be conducted as per the assignments schedule in the tutorial time on that date. They will be short (30 mins) and involve a problem similar to the one in the assignment set. Time will only be available to complete the problem if the material is well understood. The quizzes will be fully graded.

All formal testing (quizzes, midterm, final) will be open-book only. In addition to a single published textbook (either the prescribed course textbook, or one of your choosing), only 1 double-sided letter sized formula page will be permitted, along with pencils, erasers, calculators, etc. The textbook may be written in by hand (i.e. for highlighting, short notes, etc.), but must not contain any type of photocopied pages or other taped or glued in pages (i.e. sticky-notes to mark pages is fine, photocopying solutions to 10% scale and sticking into your book is not). Likewise, the formula page must not contain detailed problem solutions, only generic formulas, page references, etc. The intent is avoid students attempting to match exam questions to previous assignments, rather than working out problems from fundamental approaches. No violations to this intent will be tolerated.

The material eligible for inclusion in the mid-term and final exams will include that covered in the lectures, assignments and tutorials, and referenced to the corresponding sections of the text. The final must be passed to pass the course. Scheduling will be announced later in the term.

Hints for Success

- Attend all lectures and tutorials.
- Ask questions any time you are unsure about something.
- Practice, practice, practice lots of examples; this is the only way to master the course content.
- Do not allow yourself to fall behind. The course is cumulative and final problems will involve all aspects of the course.

ASSIGNMENTS & QUIZZES

The assignment questions are selected to give students a chance to practice the material covered in the lectures in preparation for the quizzes. Students may work in groups to solve the problems, but should attempt each problem on their own and ultimately understand the content individually. Assignments will not be marked.

Complete answers will be provided with the assignments; **however, students should work through the problems before consulting the answers** to avoid developing a false sense of confidence. Students should ensure they are comfortable with the other example problems in the textbook, beyond those in the assignment problems. Assignments will be handed out at the time of the preceding quiz (approximately 2 weeks).

Assignment #	Modules	Quiz in Tutorial Time
1	Static analysis	Sept 28
2	Basic fatigue	Oct 12
3	Advanced fatigue	Oct 26
4	Gears	Nov 16
5	Bearings/bolted connections	Nov 30
6	Weldments/LCA	No quiz

PROJECTS: (Description & Method of Delivery)

See separate project description document.

COURSE LECTURE NOTES

Unless otherwise noted, all course materials supplied to students in this course have been prepared by the instructor and are intended for use in this course only. These materials are NOT to be re-circulated digitally, whether by email or by uploading or copying to websites, or to others not enrolled in this course. Violation of this policy may in some cases constitute a breach of academic integrity as defined in the UVic Calendar.

There will be no supplemental examination for this course.

GENERAL INFORMATION

Note to Students:

Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the Chair of the Department by email or the Chair's Secretary to set up an appointment.

Attendance

Students are expected to attend all classes in which they are enrolled. An academic unit may require a student to withdraw from a course if the student is registered in another course that occurs at the same time....

An instructor may refuse a student admission to a lecture, laboratory, online course discussion or learning activity, tutorial or other learning activity set out in the course outline because of lateness, misconduct, inattention or failure to meet the responsibilities of the course set out in the course outline. Students who neglect their academic work may be assigned a final grade of N or debarred from final examinations.

Students who do not attend classes must not assume that they have been dropped from a course by an academic unit or an instructor. Courses that are not formally dropped will be given a failing grade, students may be required to withdraw and will be required to pay the tuition fee for the course." UVic Calendar, (2016) <http://web.uvic.ca/calendar2016-09/undergrad/info/regulations/attendance.html>

Accommodation of Religious Observance (AC1210)

<http://web.uvic.ca/calendar2016-09/general/policies.html>

Discrimination and Harassment Policy (GV0205)

<http://web.uvic.ca/calendar2016-09/general/policies.html>

Faculty of Engineering, University of Victoria Standards for Professional Behaviour

"It is the responsibility of all members of the Faculty of Engineering, students, staff and faculty, to adhere to and promote standards of professional behaviour that support an effective learning environment that prepares graduates for careers as professionals...."

You are advised to read the Faculty of Engineering document Standards for Professional Behaviour which contains important information regarding conduct in courses, labs, and in the general use of facilities.

<http://www.uvic.ca/engineering/assets/docs/professional-behaviour.pdf>

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult the Undergraduate Calendar for the UVic policy on academic integrity.

Policy on Academic Integrity

<http://web.uvic.ca/calendar2016-09/undergrad/info/regulations/academic-integrity.html>



Course Schedule (remove example text)

Module	Topics	Date/Week
1	<u>Time domain simulation</u> . Second order Des, finite differences, multi-step and multi-value methods, explicit and implicit techniques.	01.09
2	<u>Fourier analysis</u> . Fourier's hypothesis, Fourier series & the Fourier transform; wave spectra: spectral moments, significant wave height & wave statistics.	01.14 – 01.21
3	<u>Airy waves</u> . Derivation of linear wave kinematic equations; shallow and deep water conditions.	01.23 – 01.28
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