MecE 360: Mechanical Design II

Fall 2013 – September 4 to December 4

Instructor: Pierre Mertiny, Ph.D., Dipl.-Ing., P.Eng.
Room: MEC 4-31C
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Open door policy & scheduled group meetings

Email: pmertiny@ualberta.ca (Please start the subject line with MECE360)

Prerequisites: MecE 260, MecE 265, MatE 202 and CivE 270. It is your duty to check if you have the prerequisites. If you do not, withdraw from the course. No exemptions will be made.

Assessments: Quiz, best 1 out of 2
(#1: Friday Sept. 25, #2: Friday Nov. 20) 10%
Group assignments 5%
Group project (due December 4) 20%
Midterm exam (October 25) 15%
Final exam¹,² (December 11, 9:00 am) 50%

¹ It is necessary to pass the final exam to pass the course.
² Note that an example exam is available on the Department website at http://www.mece.engineering.ualberta.ca/en/Undergraduate/CourseLinks.aspx

- Information on the grading system: www.uofaweb.ualberta.ca/grades
- The conversion of marks from assignments and examinations into a final grade based on the four-point system will be performed by using absolute measures in combination with the subjective procedures described in Section 23.4 (4) of the University Calendar.


Compulsory notes: Course notes available through the MecE Club

UofA online books: Machinery’s Handbook, Oberg, 27th Edition; Peterson’s Stress Concentration Factors; Mark’s Mechanical Engineering Handbook

- FAG bearing is providing each student with a volume of their catalogue which contains advanced bearing theory
- A Writer’s Handbook for Engineers, McMurrey & Buchley, Thomson Learning

Website on eClass: This website provides the course information, lecture and lab notes, as well as exam marks. To access the website, go to http://www.ualberta.ca, then in the top right corner click on eClass. Using your user CCID and password, login to eClass. In your Course List, select MEC E 360.

University policies:
Policy about course outlines can be found in §23.4(2) of the University Calendar.
The University of Alberta is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Code of Student Behavior (online at www.ualberta.ca/secretariat/appeals.htm) and avoid any behavior which could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

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Global Objective of the Course:

The objective of MecE 360 is to build on the static analysis of CivE 270 and the design work of MecE 260 and introduce students to the concepts of designing components and assemblies while considering more advanced notions such as materials, fatigue loading and stress concentrations.

Homework: Unless specified otherwise, you must work in teams of three or four on the homework, handing in one team solution per assignment. These are the same groups as for the project. Assignments must be submitted in the drop box on the 4th floor of MecE by 4:00 pm on the due date. Late homework will not be accepted.

Tests: There will be two 45-minute in-class quizzes, one midterm and a final exam during the semester. All tests are open book unless otherwise specified by the instructor. The lowest QUIZ will not count.

Make up tests: No make up tests/quizzes will be given. Students with a certified medical excuse or prior instructor approval will not be penalized. The grade will be added to the value of the final exam.

Group project: The projects will be a single design done by the assignment team and are due at the end of term submitted online. A report detailing the design process, analysis and engineering drawings acceptable for immediate production are required.

Assignments, quizzes and midterm grading: The responsibility of grading assignments, quizzes and midterm fall on the TA. If you believe an error has been made in grading or that you should have gotten more points than you got, write a statement making your case and take it to the TA. The TA will re-evaluate the entire paper. Your grade might increase or decrease. If you are not satisfied with the TA’s decision, bring the written statement to the instructor who will make the final decision.

Detail Topics

1. Introduction

Unit 1: Introduction to the design process

2. Design process:
   - Brainstorming
   - Decision matrices
   - Gantt chart
   - Initial considerations
   - Uncertainties

Unit 2: Initial considerations to design

3. Initial consideration: Material selection
   - Initial consideration
   - Restrictions and assumptions
   - Decision matrix for materials
   - Ashby charts introduction
   - Basic manufacturing considerations

4. Initial consideration: Loading conditions, stress and deflection analysis
   - Loading
   - Shock, impact, suddenly applied loads
   - Fatigue (definition)
   - Stress concentration factors
   - Deflection analysis
   - Residual stresses
5. **Initial consideration: Design criteria**
   - Static failure
     - Maximum normal stress
     - Modified Mohr
     - Maximum shear stress
     - Von-Mises yield criterion
   - Fatigue failure
     - Low cycle fatigue
     - High cycle fatigue
     - Stress concentration factors

Unit 3: Component design and selection

6. **Components: Shafts**
   - General concepts
   - Loads
   - Power transmission
   - Sizing based on strength
   - Sizing based on deflection
   - Natural frequency
   - Keys and coupling

7. **Components: Gears**
   - General consideration
   - Design consideration
   - Lewis equations
   - AGMA equations
   - Spur, bevel, helical, worm gears

8. **Components: Bearings and lubrication**
   - Journal bearings
   - Rolling contact bearing

9. **Components: Connections (time permitting)**
   - Non-permanent joints
     - Screws
     - Bolts
   - Permanent joints
     - Welds
     - Adhesives

10. **other components (time permitting)**
    - Spring
    - Clutch/brakes
    - Chains/belts
    - Cams
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MecE 360: Team Policies and Expectations:

Groups of four will not be self-selected but will be assigned through a random process.

Each group is required to contact pmertiny@ualberta.ca by the date given in the project package with the selected group project (First come first serve)

Your team will have a number of responsibilities as it completes problem and project assignments. Below are some suggestions, which are not mandatory since groups may have differing dynamics.

- Designate a coordinator, recorder and checker for each assignment. Rotate these roles for every assignment.
- Agree on a common meeting time and what each member should have done before the meeting (readings, taking the first cut at some or all of the assigned work, etc.)
- It is strongly suggested that all group members do all of the assignment questions, compare and discuss answers, and submit a single sheet per group.
- Do the required individual preparation.
- Coordinator checks with other team members before the meeting to remind them of when and where they will meet and what they are supposed to do.
- Meet and work. Coordinator keeps everyone on task and makes sure everyone is involved, recorder prepares final solution to be turned in, monitor checks to make sure everyone understands both the solution and the strategy used to get it, and checker double-checks it before it is handed in. Agree on next meeting time and roles for next assignment. For teams of three, the same person should cover the monitor and checker roles.
- Checker turns in the assignment, with the names on it of every team member who participated actively in completing it. If the checker anticipates a problem getting to class on time on the due date of the assignment, it is his/her responsibility to make sure someone turns it in.
- Review returned assignments. Make sure everyone understands why points were lost and how to correct errors.
- Consult with your instructor if a conflict arises that can't be worked through by the team.

If a team member refuses to cooperate on an assignment, his/her name should not be included on the completed work. If the non-cooperation continues, the team should meet with the instructor so that the problem can be resolved, if possible. If no resolution is achieved, the cooperating team members may notify the uncooperative member in writing that he/she is in danger of being fired, sending a copy of the memo to the instructor. If there is no subsequent improvement, they should notify the individual in writing (copy to the instructor) that he/she is no longer with the team. The fired student should meet with his/her instructor to discuss options. Similarly, students who are consistently doing all the work for their team may issue a warning memo that they will quit unless they start getting cooperation, and a second memo quitting the team if the cooperation is not forthcoming. Students who get fired or quit must find a team of 3 willing to accept them as a member; otherwise they get zeroes for the remaining assignments.

As you will find out, group work isn't always easy. Team members sometimes cannot prepare for or attend group sessions because of other responsibilities, and conflicts often result from differing skill levels and work ethics. When teams work and communicate well, however, the benefits more than compensate for the difficulties. One way to improve the chances that a team will work well is to agree beforehand on what everyone on the team expects from everyone else.

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