ME E3409 Computer Aided Design: Fall 2008 Syllabus

INSTRUCTORS

	Professor Nabil Simaan	Teaching Assistant Andrea Bajo	Grader/TA: To be assigned
Office hours:	Tuesdays 3:00-4:00	Tuesday TBD Thursday TBD	

COURSE MISSION

This course is designed to provide you with the necessary skills in machine component design and selection. The theoretical focus of the course will be on the methods of analysis of stresses, deflections, and safety factors for machine components (including static and fatigue loading). The applied focus of the course is to provide you with hands-on experience in designing, building, and testing a working mechanical assembly. The course requires knowledge of Pro/Engineer and will make extensive use of Matlab.

TEXTBOOKS

Required textbooks used for this class are available from the Columbia Bookstore:

1. ***Machine Design: An Integrated Approach*** *(3rd Edition) by Robert Norton.*

Recommended Textbooks (If you are considering other alternatives for text books):

1. ***Mechanical Engineering Design*** 7th edition, by Joseph Shigley, Charles Mischke, and Richard Budynas.

The course will cover additional material beyond the scope of these textbooks (see course schedule). Such material will be conveyed in class and circulated as hand-out material.

COURSE WEBSITE

We will use "CourseWorks" as the main web page for the course. You will be able to download miscellaneous material (tutorials, homework assignments and solutions) from this web page. An FTP site for this course will be established for homework submissions and handouts.

COURSE POLICIES

Homework: A minimum submission of 6 out of 8 individual homework assignments is required to calculate your homework grade (if you submit more, we will use the best 6 grades for calculating your individual homework grade). In addition to the individual homework assignments, you are required to submit three group project assignments (Pr1-Pr3) as part of your final report preparation.

Homework assignments are due in class on the date specified on the homework sheet. Submission should be on hard copy and online using the FTP server set for the class required for your design sketches). All electronic submissions should adhere to the submission requirements that will be posted on Courseworks course web page and attached in the first homework set that will be handed out.

Course Ethics: Discussions of the lecture material and course software among students are encouraged. However, using electronic versions of the homework from other students will not help you prepare for your exams and will not be tolerated (Pro/E allows checking for electronic signatures of the files). Students that copy part of their homework will loose the full grade for the homework and will be brought in front of the undergraduate disciplinary committee.

Open door policy: The teaching staff would like the course to be as enjoyable and as beneficial to you as possible. Your constructive criticism (both positive and negative) will be welcomed as a necessary tool that will help us improve the course. You are encouraged submit your comments via email to the course instructors or to directly speak to the course instructors to voice your concerns and suggestions.

GRADING

All homework assignments will be graded and returned 2 weeks after their submission date. Some of the homework assignments will be graded such that random subset of questions out of the homework will be graded and used to calculate your homework grade.

Project and Homework	Midterm exam	Final Exam	Total
A total of 40% will be divided between homework and final project report. 20% will be given for **best 6** individual homework assignments. Homework assignments Pr1, Pr2, and Pr3 are mandatory to help you prepare your final project. Additional 20% will be allocated for final project report.	30% optional	30% if mid term grade is used. Otherwise, 60%	100%
Attendance, and peer evaluation will be used for point deduction as specified below. Bonus points will be given for the students having the best final project.			

Satisfactory attendance and participation: up to 10 points of the final grade will be deducted if a student exhibits irregular attendance during the class lectures and tutorials.

Bonus points: The best final project will be picked by the course instructors at the end of the semester. The students responsible for these projects will get an honorable mention in the class web page "hall of fame" and posters of these projects will be posted in the CAD lab provided that the students prepare the posters. In addition, these students will get 5 points of bonus on their final grade.

Grievance procedures: If you disagree with your homework grading you can submit your grievance in writing to the Teaching Assistant while documenting and supporting your case. If you are still unsatisfied you can appeal to the course instructor in a similar manner.

Suggested Team Organization

The organizational structure of each design team is the responsibility of the members of each team. There should be an equitable distribution of work among team members. Please designate at least two people in each area of expertise, to avoid problems resulting from the absence of a team member.

- Team Leader: Assign a team leader to help manage the group effort, coordinate scheduling, and check progress of team members.
- CAD Supervisor: Oversees the development of CAD models, assemblies, animations, and 2D drawings
- Fabrication Supervisor: Coordinates fabrication of components and become expert in the operation of the machine tools.

Each team member is expected to evaluate the level of participation of other teammates on a simple scale:

1. Level of participation is satisfactory (team member is participating as expected)
2. Level of participation is less than satisfactory (team member attends some or all meetings but makes no significant contributions)
3. No participation (team member fails to participate in meetings and makes no contribution)

Intra-Group Peer Evaluation System

This peer evaluation will be required every time that a team submits a report. The evaluation will be confidential and should be sent directly to the instructor and teaching assistant. If a team member receives a rating of 2 or 3 from his/her teammates, this evaluation will be reflected in the team member's grade for that report. Failure to participate will lead to a failing grade.

Guidelines for grading based on peer evaluation scores

- If two or more of your teammates have given you an evaluation of 'less than satisfactory', your grade will be reduced by a full point (e.g., from A down to B or 10 points on a scale of 0-100).
- If two or more of your teammates have given you an evaluation of 'no participation', your grade will be reduced to F for that report (55 on a scale of 0-100).
- If one of your teammate has given you a grade below satisfactory, you'll receive a warning as indicated in the comment next to your grade. Three consecutive warnings will result in a reduction of your grade by a full point.

Please do not take a confrontational attitude with your teammates if you are dissatisfied with your peer evaluation. In particular, do not ask who gave what score*. Take a constructive approach to criticism and try to clarify the reasons behind that evaluation. If you prefer not to question your teammates directly, ask the instructor to serve as an intermediary.* You can appeal the grade reductions based on peer evaluations to the instructor directly. The instructor may consult your teammates before rendering a final decision on the appeal.

Planned Course Schedule

Lecture #	Detailed Topics to be covered	Book chapters	Assignment
Tu 9/2	Introduction to course and administration. Introduction to Euler beam theory Review of load determination on beams: sign convention, shear and moment diagrams, singularity functions, superposition principle. Deflection analysis using singularity functions. Example 1, Example 2.	3.7, 3.8, 3.9, 4.10	
Th 9/4	Deflection analysis using singularity functions (continued) Distortion (Strain) energy under single component loading conditions Introduction to deflection analysis using Castigliano's method* Example 1, Example 2	4.11, Sh. 5.8	H1
Tu 9/9	Energy methods for load determination Review of the Virtual work principle, Example 1 (calculation of required power, statics using virtual work, calculation or required transmission ratio), Impact loading Example 2	4.9	
Th 9/11	Review of stress, strain, and strain energy using linear algebra Transformation of stress and strain using similarity transformations Example 1. Review of stress states in beams. Shear stresses on bending beams. Example 1 calculation of shear stress distributions Theoretical stress concentration factors	4.0-4.4 4.8 4.15	H2
Tu 9/16	Review of static failure theory (Tresca, Maximum Normal Stress, Von Mises). Coulomb-Mohr and Modified Coulomb Mohr theory Example: combined stress state on rotating object (centripetal forces) Example: design of cast iron part Example: Stresses in pressure vessels (thin walled).	4.17	
Th 9/18	Introduction to Fracture Mechanics	5.3	H3
Tu 9/23	Fatigue Failure – introduction to high cycle fatigue S-N diagrams and calculation of modified endurance limits Notch sensitivity factors	6.1-6.6	
Th 9/25	Fatigue Failure S-N diagrams and calculation of modified endurance limits	6.10	H4
Tu 9/30	Fatigue failure: Goodman and Modified Goodman diagrams	6.11	
Th 10/2	Fatigue failure: general multi—axial loading Cumulative fatigue*	6.12, 6.13	H5
Tu 10/7	Design of shafts, Goodman, Soderberg equations for shafts excluding critcal speeds	9.6,9.7, 9.8,	PR1
Th 10/9	Spring Design 1: compression springs geometry, stresses, buckling		
Tu 10/14	Spring Design 2: Fatigue loading of springs		H6
Th 10/16	**Midterm Exam**		
Tu 10/21	Spring Design 3: Extension springs, Torsion springs*, leaf springs*, spring optimization*		Pr2
Th 10/23	Fasteners 1: preloaded fasteners in static loading	14.3, 14.6,	
Tu 10/28	Fasteners 2: fatigue of fasteners, Joint stiffness factors	14.8	

Th 10/30	Fasteners 3: Shear connections (pinned connections)	14.10	H7
Tu 11/4	Election day no lecture		Pr3
Th 11/6	Welded joints 1 (torsion, bending, fatigue)	Sh. 9.0	
Tu 11/11	Welded joints 2		
Th 11/13	Design and selection of rolling bearing elements	10.9, 10.10, 10.11,10.12	H8
Tu 11/18	Introduction to gear design: gear tooth geometry, gear trains	11.1, 11.2, 11.5	
Th 11/20	Loading of spur gears, statics, stresses	11.7,	
Tu 11/25	Buckling of thin rods. Euler columns, Johnson columns. Example 1, Example 2	4.16	
Th 11/27	Thanksgiving no lecture		
Tu 12/2	Final Project Presentations **Final Project draft Report Due**		
Th 12/4	Final Project Presentations **Final Project draft Report Due**		
	Final Project Report Due		