

## Mechanical Engineering Design II – ME3E05 January 2019

(Course web site: <http://avenue.mcmaster.ca>)

**Professor:** Dr. Mukesh Jain. Office: JHE326G, Tel. ext. 27841, Email: [jainmk@mcmaster.ca](mailto:jainmk@mcmaster.ca)

**Lecture Periods:** TBD

**Tutorial Period:** TBD, Detailed examples will be covered in the tutorials.

**Tutorial TAs:** TBD

**Project Mentors (Faculty Members):**

- TBD
- TBD
- TBD
- Dr. Mukesh Jain, Office: JHE326G, Tel. ext. 27841, Email: [jainmk@mcmaster.ca](mailto:jainmk@mcmaster.ca)

**Objectives:**

To extend the concepts taught in previous mechanics courses (ME2P04, ME2Q04, ME3A03 and 2D04) to cover theory of elasticity solutions to some static loading conditions, variable (fatigue) loading, and analysis of various machine elements. The course will build on material learned in previous solid mechanics and design courses and encourage the creativity required to develop solutions to more realistic engineering design problems.

Team projects will be used to complement the lecture material. The project will provide an opportunity to apply the concepts of solid mechanics to student team-conceived and design-driven problems. The project will provide experience in creative design, design synthesis, team work, project management and technical communication.

**Learning Outcomes:**

Upon successful completion of the course the student will be expected to have demonstrated the ability to:

1. Understand how machine design impacts, and is impacted, by other stakeholders, and of the critical place of safety in design work.
2. Develop and demonstrate an understanding of the analysis of various 3D stress states in isotropic, linearly elastic, materials.
3. Identify and apply assumptions used in modelling problems, and decide if simplifications are appropriate.
4. Draw substantiated conclusions from problem analysis and make appropriate recommendations.
5. Select an open-ended design problem and set design objectives and scope (as part of a team).
6. Research aspects of design problem through self-directed and self-identified sources, critically evaluate and apply knowledge to the problem.

7. Deliver a feasible solution to the open-ended design problem, manage the team's resources, follow an engineering design process from initial problem specification to communication of final solution, and demonstrate consideration of needs of stakeholders including safety, economic and societal issues.

### **Lectures:**

Lecture notes will be uploaded on avenue (<http://avenue.mcmaster.ca>) on a weekly basis. Students are expected to browse through the notes prior to coming to the class and to bring a copy of on-line notes to the class for further additions.

### **Assignments:**

Six assignments are planned for the course. The assignment problem sheets will be typically posted on Friday of the week and will be due the following Friday (by 4 PM in the assignment drop-off box located in JHE 308). They will be given mostly bi-weekly. The graded assignment work will be placed on a tray (marked 'ME3E05'), also in room JHE308. The TA hours will be set-up for each assignment and noted on the assignment sheet. Solutions to the assignments as well as assignment marks will be posted on Avenue once the grading is completed by the TA. Dr. Jain will also set-up his office hours for consultations with students on assignment problems and other lecture related questions.

Any issues with the grading will be dealt with only for one week after the marks have been posted. These issues should be first resolved with the TA responsible for grading the assignment. If the matter remains unresolved, it should be brought to the attention of Dr. Jain.

Bonus problems will be included with the regular assignments. These problems will offer an opportunity for earning additional marks towards the final grade. Bonus problems will be posted as the last problem on the assignment sheet and should be submitted along with the assignment work.

### **Assignment TAs:**

1. TBD
2. TBD

(TA hours and location for student consultation are yet to be determined)

<b><u>Evaluation:</u></b>	Assignments (+ bonus):	10% (+3%)
	Mid-Term Test:	20%
	Final Examination:	40%
	Design Project:	30%

### **Required Textbook:**

Shigley's Mechanical Engineering Design, 10<sup>th</sup> edition, by Budynas and Nisbett, McGraw-Hill Inc., NY, 2010 and 2014. The textbook is available in the McMaster bookstore.

**Lecture Topics:**

Chapters (from textbook)	Lecture Topics	Comments
1	Introduction	A brief overview of mechanical engineering design process in the context of this course, codes and standards, factor of safety, system of units etc.
3	Load and stress analysis	Review of normal, shear, and combined principal stresses (Mohr's circle), stress concentration, stresses in pressurized cylinders and rotating rings, press and shrink fits, temperature effects, curved beams in bending and surface contact stresses.
4	Column deflection and buckling	Concentric and eccentric columns loading only
6	Fatigue failure from variable loading	Fatigue in metals, endurance limit, fatigue strength, endurance limit modifying factors, stress concentration and notch sensitivity, fluctuating stresses, fatigue failure criteria, fatigue under combination of loading modes, cumulative fatigue damage and surface fatigue strength.
7	Shaft and shaft components	Shaft design for stress and strength
8	Screws, fasteners and the design of non- permanent joints	Mechanics of power screws, threaded fasteners, joints fastener stiffness, joints- member stiffness, bolt strength, tension joints under external load, bolt torque, statically and fatigue loaded tension joints, and bolted and riveted joints in shear and bending.
9	Design of welded joints	Butt and fillet welds, stresses in welded joints in torsion and bending, static and fatigue loading of welds.
10-18	Other machine elements may be briefly covered, if time permits	

**Design Project****Format:**

The course will involve a major design project which is to be done in teams of 4 or 5 students (no less than 4 or more than 5 students per team). Each team should select a team captain (or group leader) and generate its own project. Initial discussion/consultation about project suitability and viability prior to project selection can be held with Dr. Jain or one of the Project Mentors listed earlier. Project evaluation will be based on two progress reports, and, towards the end of the term, an oral presentation of the final design and a final project report.

A good project topic is one that makes most use of the topics covered in the solid mechanics courses (2P04, 2Q04, 3A03, 2D04) and lecture portion of this course.

Teams will be supervised independently by one of the Mentors noted above. The design project teams will meet with their project Mentor on a weekly basis throughout the term to discuss design issues and to report on progress. A schedule for these meetings will be developed by each

project mentor once the teams have been formed and the team allocations to each of the project mentors has been made by Dr. Jain (in the first two weeks).

### **Design Project Schedule:**

Jan., first week	Formation of design project teams by the students
Jan., first week	Submission of team members and team captain (by each team to <u>Dr. Jain</u> )
Jan., second week	Discussion of suitable projects with a Project Mentor
Jan., second week	Submission of formal design project proposal (by each team to <u>Dr. Jain</u> )
Jan., second week	Allocation of design teams to Mentors by <u>Dr. Jain</u>
Jan., mid-month	Project work begins
Jan., 3 <sup>rd</sup> week	Submission of design project timelines* (Table/Gantt Chart) to <u>Mentor &amp; Dr. Jain</u>
Feb., second week	1 <sup>st</sup> Progress Report* to <u>Mentor</u>
Mar., first week	2 <sup>nd</sup> Progress Report* to <u>Mentor</u>
Mar., end	Design project presentations to your <u>presentation evaluator</u> (the presentation evaluator will be <u>other</u> than your <u>assigned</u> project Mentor)
April, first week	Submission of final report* to your <u>Mentor</u>

\*NO EXTENSIONS WILL BE GIVEN

### **Notice**

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice to the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course website, at least twice a week during the term to note any changes.

### **Project Timeline**

The project timeline could be in the form of a table or a Gantt chart. However, detail and clarity of the activities in the Table or Gantt chart is critical. There is no need to include timelines for submission of various reports and presentations since they are required components of the course. Try to be specific about the nature of the activities of your project in the table/Gantt chart. This document should be no more than 2 pages long.

### **Project Proposal**

This will be no more than one page, and will include the project title, and a description of the project's objective. It should include the project scope, i.e., what the project will include and

what it will not include. The proposal must briefly explain how the project objectives relate to previous solid mechanics courses (2P04, 2Q04, 3A03, 2D04) and lecture portion of this course.

### **First and Second Progress Reports**

The purpose of the team progress reports is to demonstrate that the progress is in fact being made. An 8 page (maximum) write-up for both first and second reports along with necessary drawings and sketches in the appendices should be provided as evidence of progress towards the final project goals. The main body of the reports should be typed. The reports will be evaluated and discussed with the teams by the assigned Project Mentor. Each of the 2 progress reports is worth 10% of the project mark of 30% (i.e., 3% of the course grade). A rubric will be provided on Avenue for each report ahead of the due date.

### **Project Presentations**

Formal 15 minute project presentation will be made, with 5 minutes for questions, by each of the design teams to a Presentation Evaluator other than your project mentor, and to all other students in the portfolio of their mentor, as noted above in the Design Project Schedule. The Presentation Evaluator list and a Presentation Rubric will be posted on the course web site towards the middle of the term. Presentations will be held during March 26<sup>th</sup>-30<sup>th</sup> period. It will be the responsibility of your Project Mentor to schedule the presentations in consultation with the assigned Presentation Evaluator and the student teams under his project portfolio. The presentation is worth 30% of the project mark of 30% (i.e., 9% of the course grade)

### **Final Report**

The Final Report (April, first week) is a formal engineering report that is to be done to a professional standard. The appendix to the final report should include the actual timeline for the project with an itemized man-hour contribution for individual group members and a brief comparison between the original timeline with Progress Report 1. The body of the report should be typed using 12pt font size and be contained within 20 double spaced pages, not counting figures and end of the report appendices. The report should be placed in your Project mentor's mail box in the Department office (JHE310 and not in the Assignment drop off box). There is a 'wall' of mail slots in room JHE310 to the left of the entry door marked with the names of the Department faculty members. A rubric for the final report will be posted on the course web site towards the end of the term. The final report is worth 50% of the project mark of 30% (i.e., 15% of the course grade)

### **Design Journals**

Each team member of every team (i.e., every student) must have a journal to record the design work done during the term. The journal must have bound pages and should be hard-cover (black or blue lab books available at the bookstore work well). You may continue to use a journal from a previous design course. Use the journal to sketch and record ideas, calculations, references and other sources of information, meeting minutes, schedules, to-do lists, etc. The journal should be shown to your Project Mentor during regular weekly meetings. The journal must be submitted by each student with the group's final report to your mentor as well as presented to your presentation evaluator, at the oral presentation.

## **Academic Integrity Policy**

Senate and Faculty of Engineering require all course outlines to include the following reminders:

“Students are reminded that they should read and comply with the Statement on Academic Ethics and the Senate Resolution on Academic Dishonesty as found in the Senate Policy Statements distributed at registration and available in the Senate Office.”

"Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g., the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university”.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty, please refer to the Academic Integrity Policy of McMaster located at

<http://www.mcmaster.ca/academicintegrity/students/index.html>

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g., the submission of work that is not one's own or for which other credit has been obtained.
2. Not participating fairly in the group project work.
3. Copying or using unauthorized aids in tests and examinations.

## **Discrimination**

“The Faculty of Engineering is concerned with ensuring an environment that is free of all adverse discrimination. If there is a problem, that cannot be solved by discussion among the persons concerned, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the Human Rights Consultant, as soon as possible.”

## **E-Mail Policy**

All email communication with the course instructor (Dr. Jain), Project Mentors and TAs must be made through the McMaster email system. Email sent within Avenue to Learn will not be read.

## **Missed Work (MSAF)**

Should any work be missed with valid reason, a student may apply for special consideration using the Missed Work Form Self Reporting Tool (<http://www.mcmaster.ca/msaf>) (MSAF). For policies that govern the MSAF system, please refer to the MSAF web site. If the MSAF form is issued then the student must obtain an approval and a course of action from the instructor (Dr. Jain). Please note that missed course components will not be added to the final exam. Missed assignments, exams and project components will be re-scheduled.