Instructor Dr. C. H. Hsu  
OCNL 324  
Phone: 530-898-5374  
chhsu@csuchico.edu  
Office hours: MT 1:00 – 2:50 PM

Prerequisites CIVL 311 with a grade C+ or higher, MECH 100, MECH 100L, MECH/MECA 140, MECH 210, SMFG 160. Recommended: MECH 320.

Class Times
Lecture: MWF 12:00–12:50 PM in OCNL 124, Activity: T 3:00-4:50 PM in OCNL 124

Textbooks

Grading
The overall course grade will be based on homework, projects, and exams:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
<th>Grade</th>
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</thead>
<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
<td>A: ≥85% of total</td>
</tr>
<tr>
<td>Midterms/Quizzes*</td>
<td>35%</td>
<td>B: 75-84% of total</td>
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<tr>
<td>Final Exam*</td>
<td>15%</td>
<td>C: 65-74% of total</td>
</tr>
<tr>
<td>Projects**</td>
<td>40%</td>
<td>D: 60-64% of total</td>
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</tbody>
</table>

* Selected exam problems are used to assess students’ ability to apply knowledge of Mathematics, science, and engineering (MECA and MENG).
** Projects are used to assess students’ ability to (a) carry out an engineering design to meet desired needs within realistic constraints (MENG), (b) communicate technical matters in written form (MECA and MENG), and (c) communicate technical matters in graphical form (MECA and MENG).

Minimum of sixty percent (60%) of course total AND sixty percent (60%) of homework-exams-quizzes total (0.6 x 60% = 36%) grades are needed to pass the course.

Course Organization
This course is divided into two parts. One part is intended to reinforce your knowledge from some previous courses and to acquire new knowledge of machine components, mechanical failure mechanisms, failure theories, and design against fatigue. The other part aims to integrate technical knowledge and familiarity with commercially available “standard” machine components in design projects.

Homework
Homework problems will be regularly assigned. Assigned problems are due at the start of the class period a week after they are assigned unless otherwise specified. Absence form class on the due day is not an excuse for not turning in homework. Assignments placed in my mailbox should not be later than the start of class time. Late homework will not be accepted.

Equation solving software (TK Solver, EES, or others) maybe required for specified problems, optional for others. Discussion with other students on suitable approaches to problems is encouraged, but the work should be completed individually by each student.

If not generated by computers, solutions should be done on the front side of engineering computation paper. All solution should be arranged in numerical order of problem numbers. Class number and student name should be visible on the first page. Solution keys will be posted on Blackboard Learn.

Exams
There will be three 90-minute midterm exams, some short quizzes, and a two-hour final
exam. All exams are open-book. The midterm exams primarily cover new topics from lectures, homework problems, specified textbook chapters, and reference material. Quizzes are on the most recent topics. Since the course is progressive, exams may inevitably include some material from previous exams. The final exam is comprehensive.

A make-up exam is available only with permission and prior arrangement. A doctor’s note is required for the absence from exams due to illness. A week advance notice/confirmation will be given for midterm dates. All students will take the final exam as scheduled by the university.

**Design Projects**

Design projects will allow the student to integrate knowledge from previous courses with that from this course, and consider various aspects of mechanical design. Design projects will vary in scope from small (individual) tasks to more comprehensive (group) ones. These design projects demonstrate student competency in mechanical engineering design as described in the Grading section.

For selected design projects, students are required to submit a design summary (executive summary) to the instructor (your supervisor) in the form of memorandum. The design summary is a brief, yet informative and concise, report of your final design solution. It includes problem description, engineering specifications and assumptions, decisions, and an adequate overview of your design solution that readers can understand and grasp. If needed, sketches, formal drawings, tables, or plots may be included. Keep in mind that the focus is on the design solutions, not the step-by-step narrative or chronological record of what you did to arrive at the final solution. Additional material may be required as stated in the assignment handout.

Formal Word-processed project reports with detailed drawings will be required for selected design project(s).

**Design Logbook**

Good documentation is key to a successful project. Logbook is a tool to document your design and development process. Logbook entries are important legal evidence of inventions.

The engineer’s logbook basically is a work diary where new ideas, research and development activities should be recorded. Each student should keep a logbook detailing the progress of his/her project(s). Typical entries include, but not limited to:

- Problems worked on, possible and actually solutions
- Ideas, decisions, analysis, calculations, experiments and results
- Notes on product information from catalogs, websites, vendors, or other sources
- Photos, drawings, sketches, graphs of hardware

The logbook should be a bound book (loose leaf is not allowed) with all pages sequentially pre-numbered. All entries should be dated and signed. Learning to keep a detailed logbook, as part of your college experience, is crucial in protecting your or employer’s intellectual properties in professional career. The design logbook will be graded.

**Student Learning Center**

The mission of the Student Learning Center (SLC) is to provide services that will assist CSU, Chico students to become independent learners. The SLC prepares and supports students in their college course work by offering a variety of programs and resources to meet student needs. The SLC facilitates the academic transition and retention of students from high schools and Community colleges by providing study strategy information, content subject tutoring, and supplemental instruction. The SLC is online at http://www.csuchico.edu/slc.

**Academic Honesty**

With computer-based assignments, it is often tempting and convenient to copy the work of others. This is plagiarism and is not tolerated. Incidences of plagiarism, or other forms of academic dishonesty, will be referred to the Student Judicial Affairs. Refer to the Academic
Honesty section of the university catalog at http://catalog.csuchico.edu/viewer/16/ACAREGS.html#AcademicHonesty, or ask the instructor if you are unclear about a specific situation.

If you need course adaptations or accommodations because of a disability or chronic illness, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Please also contact Accessibility Resource Center (ARC) as they are the designated department responsible for approving and coordinating reasonable accommodations and services for students with disabilities. ARC will help you understand your rights and responsibilities under the Americans with Disabilities Act and provide you further assistance with requesting and arranging accommodations. Accessibility Resource Center (530-898-5959) is in room 170 of the Student Services Center (https://www.csuchico.edu/arc/about/index.shtml).

Course Objectives

1) Learn a process for designing mechanical components or systems with a balance of the conceptualization and detail design phases of the process.
2) Synthesize and apply concepts from the engineering sciences including statics, dynamics, strength of materials, materials science, thermodynamics, fluids, etc.
3) Practice choosing parameters for a mechanical system (e.g., dimensions and material properties) based on a set of performance specifications.
4) Learn how to determine allowable stresses in a component based on an appropriate theory of failure and a reasonable set of assumptions including factors of safety where appropriate.
5) Learn how to mathematically model a selection of common mechanical components in order to predict particular performance measures and to utilize equation solving software to streamline the analytical solution process.
6) Have opportunities to be creative, and at the same time, mindful of the constraints imposed by material and economic limitations, manufacturing, standard practices, codes and standards, and impact to environment and society.
7) Be introduced to the concepts of uncertainty and reliability in design, as they pertain to material properties, manufacturing processes, and applied loads.

Course Outcomes

Students shall be able to:

1) Relate the steady-state input/output characteristics of machines to quantities such as torque, force, velocity, and angular velocity.
2) Determine stresses in straight, slender bodies caused by combinations of axial, shear, bending, and torsional loads.
3) Determine stresses in curved beams.
4) Determine miscellaneous stresses in machine components such as direct shear, tearout, and bearing stresses that occur commonly with interconnected machine parts.
5) Determine static and dynamic (fatigue) stress concentration factors and apply them where appropriate.
6) Determine principal stresses and effective von Mises stresses.
7) Size components for specified factor of safety using static failure theories.
8) Size components for specified factor of safety using fatigue failure theories.
9) Estimate and apply appropriate factors of safety for a given machine environment and loading, and apply them in selecting materials and sizing machine components.
10) Determine the appropriate size of a rotating shaft for infinite-life performance.
11) Gain knowledge for analysis and selection of components such as keys, bearings, gears, and springs based on accepted practice and theory for particular machine elements.
Design Drawings

Design drawings are expected to conform to the MMEM department drawing standards at:
http://www.csuchico.edu/mmem/drawing_standards.shtml, with Specific guidelines at

Templates for SolidWorks drawings which conform to the MMEM Department Standards for
working drawings are available on the College of ECC computer network in the folder
Y:\MMEM Dept Drawing Standards. Available files are:

1. MMEM Standard Drawing Template - Size A.slddrt
2. MMEM Standard Drawing Template - Size B.slddrt
3. MMEM Bill Of Materials Template.sldbomtbt
4. MMEM Revision Table Template.sldrevtbt

Search Engines

Online reference for engineers: http://www.efunda.com/home.cfm
Design: http://www.machinedesign.com
Machine components: https://www.thomasnet.com/browse/
http://www.mcmaster.com
Some part CAD models: http://www.thomasnet.com
Material properties: http://www.matweb.com

Course Schedule***

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<thead>
<tr>
<th>Week of</th>
<th>Topics</th>
<th>Textbook Chapter</th>
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<tbody>
<tr>
<td>1. 1/22 – 1/25</td>
<td>Introduction to Mechanical Engineering Design, Materials</td>
<td>Chapters 1, 2</td>
</tr>
<tr>
<td>2. 1/28 -2/1</td>
<td>Load and Stress Analysis</td>
<td>Chapter 3</td>
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<tr>
<td>3. 2/4 – 2/8</td>
<td>Load and Stress Analysis</td>
<td>Chapter 3</td>
</tr>
<tr>
<td>4. 2/11 – 2/15</td>
<td>Deflection and Stiffness, <strong>Midterm 1</strong></td>
<td>Chapter 4</td>
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<tr>
<td>5. 2/18 – 2/22</td>
<td>Failures Resulting from Static Loading</td>
<td>Chapter 5</td>
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<tr>
<td>6. 2/25 – 3/1</td>
<td>Fatigue Failure Resulting from Variable Loading</td>
<td>Chapter 6</td>
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<tr>
<td>7. 3/4 – 3/8</td>
<td>Fatigue Failure Resulting from Variable Loading</td>
<td>Chapter 6</td>
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<tr>
<td>8. 3/11 – 3/15</td>
<td>Shafts and Shaft Components, <strong>Midterm 2</strong></td>
<td>Chapter 7</td>
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<tr>
<td>9. 3/18 – 3/22</td>
<td>University Holidays</td>
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<tr>
<td>11. 4/2 – 4/5</td>
<td>Mechanical Springs</td>
<td>Chapter 10</td>
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<tr>
<td>12. 4/8 – 4/12</td>
<td>Rolling-Contact Bearings</td>
<td>Chapter 11</td>
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<tr>
<td>13. 4/15 – 4/19</td>
<td>Gears - General, <strong>Midterm 3</strong></td>
<td>Chapter 13</td>
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<tr>
<td>14. 4/22 – 4/26</td>
<td>Flexible Mechanical Elements</td>
<td>Chapter 17</td>
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<tr>
<td>15. 4/29 – 5/3</td>
<td>Clutches, Brakes, Couplings, and Flywheels</td>
<td>Chapter 16</td>
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<tr>
<td>16. 5/6 – 5/10</td>
<td>Design Project Review</td>
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<tr>
<td>17. 5/16 (Wed)</td>
<td>Final Exam, <strong>12:00 – 1:50 PM in OCNL 124</strong></td>
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***The schedule might be modified based student progress and time availability.