California State University, Chico  
MECH 340 - Mechanical Engineering Design  
Fall 2016

Instructor  Dr. C. H. Hsu  OCNL 313A  Phone: 530-898-5374  chhsu@csuchico.edu
Office hours:  W 2:00 – 2:50 pm

Prerequisites  CIVL 311 (Strength of Materials) with a grade C+ or better,
MECH 210 (Materials Science and Engineering), MECH 100 and 100L (Graphics I and Lab)

Class Times  MWF  11:00 – 11:50 am in LANG 104


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

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
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<tbody>
<tr>
<td>Homework</td>
<td>15%</td>
</tr>
<tr>
<td>Midterms*</td>
<td>40%</td>
</tr>
<tr>
<td>Final Exam*</td>
<td>15%</td>
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<tr>
<td>Design Projects**</td>
<td>30%</td>
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</tbody>
</table>

* Exams are used to assess students’ ability to apply knowledge of mathematics, science, and engineering.
** Design projects are used to assess students’ ability to (a) carry out an engineering design to meet desired needs within realistic constraints, (b) communicate technical matters in written form, and (c) communicate technical matters in graphical form.

Minimum of sixty percent (60%) of total AND sixty percent of homework/exams combined grade (0.6 x 70% = 42%) are needed to pass the course.

Course Organization  This course is divided into two primary parts. The first 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 second part is intended for you 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. Absence from 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 class time. Late homework will not be accepted.

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

If not generated by computers, homework problems should be done on one side of engineering calculation paper. All problem solution should be arranged in the same numerical order of problem numbers. Class number and student name should be shown on the first page. About half of the problems will be graded. Solution keys to the problems will be posted in the Blackboard Learn class folder.

Exams  There will be three 50-minute midterm exams and a two-hour final exam. All exams are open-book. The midterm exams primarily cover untested new topics from lectures, homework problems, specified textbook chapters, and reference material. Since the course is progressive, exams may inevitably include some material from previous ones. 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 exam due to illness. A week advance notice will be given for midterms. All students will take the final exam on the day and time scheduled by the university.

**Design Projects**

Design projects will allow you 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 open-ended textbook assignments to more comprehensive design projects. 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.

Formal Word-processed project reports with detailed CAD drawings will be required for selected design project(s). A grading rubric will be provided on grading specified project(s).

**Design Log Book**

Good documentation is key to a successful project. Log book is a tool to document your design and development process. Log book entries can also be important legal evidence of inventions.

The engineer’s log book basically is a work diary where new ideas, research and development activities should be recorded. Each student should keep a log book detailing the progress of his/her project. 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 catalog, websites, or vendor, or other sources
- Photos, drawings, sketches, graphs of hardware

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

**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. The consequence may range from failure in this course to expulsion from the University. Refer to the Academic Honesty section of the university catalog at [http://catalog.csuchico.edu/viewer/16/ACAREGS.html#AcademicHonesty](http://catalog.csuchico.edu/viewer/16/ACAREGS.html#AcademicHonesty), or ask the instructor if you are unclear about a specific situation.

**Course Objectives**

1) Learn a process for designing mechanical 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, and materials science.
3) Practice choosing parameters for a mechanical system (e.g., dimensions and material properties) based upon 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 relate 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) Apply stress concentration factors where appropriate.

6) Determine principal stresses due to combinations of simple stress states.

7) Size components using static failure theory.

8) Size components using fatigue failure theory.

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 selection of components such as bearings, gears, springs, threaded fasteners, clutches and brakes based on accepted practice and theory for particular machine elements.

**Design Drawings**

Design drawings are expected to conform to the MMEM department drawing standards. These drawing standards can be found on: [http://www.csuchico.edu/mmem/drawing_standards.shtml](http://www.csuchico.edu/mmem/drawing_standards.shtml).

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](http://www.efunda.com/home.cfm)

Design: [http://www.machinedesign.com](http://www.machinedesign.com)

Machine components: [http://www.thomasnet.com](http://www.thomasnet.com)
[http://www.mcmaster.com](http://www.mcmaster.com)

Some part CAD drawings: [http://www.thomasnet.com](http://www.thomasnet.com)

Material property: [http://www.matweb.com](http://www.matweb.com)

**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](http://www.csuchico.edu/slc).
## Proposed Course Outline

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<th>Week of</th>
<th>Topics</th>
<th>Textbook Chapter</th>
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<tbody>
<tr>
<td>1. 8/22 – 8/26</td>
<td>Introduction to Design</td>
<td>Chapter 1</td>
</tr>
<tr>
<td>2. 8/29 -9/2</td>
<td>Review of Materials Science and Strength of Materials</td>
<td>Chapters 2, 3, 4</td>
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<tr>
<td>3. 9/5 – 9/9</td>
<td>Static Failure Theories</td>
<td>Chapter 5</td>
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<td>4. 9/12 – 9/16</td>
<td>Fatigue Failure Theories</td>
<td>Chapter 6</td>
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<td>5. 9/19 – 9/23</td>
<td>Fatigue Failure Theories, <strong>Midterm 1</strong></td>
<td>Chapter 6</td>
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<tr>
<td>6. 9/26 – 9/30</td>
<td>Fatigue Failure Theories</td>
<td>Chapter 6</td>
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<td>7. 10/3 – 10/7</td>
<td>Surface Failure</td>
<td>Chapter 7</td>
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<td>8. 10/10 – 10/14</td>
<td>Shaft. Keys, and Couplings</td>
<td>Chapter 10</td>
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<td>9. 10/17 – 10/21</td>
<td>Bearings and Lubrication, <strong>Midterm 2</strong></td>
<td>Chapter 11</td>
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<tr>
<td>10. 10/24 – 10/28</td>
<td>Bearings and Lubrication</td>
<td>Chapter 11</td>
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<td>11. 10/31 – 11/4</td>
<td>Gears</td>
<td>Chapter 12</td>
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<td>12. 11/7 – 11/11</td>
<td>Gears</td>
<td>Chapters 12, 13</td>
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<td>13. 11/14 – 11/18</td>
<td>Spring Design, <strong>Midterm 3</strong></td>
<td>Chapter 14</td>
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<tr>
<td>14. 11/21 – 11/25</td>
<td>Thanksgiving break, no classes</td>
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<tr>
<td>15. 11/28 – 12/2</td>
<td>Screws and Fasteners</td>
<td>Chapter 15</td>
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<tr>
<td>16. 12/5 – 12/9</td>
<td>Screws and Fasteners</td>
<td>Chapter 15</td>
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<tr>
<td>17. 12/12 – 12/16</td>
<td>Final Exam, <strong>Monday (12/12) 12:00 – 1:50 pm</strong></td>
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