

**UNITED STATES COAST GUARD ACADEMY  
DEPARTMENT OF ENGINEERING**

**Credit Hours:** 4.0  
**Format:** Class / Laboratory  
**Prerequisite:** ME 1370 (Mechanisms)

**Course Description:** Design of machine elements, including considerations such as material strength, manufacturing processes, safety, reliability, stress concentration, fatigue, corrosion, and tribology. Mechanical power transmission devices, including shafts, gears, belts, springs, fasteners, bearings, and couplings. Introduction to mechanical component integration and design-and-build projects.

**Course Objectives:** Specific objectives from this course include the following abilities:

- Calculate stresses in curved members of various cross-sections.
- Calculate contact stresses and bending stresses in gears.
- Be able to select appropriate components for specific functions because s/he has sufficient understanding of the functional capabilities of common machine elements.
- Apply previous subjects (statics, strengths of materials, dynamics) to design situations and problems.
- Demonstrate a logical application of theory to the design of machine elements and demonstrate understanding of the necessary underlying assumptions and approximations.
- Demonstrate understanding of the relation between the strength of a machine element and its anticipated loading (static & dynamic) and analyze to select the optimum material and dimensions to prevent undesired failure.
- Demonstrate the proper use of safety factors.
- Conduct deflection analysis when important to design situations.
- Use CAD and multimedia tools to communicate effectively.
- Design a product and present the design to an audience of peers.

**Text:** Mechanical Engineering Design, 5<sup>th</sup> Ed. by Joseph E. Shigley and Charles R. Mischke

**References:** Mechanics of Materials, 4<sup>th</sup> Ed. by R. C. Hibbeler  
Engineering Mechanics: Statics, 9<sup>th</sup> Ed. by R. C. Hibbeler  
Fundamentals of Engineering Design, by Barry Hyman  
Marks' Standard Handbook for Mechanical Engineers, 10<sup>th</sup> Ed. by Eugene A. Avallone and Theodore Baumeister III  
Machinists' Ready Reference, 8<sup>th</sup> Ed. by C. Weingartner

**Instructor:** LT Michael Plumley                      ext: 6521                      Office: M102B  
email: [Michael.plumley@uscga.edu](mailto:Michael.plumley@uscga.edu)

<b>Grading:</b>	Homework	20 %	Design Project/ Lab Work	25 %
	Hourly Exams (3)	30 %	Final Exam	15 %
	Term Paper (1)	10 %		

**Grades:** Grades will be based on the following scale:  
A: 90-100                      B: 80-89.9                      C: 70-79.9  
Their will be plus and minus categories as appropriate.

**Course Structure:** Lectures, reading and homework will be presented as integrated pieces specifically designed to promote effective use of time and development of engineering analysis and problem solving skills. Students will need to use their time effectively. Effective use of time involves: spreading work out into consistent even pieces, being prepared to actively participate in class, productive use of resources and efficient studying.

Reading: Reading assignments are listed in the course schedule. Students should skim through each section prior to lecture at a level that prepares them to participate in class. Students should go back to the text after class to develop detailed understanding for homework, quizzes, and tests.

Lecture: It is assumed students have completed the assigned reading. Lecture time will generally be devoted to definitions, outlining key concepts, the solution of example problems, and the review of homework problems. Selected students may be tasked to set up and work through homework related problems.

Homework: The homework problems are shown on the course schedule. Small group collaboration with other students in which each student works on and understands the solution to each problem is encouraged. Group effort in which solutions are copied from other group members is not acceptable. Each homework assignment is weighted equally for grading purposes except where specified. The problems are due at the beginning of class on the dates as listed on the schedule. Late homework will be accepted for half credit at any time up to the beginning of the next scheduled exam.

Homework shall be completed on green engineering paper, front face only or white (notebook or plain) paper with similarly delimited margins and binder holes. Begin each problem on a new page unless problems are short. Homework shall be neatly printed and all mistakes erased thoroughly. Place proper titles across the top of the page to include, at a minimum, "Name", "Date", "Course", "Problem Number", "Page Number/Total Number of Pages". Include a detailed problem statement, appropriate figures, assumptions, and calculations. Include comments about source of equations, figures or tables used, or material properties. Answers must include units and shall be clearly identified.

Exams and Quizzes: There will be three hourly exams. Exam dates are specified on the course schedule. There may be quizzes throughout the semester and grading will be determined based on the number of quizzes and their difficulty. Cadets requesting exemption from the final must have turned in all required work, must have a weighted average of 90% or above for homework, exams, and the design project, and must have demonstrated a mastery of all topics covered in the course. The final exam will be given at that time and place scheduled by the registrar.

Design Project: A design project will be assigned in the laboratory portion of this course and will be discussed separately in lab. The project involves the design and build of a system having multiple machine components. Students will perform analyses on the components prior to construction to ensure reliability, submit a report, and present their findings.

Assistance and Documentation: Students are highly encouraged to seek assistance and to work together to learn the material. Homework completed with assistance or guidance from someone else will be accepted for full credit provided it represents the understanding of the student. Copying homework from other students, or from past or present homework solutions is expressly forbidden. Assignments completed with assistance or guidance from someone or something other than the student completing it must be documented with a brief statement specifying the type and source of help received.

Course Notebook: Every student is encouraged to maintain a course notebook, the keeping of which is entirely at student discretion.

### Achieving Educational Outcomes

This course, which is required of all students majoring in ME, is intended to help you achieve some of the desired outcomes of an undergraduate engineering program. The accrediting agency for engineering programs, ABET, has specified the following as required outcomes for all undergraduate engineering majors. Areas shown in italics only indicate that some knowledge development should occur as a result of completing this course. Those areas in bold and italics indicate outcomes that are intended to have significant knowledge development by your experience in this course. At the completion of the course, you will be asked to self-evaluate how well you have achieved these outcomes through your efforts:

*Engineering programs must demonstrate that their graduates have:*

- 1. An ability to apply knowledge of mathematics, science and engineering***
- 2. An ability to design and conduct experiments as well as to analyze data***
- 3. An ability to design a system, component or process to meet desired needs***
- 4. An ability to function on multi-disciplinary teams*
- 5. An ability to identify, formulate and solve engineering problems***
- 6. An understanding of professional and ethical responsibility*
- 7. An ability to communicate effectively*
- 8. The broad education necessary to understand the impact of engineering solutions in a global and societal context*
- 9. A recognition of the need for and an ability to engage in life-long learning*
- 10. A knowledge of contemporary issues*
- 11. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.***
- 12. An ability to develop as leaders in the Coast Guard.*

Additional ABET requirements for graduates of Mechanical Engineering programs include:

- 1. Knowledge of chemistry and calculus based physics with depth in at least one;***
- 2. Ability to apply advanced mathematics through multivariate calculus and differential equations;***
- 3. Familiarity with statistics and linear algebra;*
- 4. The ability to work professionally in both thermal and mechanical systems areas including the design and realization of such systems.***

## Tentative Schedule-Revised 12OCT05

1	Th "M"	8/18	Course Intro; Design Process; Term Paper Intro	Chapter 1	
2	M	8/22	Limits, Fits, Tolerances, Dimensions	Sections 4-8 & 9	Personal Bio;
3	W	8/24	Tolerances; Project Intro	5-4,20 & 6-1 to 10	Thesis Draft;
LAB1	Th	8/25	Lab Safety & Project Intro		
5	F	8/26	Review Mechanics of Materials Quiz	Mech Mat'ls Ref	4-25a, 4-31
6	M	8/29	Review Mechanics of Materials Quiz	Mech Mat'ls Ref	Quiz Corr
7	W	8/31	Review Mechanics of Materials		Handout HW#5
LAB2	Th	9/1	Design Project-develop plan/alternatives		
8	F	9/2	Fatigue Strength	7-1 to 7-6	6-6, 6-8
	M	9/5	LABOR DAY		
9	W	9/7	Fatigue Strength		Submit paper biblio. & final thesis statement
LAB3	Th	9/8	Design Project-alternatives		
10	F	9/9	Endurance Limit	7-8 to 7-9	7-1
11	M	9/12	Fluctuating Stresses	7-12 to 7-15	7-5, 7-9
12	W	9/14	Fluctuating Stresses		
LAB4	Th	9/15	Gears/Design Project-calculations		
13	F	9/16	Gears-General and Trains	13-1to 8,13-12to 13	7-21, 7-22, 7-26
14	M	9/19	Gears-General and Trains		
15	W	9/21	Gears-Force Analysis and Shaft Sizing	13-14 & 18-1 to 5	HW Handout Problem "11-1" (some did 13-2,4)
LAB5	Th	9/22	EXAM #1/ Design Project		
16	F	9/23	Gears-Bending and Wear Stresses	2-21 & Chap 14	
17	M	9/26	Gears-Bending and Wear Stresses		13-22 (some did 13-21)
18	W	9/28	Gears-Bending and Wear Stresses/Test Discussion		
LAB6	Th	9/29	Design Project-calculations & drawings		
19	F	9/30	Belts and Chains	17-1 to 17-3	18-1
20	M	10/3	Belts and Chains	17-4 to 17-5	
21	W	10/5	Bearings-Rolling Contact	11-1,2,3,6,9,10	<b>17-1</b>
LAB7	Th	10/6	Design Project-calculations & drawings		
22	F	10/7	Bearings-Journal	12-1 and 13-16	<b>14-27</b>
	M	10/10	COLUMBUS DAY		
23	W	10/12	Bearings- Journal		{Exam Corr Due}, <b>11-9</b>
LAB8	Th	10/13	Design Project		
24	F	10/14	Springs- Ext and Compression	10-1 to 8	{Term Paper first draft due-15% grade}
25	M	10/17	Springs- Ext and Compression		
26	W	10/19	Spring Fatigue and Torsion	10-11 & 12	<b>HW Handout Problem (brg</b>
	Th	10/20	New War Threat Seminar		
27	F	10/21	Spring Fatigue and Torsion cont;		{Term Paper Reviews due-5% grade} <b>10-4, 10-11</b>
28	M	10/24	Spring Lab		<b>10-21</b>
29	W	10/26	Power Screws	8-1 & 8-2	
LAB9	Th	10/27	EXAM 2/ Design Project		
30	F	10/28	Power Screws & Threaded Fasteners	8-3 to 5	
31	M	10/31	Threaded Fasteners and Stiffness		
32	W	11/2	Bolt Strength and Loads	8-6 to 9 & 16	<b>8-6, 8-13</b>
LAB10	Th	11/3	Design Project		<b>Spring Lab Due</b>

**MACHINE DESIGN (1440)**
**FALL 2005**

33	F	11/4	Set Screws		
34	M "F"	11/7	Clutches	16-1 to 2	{Term Paper due}
35	W	11/9	Clutches	16-1 to 2	<b>8-20, 8-26</b>
<b>LAB11</b>	<b>Th</b>	<b>11/10</b>	<b>CLUTCHES/Design Project</b>		
	F	11/11	VETERANS DAY		
36	M	11/14	Clutches	16- 3	<b>16-7</b>
37	W	11/16	Brakes and Flyweels	16-6,7,10,12	<b>16-7</b>
<b>LAB12</b>	<b>Th</b>	<b>11/17</b>	<b>EXAM 3/Project</b>		<b>Clutch Lab Due</b>
38	F	11/18	Welding	9-1 to 9-5	
39	M	11/21	Welding		
40	W	11/23	Welding		
	Th	11/24	THANKSGIVING		
	F	11/25	THANKSGIVING		
41	M	11/28	TBD		<b>9-1, 9-5, 9-6, 9-10 (2 assignmen</b>
<b>LAB13</b>	<b>T "Th</b>	<b>11/29</b>	<b>Design Project</b>		<b>Additional Assignments may follow</b>
42	W	11/30	TBD		
<b>LAB14</b>	<b>Th</b>	<b>12/1</b>	<b>Design Project-PRESENTATIONS</b>		
43	F	12/2	TBD		
44	M	12/5	TBD		
45	W	12/7	Final Exam Review		
	M	12/12	Final Exam		

- Answers provided at the end of the chapter, but they may not always be correct.
- {} Are not calculated into homework grade.
- Pop quizzes are counted as homework assignments
- Lab reports are counted as two homework assignments each