

ME 414: Machine Design

Syllabus

Fall 2011

Course description:	Optimal design of machinery; analysis for prevention of machine elements failure.
Number of credits:	3
Prerequisites by course:	CE 215, ME 316 or c//, major in engineering; rec ME 220
Prerequisites by topic:	1. Concepts of stress, strain and their relationships 2. Axial, bending, torsion, shear loads and their combinations
Post requisites:	ME 416, ME 472, ME 530, ME 534
Textbooks/other required materials:	Budynas, R., Nisbett, J.K., <i>Shigley's Mechanical Engineering Design</i> , McGraw-Hill, 9/e.
References:	Hamrock, B.J., Schmid, S.R., Jacobson, B., <i>Fundamentals of Machine Elements</i> , Elizabeth A. Jones, 2/e. Norton, R. L., <i>Machine Design: An Integrated Approach</i> , Pearson Education, 3/e.
Class:	Pullman Campus: M, W, F 9.10AM, EME B46 OC Campus: : M, W, F 9.10AM, HSS 306
Instructor:	Dr. Uma Jayaram E-mail: ujayaram@wsu.edu ; Phone: 335-8571, 335-1900 (Lab) Office: ETRL 249/252 VRCIM Lab
Office Hours:	Tues 2:45-3:45PM
TA:	Bryant Hawthorne E-mail: bryant.hawthorne@email.wsu.edu Office: ETRL 249/252 VRCIM Lab Office Hours: Tues 2:45-3:45PM, Thu 11-12:30PM (or email to schedule additional times)
Course objectives:	The students will: 1. Review concepts of statics and strength of materials used to determine the stress, strain and deflection of one-dimensional structures. 2. Learn fundamental approaches to failure prevention for static

and repeated loading.

3. Consider the design of common machine elements such as shafts, fasteners, springs, bearings, and gears.
4. Solve an open-ended design problem involving cost, drawings, and structural analysis.

Topics covered:

1. 2-D stress
2. 1-D deflection and stiffness
3. Failure criteria
4. Fatigue
5. Shafts and shaft components
6. Gears
7. Springs
8. Fasteners
9. Bearings
10. Other machine elements

Expected student outcomes:

The students will be able to:

1. Determine the stress, strain and deflection of simple machine elements.
2. Estimate safety factors of simple structures exposed to static and repeated loads.
3. Determine performance requirements in the selection of commercially available machine elements.
4. Solve simple, open-ended design problems.

Class schedule:

Three 50-minute lectures per week, for one semester

Laboratory schedule:

None

Contribution to meeting the professional component:

Engineering Topic.

Relationship of course to program objectives:

Meets: Program Objectives 1 and 2.
Program Outcomes *a*, *c*, and *e*.
EC 2000 Criterion 3 Outcomes *a*, *c*, and *e*.

Grading:

Homework - 20%
In Class Work/Quizzes - 20%
Tests - 50 %
Project - 10%

Angel Website:

<https://lms.wsu.edu/>

Detailed Content: (May be modified during the semester)

Topic 1	Introduction to Mechanical Design – Course Overview, Design Process; Materials – Material Properties, Materials Selection, Combined Loading
Topic 2	Load and Stress Analysis – Equilibrium and Free Body Diagrams, Shear Force and Bending Moments, Stress, Strain, Torsion, Mohr’s Circle
Topic 3	Deflection and Stiffness – Deflection Due to Bending, Deflection Analysis, Compression, Elastic Stability
Topic 4	Failures Resulting from Static Loading – Static Strength, Stress Concentration, Failure Theories for Ductile and Brittle Materials, Cyclic Stress, Fatigue Regimes
Topic 5	Fatigue Failure Resulting from Variable Loading, Fatigue Strength and Endurance Limits, Fluctuating Stresses and Influence of Non-Zero Mean Stress, Combination of Loading Modes
Topic 6	Shafts and Shaft Components – Shaft Materials, Shaft Layout, Shaft design for Stress, Deflection Considerations, Critical Speeds for Shafts
Topic 7	Gears – Types of Gears, Gear Trains
Topic 8	Gears - Force Analysis, Spur and Helical Gears, Bevel and Worm Gears, Selection of Gears
Topic 9	Mechanical Springs – Stresses and Deflection in Helical Springs, Compression Springs, Stability, Spring Materials
Topic 10	Screws, Fasteners and the Design of Nonpermanent Joints – Thread Standards and Definitions, Threaded Fasteners, Joints, Bolt Strength
Topic 11	Rolling Contact Bearings and Lubrication – Bearing Types, Bearing Life, Bearing Life, Rating Life, Selection of Bearings
Topic 12	Clutches, Brakes, and Flywheels, Flexible Mechanical Elements
Topic 13	Design Case Studies and Project Presentations

Disability Statement:

Reasonable accommodations are available for students who have a documented disability. Please notify the instructor during the first week of class of any accommodations needed for the course. Late notification may cause the requested accommodations to be unavailable. All accommodations must be approved through the Disability Resource Center (DRC) in Administration Annex 205, 335-1566 in Pullman

Make-up Policy

Make-up will be given for tests only in the following cases:

- Prior permission
- University authorized travel/absence
- Genuine illness leading to hospitalization or some other emergency