

Course Plan

School : Engineering
Department : Mechanical Engineering
Course Code : ME-305
Course Name : Mechanical Design
Instructor : Dr. Dilip Datta (Autumn Semester 2016)

Abstract: In this course, the analytical design of various machine elements under different loading and service conditions is taught. The covered main topics include riveted joints, welded joints, threaded fasteners, power screws, shafts, shaft coupling, keys, pins, belt drive, rope drive, gear, spring, bearing, clutches, and brakes.

Objective: The main objectives of teaching the course are:

- To make the students familiar with different design considerations, such as safety factor, service factor, stress concentration, dynamic effect, and failure conditions.
- To analyze various forces acting on a machine component and accordingly to design it subject to related design considerations.
- Also to introduce various design standards and their applications.

Prerequisites of the course: Good knowledge on *Theory of Mechanisms and Machines* is essential in designing a machine component. The students have already studied this course (ME-207) in the previous semester (4th semester).

Evaluation Plan:

SN	Evaluation	Marks
1	Test I	25
2	Test II	25
3	Mid-term (Major I)	40
4	Test IV (Assignment)	25
5	Test V	25
6	End-term (Major II)	60
Total		200

Pedagogy: Lecture and discussion, tutorials, tests, and home assignments.

Expected outcome: Towards the end of the course, the student should be familiar with different design considerations as well as will be able to analyze and design various machine components.

Referred books:

1. V. B. Bhandari, *Design of Machine Elements*, 3/e, Tata McGraw-Hill, New Delhi, 2010
2. J. E. Shigley et al., *Mechanical Engineering Design*, Tata McGraw-Hill, New Delhi, 2008
3. M. F. Spotts et al., *Design of Machine Elements*, 8/e, Pearson Education, Delhi, 2006
4. P. Kanniah, *Machine Design*, 2/e, Scitech Publications Pvt. Ltd., Chennai, 2003.

Lesson Plan:

SN	Topic	Contents	L+T
1	Introduction	Definition and types of machine design; Engineering materials.	1+0
2	Mechanics of Solids	Factor of safety; Two-dimensional stress analysis – general stress system, principal planes and stresses, maximum shear stress.	1+0
3	Failure Theories and Dynamic Loading	Modes of failure; Old failure theories (maximum principal stress, maximum principal strain, total energy, energy of distortion); Modern failure theories (Tresca or maximum shear stress, von Mises or octahedral shear stress); Dynamic loading – stress, endurance limit, failure theories (Gerber, Soderberg and Goodman lines).	2+0
4	Riveted joints	Lap and butt joints; Failure modes (tearing of plates, shearing and crushing of rivets); Eccentric loading; Design of structural and boiler joints.	4+2
5	Threaded Fasteners and Power Screws	Terminologies; Stresses in bolted joints due to initial tightening and external loads; Eccentric loading; Failure theories; Stress under dynamic loading; Power screws – force analysis, self-locking and efficiency of square threaded screw jack.	5+2
6	Welded Joints	Lap and butt joints; Stresses in lap and butt joints; Eccentric loading; Welded joints under bending moment.	2+1
7	Shafts Design	Types of shafts; Shafts under bending and torsion; Rigidity of shafts.	2+1
8	Shaft Coupling	Classification; Design of sleeve/muff and flange couplings.	2+1
9	Keys and Pins	Types of keys; Design of square and flat keys; Design of taper pins.	1+1
10	Belt Drive	Flat and V belts; Velocity ratio and length; Tensions; Power transmission; Velocity for maximum power transmission; Stresses.	4+1
11	Spring Design	Stress and deflection in helical spring, Design of compression and tension helical springs, Fatigue loading in spring.	4+1
12	Gear Design	Spur and Helical Gears; Geometry of gears; Laws of gearing; Force analysis; Lewis's beam strength of gear tooth; Gear design against wear.	5+2
13	Bearing Design	Lubricants and lubrications; Petroff's relationship; Journal bearing; Heat dissipation; Rolling contact bearing – types, life, equivalent radial load, selection of bearing.	5+2
14	Friction Clutches	Torque transmission in disk clutch (uniform pressure and wear); Multi-disk clutch.	2+1
15	Brakes	Classification; Shoe brake; Band brake; Hand brake; Thermal considerations during braking.	2+1
Total			42+16