

S.E. (Production)-2012 & 2015 course
Design of Machine Elements
(Semester - II)

Time: 2 Hours**Max. Marks : 50****Instructions to the candidates:**

- 1) *Neat diagrams must be drawn wherever necessary.*
- 2) *Figures to the right side indicate full marks.*
- 3) *Use of Calculator is allowed.*
- 4) *Assume Suitable data if necessary*

- Q1) a) A shaft is subjected to bending moment of 500 N-m and twisting moment of 400N-m. Find the diameter of the shaft considering factor of safety 2. For shaft material, ultimate tensile stress = 700 MPa; yield stress = 400 MPa; corrected endurance limit = 270 MPa. [8]
- b) A spring is designed to absorb the shock of impact of 2 KN force falling freely from a height of 0.5m. Find maximum stress induced in spring if it has wire diameter of 25mm, spring index is 10, Number of active coils are 20, and Modulus of rigidity of spring material is 80 GPa. [8]

OR

- Q2) a) A power screw having double start square threads of 25 mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 KN. Coefficient of thread friction is 0.2 and allowable thread bearing pressure is 5.8 MPa. Determine shear stress in the screw and number of threads of nut in engagement with screw. [10]
- b) An element is subjected to following stress conditions: [6]
 Stress component along x direction (σ_x) = 90 MPa, Stress component along y direction (σ_y) = -60 MPa, and shear stress (τ_{xy}) = 20 MPa.
 Calculate Maximum and minimum principal stresses and maximum shear stress.
- Q3) a) Explain terminology of spur gear. [8]
- b) Design a pair of spur gears having reduction ratio 1:3 used to transmit 5KW power at 1750 rpm of pinion. Permissible bending stress for both gear and pinion material is 220 MPa. Assume face width to be 10 times module, Lewis form factor $y = 0.154 - \frac{0.912}{Z}$. Where, Z is number of teeth, and factor of safety as 1.5. [9]

Assume number of teeth on pinion as 20.

OR

- Q4) a) A pair of spur gears with 20° involute full depth teeth has a module 6 mm. the pitch circle diameter of gear is 300 mm. The gear ratio is 2.5:1. For each wheel, calculate the number of teeth, outside diameter, root diameter, base circle diameter. Also calculate addendum, dedendum, total depth, and clearance. [9]

- b) Determine the number of teeth on all gears and draw the layout of a single stage two speed reduction gear box operating with minimum speed of 300 rpm and geometric progression ratio as 1.6. Assume minimum number of teeth on any gear as 20. What will be the center distance between shafts if module for gears is 6? [8]

- Q5) a) A ball bearing operates on the following work cycle: [12]

Element No.	Radial load (N)	Speed (RPM)	Element time (%)
1.	4000	300	35
2.	7000	450	25
3.	4500	500	40

The dynamic load capacity of the bearing is 25000 N. Calculate the average speed of rotation, equivalent radial load and the bearing life.

- b) Why the radial load capacity of roller bearing is more than that of ball bearing? [5]

OR

- Q6) a) A certain application requires a bearing to last for 2200 hours at 1500 rpm with a reliability of 95%. What should be the rated life of bearing? [5]

- b) Define the following terms related to rolling bearing: [6]

i) Rating life

ii) Median life

iii) Dynamic load carrying capacity

iv) Load life relationship.

- c) With neat sketch, explain the working of self-aligning ball bearing and spherical roller bearing? Also state their applications. [6]