

CT Inst. of Engg

Roll No.

Total No. of Pages : 03

Total No. of Questions : 09

B.Tech. (IE-2008 Batch)/(ME) (Sem.-5th)**MACHINE DESIGN-I**

Subject Code : ME-301

Paper ID : [A0814]

Time : 4 Hrs.

Max. Marks : 60

INSTRUCTION TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students has to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students has to attempt any TWO questions.

SECTION-A**I. Answer briefly :**

- a. Explain the contribution of Brain Storming in Machine Design with a suitable example.
- b. State the functions of shaft, coupling and lever as machine elements.
- c. Draw a rough sketch (outlines only) of any mobile set and discuss the ergonomic view point in design features.
- d. Differentiate between crushing and bearing stress with a suitable example.
- e. Why is it not important to consider stress concentration factor in case of ductile material subjected to static loading?
- f. How is torque transmitted through clamp or compression coupling? Explain with suitable figures indicating the forces.
- g. Where are stepped shafts employed? Draw two configurations of stepped shafts and discuss the advantages of respective configuration.

- h. A tube is to be designed to support a tensile load. The calculations result in outer and inner diameters of 59.8 mm respectively. Recommend the standard sizes with justifications.
- i. Can we connect two square rods with spigot and cotter joint? If, NO, why? If, YES, how?
- j. Radius of a circular wire is decreased to half its original value. Find the stretch of the wire by a load of 200 kN if the modulus of elasticity of the wire is 200 GPa.

SECTION-B

2. A hollow shaft is required to transmit 600 kW at 1500 rpm. The torque being 20% greater than the mean. The maximum shear stress should not exceed 63 MPa and twist in a length of 3 m not more than 1°. Find the external diameter of the shaft, if the internal diameter is 3/8 of the external diameter.
3. A gib and cotter joint is used to connect two rectangular bars of section and is subjected to a tensile load of 100 kN. The allowable stress in tension is $\sigma_t = 75 \text{ N/mm}^2$ and the strength in compression is twice the strength in tension. Design the strap (cotter) and gib. The load carrying capacity is almost 1.25 times the tensile strength of the possible mode of failure.
4. An angle 100 mm × 90 mm × 10 mm is welded to a wall on the broader side of the angle. The size of weld is 8 mm. The allowable stress in weld is 90 MPa. The angle is subjected to a tensile load of 100 kN. Find the weld length.
5. Design a Muff coupling to transmit 5 hp at 1440 rpm. The allowable stress in the material is 100 MPa. Design the coupling with appropriate dimensions and properties.
6. Prove the following for the design of a fulcrum pin.

$$\frac{l_p}{d_p} = 0.686 \sqrt{\frac{\sigma_d}{p_b}} \quad \text{Symbols have their usual meaning}$$

SECTION-C

7. A cantilever beam of rectangular cross section has a span of 800 mm. The depth is 200 mm. The free end of the beam is subjected to a transverse load that fluctuates 80 kN upward to 50 kN downward. It is made of steel having ultimate strength of 550 MPa and yield strength of 400 MPa. Find the width of section taking factor of safety of 2.5. The size and surface factors are 0.8 and 0.85 respectively.
8. A steel bolt of M20 is used to connect two plates of each 16 mm thick. A soft copper gasket of 3 mm thickness is used in between the plates for the joints to be leak proof. The outside and inside diameters of gasket are 50 mm and 22 mm respectively. Take modulus of elasticity of bolt material as 200 MPa and for gasket material as 120 MPa. The bolt is subjected to an axial load 15 kN. Determine the stress induced in the bolt.
9. Two lengths of mild steel tie rods having width 200 mm and thickness 12.5 mm are to be connected by means of a riveted joint with equal straps. Design the joint if the permissible working stresses are $\sigma_t = 80 \text{ MPa}$; $\tau = 50 \text{ MPa}$ and $\sigma_c = 150 \text{ MPa}$. Also determine the efficiency of the joint.