Instructions: (1) All questions are compulsory.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.
(5) Preferably, write the answers in sequential order.

1. Attempt any FIVE of the following: [10]
   (a) Define term 'Stress Concentration'.
   (b) State the significance of 'Wahl's factor'.
   (c) Explain Torsional Shear Stress
   (d) Classify 'Key'.
   (e) Explain Term “Self-locking of Screws”.
   (f) List the applications of sliding contact bearings.
   (g) Define Term “Dynamic Load Rating” of Bearing.

2. Attempt any THREE of the following: [12]
   (a) Enlist the steps involved in general design procedure.
   (b) Differentiate between Knuckle joint and Cotter joint. (any four points of difference)
   (c) State the effect of keyway on the strength of the shaft.
   (d) State the strength equations of double parallel fillet weld and single transverse fillet weld with neat sketches.

3. Attempt any THREE of the following: [12]
   (a) Define term 'factor of safety'. State its importance in design of machine elements.
   (b) Compare welded joints with screwed joints.
   (c) Define following terms with respect to springs:
       (i) Free length  (ii) Solid height  (iii) Spring rate  (iv) Spring index
   (d) List the factors to be considered while selecting the material for design of Machine element.
   (e) A wall bracket as shown in figure is fixed to a wall by means of four bolts. Find the size of the bolts. The safe stress in tension for the bolt may be assumed as 70 N/mm².

4. Attempt any TWO of the following: [12]
   (a) Explain with suitable example the importance of Aesthetics and Ergonomics while designing Machine element.
   (b) Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression.
   (c) A hollow shaft is to be designed to transmit 600 kW at 110 rpm. The maximum torque
being 20% greater than the mean. The shear stress is not to exceed 63 MPa and angle of twist in a length of 3 met. not to exceed 1.4 degree. Find external diameter of the shaft if the internal diameter to external diameter is 3/8. Take modulus of rigidity 84 GPa.

5. Attempt any TWO of the following:

(a) Design a bushed pin type flexible coupling for connecting a motor shaft to a pump shaft for the following service conditions.
   - Power to be transmitted = 40 kW.
   - Speed of the motor shaft = 1000 RPM.
   - Diameter of the motor shaft = 50 mm
   - Diameter of the pump shaft = 45 mm
   - The bearing pressure in the rubber bush and allowable stress in the pins are to be limited to 0.45 N/mm$^2$ and 25 MPa respectively.

(b) A power screw on a machine has single start square thread with a non rotating bronze nut. Axial force on the screw is 15 kN. Allowable stresses for screw material in compression and shear are 85 MPa and 37 MPa respectively. Allowable bearing pressure for the screw nut pair is 5 MPa. Find
   (i) Core diameter of screw
   (ii) Length of the nut
   (iii) Efficiency of power screw in coefficient of friction between screw and nut is 0.12.

(c) Write down the procedure for selection of bearing from manufacturer's catalogue with suitable example.

6. Attempt any TWO of the following:

(a) (i) A plate 100 mm wide and 10 mm thick is to be welded by another weld by means of double parallel fillet welds. The plates are subjected to a static load of 80 kN. Find the length of weld.
   (Take permissible Shear stress = 55 N/mm$^2$).
   (ii) Draw Symbolic Representation of

(b) A closed coil helical spring is used for front suspension of an automobile. The spring has stiffness 90 N/mm with square and ground ends. The load on the spring causes a total deflection of 8.5 mm. By taking permissible shear stress of material as 450 MPa. Find
   (i) Spring wire diameter
   (ii) Length of spring
   Assume spring index = 6 and $G = 80 \times 10^3$ N/mm$^2$

(c) A belt pulley is fastened to a 90 mm diameter shaft running at 300 r.p.m. by means of a key 20 mm wide and 140 mm long. Allowable stress for the shaft and key material are 40 N/mm$^2$ in shear and 100 N/mm$^2$ in crushing. Find the power transmitted and the depth of the key required

T.Y. Diploma Sem-V: Paper Discussion Schedule

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<td>Group</td>
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