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Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

(8) Use of steam tables, logarithmic, Mollier's chart is permitted.

Marks

1.   **Attempt any FIVE of the following:**   **10**

a) Explain term 'Endurance Limit'.

b) State the significance of Wahl's correction factor in Design of spring.

c) List any four applications of Foot lever.

d) Classify Keys.

e) Draw Acme and V thread profile.

f) List different materials used for making springs.

g) Name any two bearing manufacturers.

Marks

2.   **Attempt any THREE of the following:**   **12**

   a) Explain in brief the general design procedure.

   b) Explain design procedure of muff coupling.

   c) Design an offset link for a load of 1000 N. Maximum permissible stress in tension for link material is 60 N/mm^2. Assume $b = 3t$ for rectangular cross section of the link. Refer Fig. No. 1.
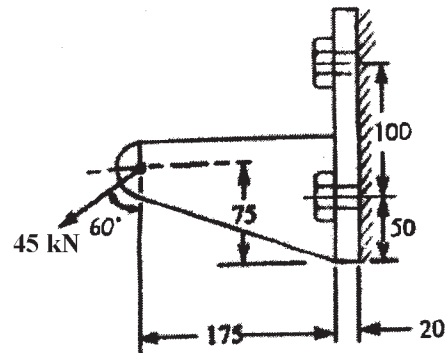
Fig. No. 1.

   d) A bracket as shown in Fig. No. 2 is fixed to a vertical steel column by means of four standard bolts. Determine the diameter of the fixing bolts. Assume safe working stress of 70 MPa in tension and 50 MPa in shear.

Fig. No. 2.

Marks
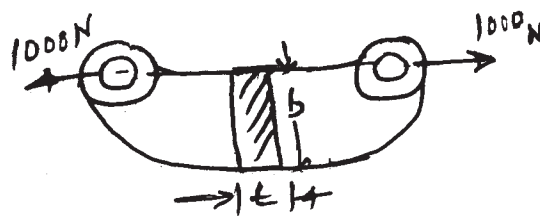
3. Attempt any THREE of the following: **12**

a) State the meaning of following colour codes used in Aesthetic considerations while designing a product

     i) Red

     ii) Green

     iii) Orange

     iv) Blue

b) Explain the term Self locking and overhauling of Screw.

c) Explain construction of leaf spring and state its applications.

d) Explain the term 'Stress Concentration'. State its causes and remedies with suitable example.

e) Write strength equations for designing symmetrically loaded parallel and transverse weld with neat sketch.

4. Attempt any TWO of the following: **12**

a) State the necessity of 'Ergonomic' considerations while designing product. Explain any four ergonomic consideration in the designing of machine element.

b) Design a Knuckle joint to withstand 150 kN, the design stress are 75 MPa, 60 MPa and 150 MPa in tension, shear and compression respectively.

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 mts 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.

Marks

5. **Attempt any TWO of the following:**   **12**

a) 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.

b) A screw jack is used to lift a load of 50 kN through a maximum lift of 200 mm. The material used for a screw is steel of allowable stresses in tension and compression as 100 N/mm^2 and 50 N/mm^2 respectively. The pitch of screw is 8 mm. The nut is made of phosphor bronze with allowable stresses as 50 N/mm^2 and 45 N/mm^2 in tension and crushing. The allowable shear stress for nut material is 40 N/mrn^2. The allowable bearing pressure between nut and screw is not to exceed 20 N/mm^2. If the coefficient of friction between screw and nut is 0.14, design the screw and nut.

c) Explain the selection process of deep groove ball bearing for given application with manufacturer's catalogue with suitable example.

6. **Attempt any TWO of the following:**   **12**

a) A double start square thread of power screw has nominal diameter 100 mm pitch 12 mm is to used to raise the load of 300 kN. The coefficient of friction at screw thread is 0.25 Neglect collar friction calculate Torque required.

b) A helical spring is made from a wire of 8 mm diameter and has outside diameter 90 mm; if the permissible shear stress is 350 N/mm^2 and modulus of rigidity 84 kN/mm^2, find the axial load which the spring can carry and the deflection per active turn.

    i) Neglecting the effect of curvature

    ii) Considering the effect of curvature

c) Design "C" clamp frame for a total clamping force of 20 kN. The cross-section of the frame is rectangular and width to thickness ratio is 2. The distance between the load line and natural axis of rectangular cross section is 120 mm and the gap between two faces is 180 mm. The frame is made of cast steel for which maximum permissible tensile stress is 100 N/mm^2.

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