

Design of Machine Elements

P. Pages : 3

Time : Three Hours

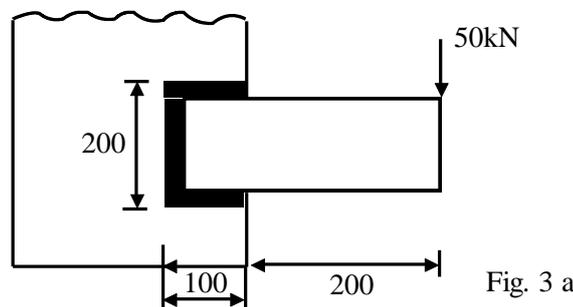


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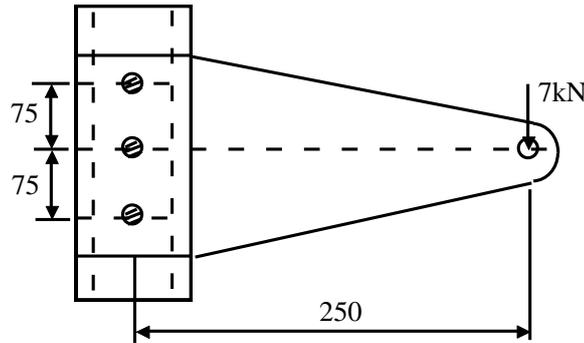
Max. Marks : 80

- Notes :
1. All questions carry marks as indicated.
 2. Solve Question 1 OR Questions No. 2.
 3. Solve Question 3 OR Questions No. 4.
 4. Solve Question 5 OR Questions No. 6.
 5. Solve Question 7 OR Questions No. 8.
 6. Due credit will be given to neatness and adequate dimensions.
 7. Assume suitable data whenever necessary.
 8. Illustrate your answers whenever necessary with the help of neat sketches.
 9. Use of non programmable calculator is permitted.
 10. Use of design data book is permitted.

1. a) Explain basic process of designing the machine element. **8**
b) Design a Knuckle joint to connect rods of wagons for carrying axial tensile load of 75kN. Rods are co-axial and small angular movement between there axes is permissible consider material for joint as SAE1030 steel and factor of safety as 2. **12**
2. a) State and explain various manufacturing considerations used in designing of machine component. **8**
b) Design a socket and spigot cotter joint for carrying an axial load of 60kN. Consider Steel SAE1020 as material for joint. **12**
3. a) A welded connection of steel plates as shown in Fig. 3 a is subjected to an eccentric load of 50kN. Determine the size of weld. If permissible shear stress in the weld not to exceed 80 N/mm^2 . **10**



- b) A steel plate subjected to a force of 7kN is fixed to a channel by means of three identical bolts as shown in Fig. 3-b. **10**



Consider bolt material as carbon steel having $\rho_{y+} = 400 \text{ N/mm}^2$ and factor of safety is '3'. Determine diameter of bolt.

4. a) Design a cylindrical pressure vessel to store a gas at pressure of 5mpa. Consider internal diameter of vessel as 300mm and it is made of steel SAE1040 material. **16**
Determine
- i) Thickness of cylinder
 - ii) Number of bolts, size of bolts and bolt material
 - iii) Gasket material for leak proof it.
 - iv) Thickness of top and bottom cover plates considering it to be flat circular.
- b) State various applications of pressure vessel-4 explain in brief how pressure vessels are classified. **4**
5. A shaft made of SAE1045 steel is supported on two bearings B_1 and B_2 which are 500mm apart. The shaft carries two pulleys P_1 and P_2 located at 100mm from both bearings inside the bearings. Pulley ' P_1 ' has horizontal belt drive and pulley ' P_2 ' has vertical belt drive. The shaft receives power from pulley ' P_1 '. The tensions in belt running over pulley ' P_1 ' are 1500N and 300N. Belt tension ratio of pulley ' P_2 ' is 3:1. Diameter of pulley P_1 is 200mm and that of pulley P_2 is 475mm. Consider self weight of pulley ' P_1 ' and ' P_2 ' as 75N and 100N respectively. Find diameter of shaft assuming ASME code. Consider $K_b = 1.75$ and $K_t = 1.25$. **20**
6. a) In a automotive plate type clutch six identical helical compression springs are arranged in parallel to provide the axial thrust of 1500N. The springs are compressed by 10mm to provide this thrust force. Consider spring index as '6' and permissible shear stress for spring wire as 550MPa. The springs have square and ground ends. Consider the gap of 1mm to be maintain between adjacent coils when spring is subjected to maximum force. Design the springs (Assume $G = 80 \text{ GPa}$). And determine all specifications. **10**

- b) A semi-elliptical leaf spring used in automobile suspension consists of three extra full length leaves and fifteen graduated leaves including master leaf. The center to center distance between two eyes of spring is 1 meter and band width is 100mm. The maximum force on spring is 75kN. The leaves are pre-stressed in such way that the force is maximum and stress induced in all leaves is same and equal to 450 N/mm^2 . Determine.
- Width and thickness of leaves
 - Initial gap
 - Initial pre load required to close the gap.
- Take $E = 2 \times 10^5 \text{ MPa}$.

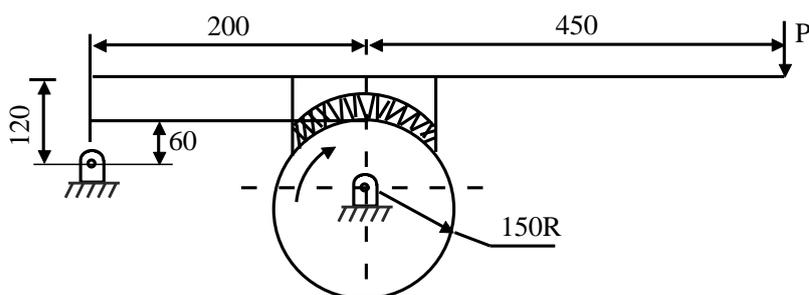
7. a) Design a multiplate clutch for transmitting 15kw power at 1400rpm. Consider coefficient of friction as 0.15 and permissible intensity of pressure as 0.8 N/mm^2 . 12

- b) Explain uniform wear and pressure theories used in design of clutch. Which theory is preferred? Why? 8

8. a) A slice valve used in water pipeline consist of gate weighing 7.5kN raised by the Spindle. Which is rotated by hand wheel. Spindle has single start square threads with nominal diameters of 36mm and pitch of 6mm. The inner and outer diameter of friction collar are 30mm and 50mm respectively. The coefficient of friction at thread and collar are 0.15 and 0.20 respectively. Consider frictional resistance to open the valve due to water pressure as 2.5kN. Using uniform wear theory calculation.

- Torque required to raise the gate
- Overall efficiency of mechanism.

- b) A single block brake with torque capacity of 15 N-m is shown in Fig 8-b. Coefficient of friction is 0.3 and the maximum pressure on brake lining is 1 N/mm^2 . 8



Calculate:

- Actuating force (P)
- Dimensions of block (Consider width of back equal to its thickness)
- Resultant hinge-pin reaction
