Total No. of Questions : 10]

SEAT No. :

**P2366**

[Total No. of Pages :5

# [4758] - 511
## T.E. (Mechanical)
## DESIGN OF MACHINE ELEMENTS - I
## ( 2012 Course) (Semester - I) (End Semester) (302041)

*Time : 3 Hours]* *[Max. Marks : 70*

***Instructions to the candidates:***

1) ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Assume suitable data if necessary, and mention it clearly.***
5) ***Use of Electronic Pocket Calculator is allowed.***

***Q1)*** a) Write in brief use of standards in design on machine element. What are three basic types of standards used in a design office? **[6]**

b) Determine the diameter below which the angle of twist of a shaft, and not the maximum stress, is the controlling factor in design of a solid shaft in torsion. The allowable shear stress is 55MN/m$^2$ and the maximum allowable twist is 0.3deg/m. (Consider a shaft with no key). G = 80 GN/m$^2$. **[4]**

OR

***Q2)*** a) A spring clip, made from a 25mm diameter rod, is shown in figure 1. Determine the maximum shear stress and specify its location or locations. **[6]**

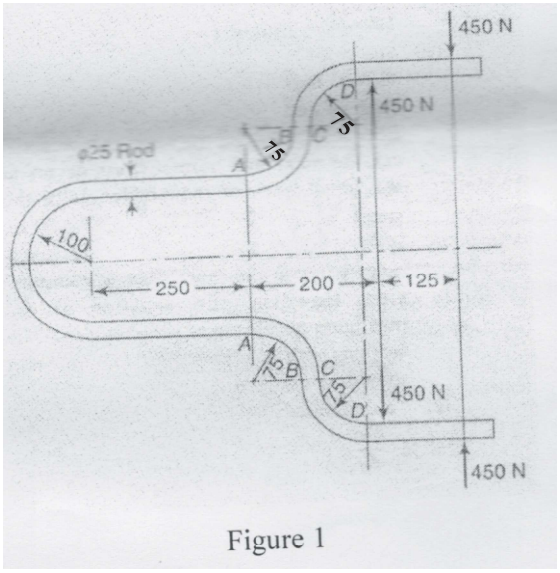



Figure 1

b) Explain design of splines. **[4]**

***P.T.O.***

***Q3)*** a) Explain ASME code of shaft design. **[2]**

b) Determine the diameter of a circular rod made of ductile material with a fatigue strength(complete stress reversal), $\sigma_e$ = 265 MPa and a tensile yield strength of 350MPa. The member is subjected to a varying axial load from Wmin = -300kN to Wmax = 700kN and has a stress concentration factor = 1.8. Use factor of safety as 2.0 **[8]**

OR

***Q4)*** a) Explain theories of failures used in Shaft Design. **[2]**

b) A centrifugal blower rotates at 600rpm. A belt drive is used to connect the blower to a 15kW and 1750 rpm electric motor. The belt forces a torque of 250N-m and a force of 2500N on the shaft. Figure 2 shows the location of bearings, the steps in the shaft and the plane in which the resultant belt force and torque act. The ratio of the journal diameter to the overhung shaft diameter is 1.2 and the radius of the fillet is 1/10$^{th}$ of overhung shaft diameter. Find the shaft diameter, journal diameter and radius of fillet to have a factor of safety 3. The blower shaft is to be machined from hot rolled steel having the following values of stresses:

Endurance limit = 180MPa, yield point stress = 300MPa, ultimate tensile stress = 450MPa. Theoretical stress concentration factor at fillet is 1.62, at keyway is 1.6. **[8]**

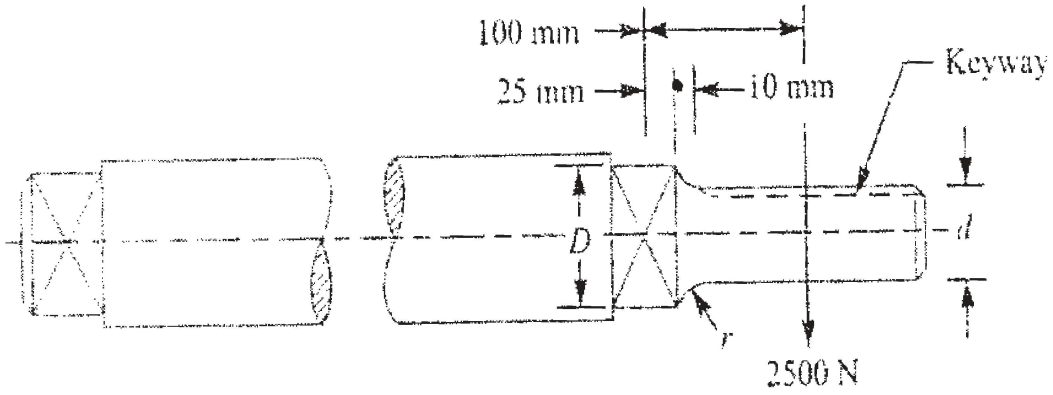



Figure 2

***Q5)*** a) Explain significance of helix angle in efficiency of square threaded screw. Also explain two methods to increase efficiency of a square threaded screw. **[6]**

b) Design nut of screw jack for taking up a load of 50kN for a lift taking up a load of 50KN for a lift of 500mm. Take $S_{yt}$ = 300MPa, Factor of safety = 5, pitch = 12mm and $P_b$ = 12MPa. **[10]**

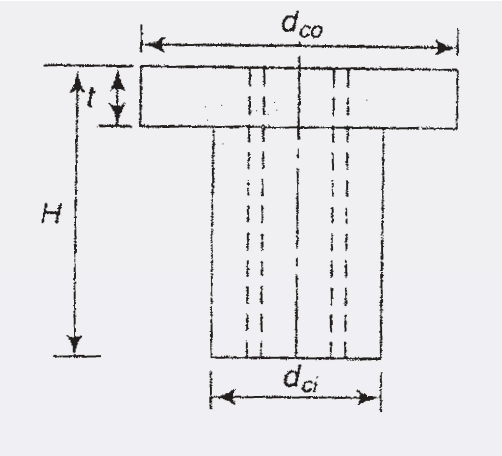



Figure 3

OR

***Q6)*** a) Explain with neat sketch recirculating ball screw. State its applications. **[6]**

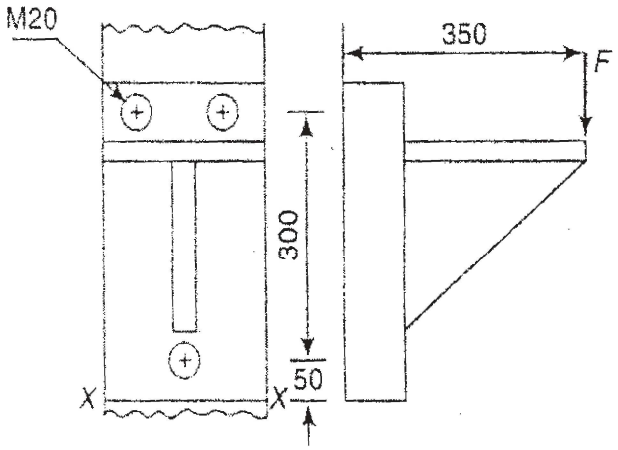
b) A load of 600kN is to be raised and lowered by means of two square threaded screws. If the coefficient of frictions between the screw and nut is 0.048, determine the size of screw and nut. Take $\sigma_t$ =80MPa, P = 15MPa, pitch = 10mm. Find also the torque required to raise and lower the load. **[10]**

***Q7)*** a) Derive the strength eq$^n$ of **[8]**

i) single transverse fillet weld

ii) double parallel filled weld.

b) A steel bracket as shown in Figure 4 is mounted on a wall by means of three bolts of M20 size. Find the maximum load which may be taken by the bracket when applied at 350mm from the wall. Ignore initial tightening of bolt. Take $S_t$ = 60MPa. **[8]**




OR

Figure 4

OR

***Q8)*** a) Explain with neat sketch 4 types of screw fasteners. **[8]**

b) Determine the torsional stress in the weldment as shown in figure 5. This is a case where a crank is made of a plate whose one end is welded to a shaft while other end is subjected to a tangential force of 12kN. Take weld thickness = 5mm and overload factor =1.2. **[8]**

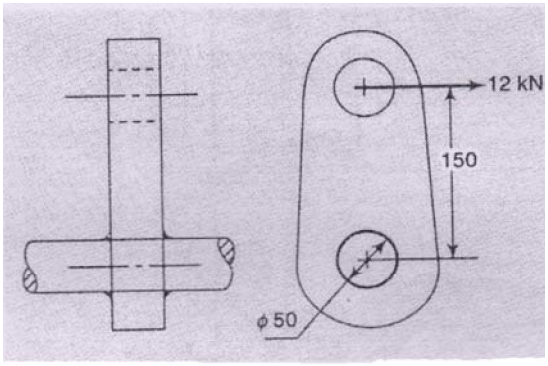



Figure 5

***Q9)*** a) Derive basic two equations for the design of helical spring. Also state the importance of Wahl factor in spring design. **[8]**

b) A railway wagon of mass 250kN moving with a velocity of 2.5m/sec is brought to rest by springs of mean diameter 350mm. The maximum deflection of the spring is 210mm. Find the wire diameter and number of turns. Take $S_s$ = 600MPa and G = 80 GPa. **[10]**

OR

***Q10)*** a) Explain the following methods. **[8]**

i) Shot peening

ii) Nipping of leaf spring.

b) One helical spring is nested inside another; the dimensions are as tabulated. Both springs have the same free length and carry a total maximum load of 2500N. **[10]**

| | Outer spring | Inner spring |
|---|---|---|
| Number of active coils | 6 | 10 |
| Wire diameter, mm | 12.5 | 9.0 |
| Mean coil diameter,mm | 100 | 70 |

Determine:

i) The maximum load carried by each spring.

ii) The total deflection of each spring.

iii) The maximum stress in two springs. Take G = 83 GN/$m^2$.

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