[4658] – 11

Seat No.	

T.E. (Mechanical) (Semester – I) Examination, 2014
MACHINE DESIGN – I
(2008 Course)

Time : 4 Hours Max. Marks : 100

SECTION – I

1. A V-grooved pulley 200 mm pitch circle diameter is receiving 5 kW from a motor and rotates a shaft at 300 r.p.m. (figure 1). A crowned pulley, 500 mm in diameter, supplies power to a machine in a workshop. The angle of wrap for both pulleys is π and the coefficient of friction between belt and pulley is 0.3. The semi-groove angle for smaller pulley is 20°. For the material of shaft, E = 205 kN/mm^2, and G = 84 kN/mm^2. Shaft is made of carbon steel having s_{yt} = 267 N/mm^2 and s_{ut} = 530 N/mm^2. The pulleys are keyed to the shaft. Determine the diameter of shaft according to A.S.M.E. code. K_b = 1.5 and K_t = 2.0. Neglect centrifugal tension in belt. Check that $\theta < 0.5°$. **18**

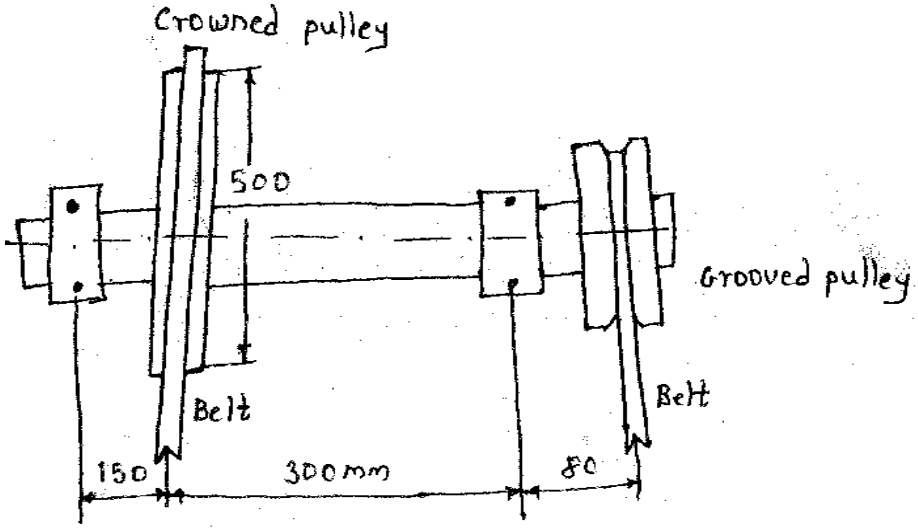

Figure 1

OR

2. a) Design a cost iron flange coupling for joining two mild steel shafts transmitting 100 kW of 250 rpm. The angle of twist is not to exceed 1° in a length of 25 diameters. Take allowable permissible shear stress for shaft is 40 MN/m^2 and for bolts is 28 MN/m^2. Allowable permissible shear stress for C1 flange is 15 MN/m^2. P.C.D. for bolls is 225 mm and no. of bolls are 6. G = 80×10^9 Pa.

   Standard values for shaft are 80, 85, 90, 95, 100, 105, 110, 115, 120 mm. **12**

   b) What are different types of keys ? Explain design of splines. **6**

P.T.O.

3. a) Explain selflocking and overhauling of power screw. **4**

   b) Following data refers for C-Clamp.

   - Maximum clamping force – 4 kN
   - Nominal diameter – 12 mm
   - Pitch of screw – 2 mm
   - Coefficient of screw friction – 0.12
   - Coefficient of collar friction – 0.25
   - Type of screw – Single start square thread
   - Mean collar radius – 6 mm
   - Operator force applied of the end of handle – 80 N
   - Distance between axis of handle and surface of nut in clamped condition – 150 mm
   - Nut height – 25 mm

   Determine :

   1) Dimensions of screw
   2) Total torque required to clamp the work piece
   3) Length of handle
   4) Stresses in two critical section of screw body
   5) Bearing pressure on threads. **12**

OR

4. a) Derive the expression for efficiency of square thread screw. Also obtain the equation for maximum efficiency. **6**

   b) A double threaded power screw with trapezoidal threads is used to raise the load of 300 kN. The nominal diameter is 100 mm and pitch 12 mm. The coefficient of friction at screw threads is 0.15.

   Neglect collar friction torque. Calculate

   1) Torque required to raise the load
   2) Torque required to lower the load
   3) Efficiency of the system.

   State weather screw is self locking or not. **10**

5. a) Explain with neat sketch, concept of following :

   1) Bolt of uniform strength
   2) Preloading of bolt. **8**

b) A steel plate subjected to a force of PKN and fixed to a vertical channel by using four identical bolt as shown in figure 2. Write down the procedure to find out diameter of bolts. **8**

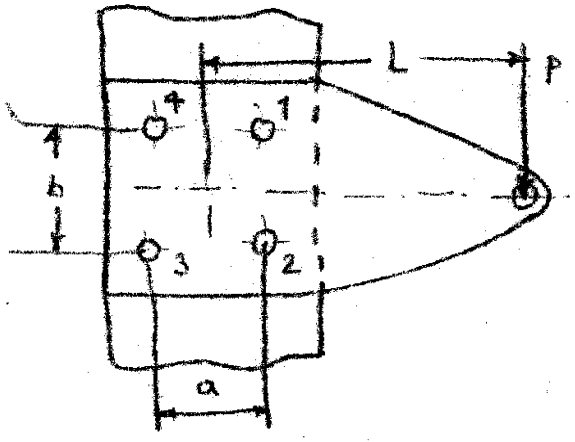

Figure 2

OR

6. a) What are the assumptions made in the design of welded joint, also discuss the design procedure for an eccentric loaded welded joint. **6**

b) A welded joint as shown in figure. 3 is subjected to an eccentric load 55.30 kN. A bracket is welded to the side of coloumn. Calculate the size of weld when maximum shear stress is 80 MN/m^2. **10**

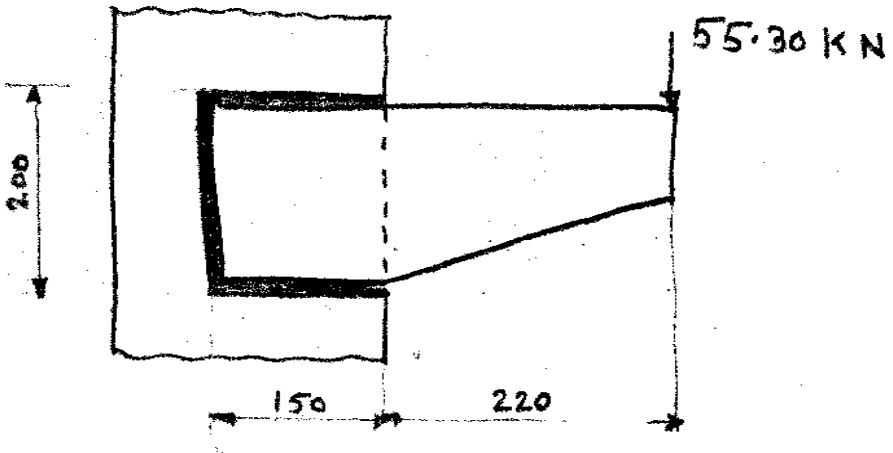

Fig. 3 (All d.m. are in mm)

SECTION – II

7. a) State any two functions of Flywheel. State different materials used for Flywheel. **4**

   b) The torque developed by three cylinder engine running at 350 rpm is, 1

   $T_i = 16000 + 6000 \sin 3\theta$ –

   $T_o = 16000 + 3600 \sin \theta$ – (resisting torque)

   Where θ is crank angle.

   The coefficient of fluctuations of speed is 0.05 assume that MI of rim 95% of MI of Flywheel determine rim dimentions if b = 2t Rim Flywheel is made of cast iron with ρ = 7250 Kg/m^3, consider linear velocity is 25 m/s. **12**

OR

8. a) Compare solid disc Flywheel with rim Flywheel. **4**

   b) The areas of turning moment diagram for one revolution of multi cylinder engine with ref. to the mean turning moment below and above the line are, – 32, + 408, – 267, +333, – 310, + 226, – 374, +260 and – 244 mm^2. The mean speed is 300 rpm with I/O speed Fluctuations of $\pm$ 1.5%. If hoop stress in material of rim is not exceed 5.6 MPa. Determine the suitable diameter and c/s of flywheel assuming that b = 4t. Assume ρ = 7200 Kg/m^3. Neglect the effect of boss and arm. Assure scale 1mm = 2.4° and 1mm = 650 N–m on X & Y axis resp. **12**

9. a) Draw a neat sketch of multi leaf spring, show its essential parts. Also explain nipping of leaf spring. **8**

   b) A helical compression spring made of circular wire is subjected to an axial load of 3.5 kN. The deflection of spring should be approximately 5 mm. The spring index can be taken as 5 mm. The spring has square and ground ends. The spring is made of cold drawn steel wire with s_{ut} = 1050 N/mm^2 and modulus of rigidity 81370 N/mm^2. The permissible shear stress is taken as 50% of ultimate tensile strength. Design the spring and calculate :

   1) Wire diameter
   2) Mean coil diameter
   3) No. of active coils
   4) Total no. of coils
   5) Solid length of spring
   6) Free length of spring
   7) Actual spring rate. **10**

OR

10. a) Two helical springs are arranged in a concentric manner with one inside the other. Both spring have same free length and carries a load of 5500 N. The outer spring has 8 coils with mean coil diameter 128 mm and wire diameter 16 mm. The inner spring has 12 coils with mean coil diameter 84 mm and wire diameter 12 mm. Calculate :
    i) Maximum load shared by each spring
    ii) Total deflection of each spring
    iii) Maximum stress in each spring

    Assume modulus of rigidity 81×10^3 MPa. **12**

    b) A helical torsion spring subjected to axial load of 160 N. The mean radius of coil is 25 mm, radius of wire 2.5 mm and no. of effective turns are 6. Find the bending stress induced and the angular deflection in degree.

    Assume modulus of elasticity of spring material 210 GPa. **6**

11. a) Explain the selection of flat belt from manufacture's catalogue. **4**

    b) Two shaft whose centres are one meter apart are connected by V-belt drive. The driving pulley is supplying with 95 kW power and has an effectives diameter of 300 mm. It runs at 1000 rpm while driven pulley runs at 375 rpm. Angle of groove on pully is 40°. Permissible tension in 400 mm^2 cross sectional area of belt is 2.1 N/mm^2 and density of belt 1100 Kg/m^3. The driven pulley is overhauling. The distance of centre from the nearest bearing 200 mm. The coefficient of friction between the belt and pulley is 0.28. Calculate :
    1) No. of belts required
    2) Diameter of driven pulley shaft if Permissible shear stress is 42 MPa. **12**

OR

12. a) Explain construction of wire rope and lay of wire rope. **4**

    b) An extra flexible 8×19 plough steel wire rope of 38 mm diameter is used with 2m diameter hoist drum to lift 50 kN of load find the factor of safety under the following conditions. The wire rope is required to lift from a dept of 900 meters. The maximum speed is 3 m/s and acceleration is 1.5 m/s^2 when starting under no slack condition. The diameter of the wire is 0.05 d, where d is diameter of wire rope. The breaking strength of plough steel is 1880 N/mm^2 and modulus of elastisity of the entire rope is 84 GPa. The weight of rope is 53 N/m length. **12**

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