Sixth Semester B.E. Degree Examination, Dec.2014/Jan.2015
Design of Machine Elements – II

Time: 3 hrs.   Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting*
atleast TWO questions from each part.
2. Use of design data hand book is permitted.

PART – A

1   a. Derive expressions for extreme fibre stresses in a curved beam subjected to pure bending moment. **(08 Marks)**

    b. Determine the combined stresses in the inner and outer fibers at the critical section of a crane hook which is required to lift loads upto 50kN. The hook has trapezoidal cross-section with inner and outer sides of 90mm and 40mm respectively depth is 120mm. The centre of curvature of the section is at a distance of 100mm from the inner side of the section and the load line passes through the centre of curvature. Also determine the factor of safety according to max shear stress theory if $\tau_d = 80$MPa. **(12 Marks)**

2   a. A cast steel cylinder of 350mm inside diameter is to contain liquid at a pressure of 13.5MPa. It is closed at both ends by flat cover plates which are made of alloy steel and are attached by bolts.

       i) Determine the wall thickness of the cylinder if the maximum hoopstress in the material is limited to 55MPa.

       ii) Calculate the minimum thickness necessary of the cover plates if the working stress is not to exceed 65MPa. **(08 Marks)**

    b. A 150mm diameter steel shaft is to have a press fit with a 300mm o.d. by 250mm long hub of cast iron. The maximum tangential stress is to be 35MPa. E = 200 GPa for steel and 100 GPa for cast iron; μ = 0.3 assumed for both steel and cast iron (Poisson's ratio) and the coefficient of friction f = 0.12.

       i) Determine the maximum diametral interference.

       ii) What axial force will be required to press the hub on the shaft?

       iii) What torque may be transmitted with this fit? **(12 Marks)**

3   a. Derive an expression for the stress induced in helical coil spring. **(04 Marks)**

    b. Design a helical compression spring for a maximum load of 1000N and for a deflection of 25mm. The maximum permissible shear stress for a spring wire is 420 MPa, modulus of rigidity is 0.84×10^5 MPa and value of spring index is 6. **(10 Marks)**

    c. A one meter long cantilever spring is composed of 8 graduated leaves and one extra full length leaf. The leaves are 45mm wide. A load of 2000N at the end of the spring causes a deflection of 75mm. Determine the thickness of the leaves and the maximum bending stress in the full length leaf assuming that the leaves are not prestressed. **(06 Marks)**

4   A cast steel pinion rotating at 900rpm is to drive a cast iron gear at 144rpm. The static design stresses for pinion and gear materials are 103MPa and 55MPa respectively. The teeth are to have Std. 20° stub involute profile and the maximum power to be transmitted is 25kW. Design the spur gears completely and check for the dynamic and wear loads. The gear surfaces are hardened to BHN250. Use 16 teeth on pinion. **(20 Marks)**

PART – B

5   Design a Worm Gear to transmit 40kW at 500 rpm of worm. The speed ratio is 25. Material for gear is phosphor bronze and that of worm is hardened steel. Determine the efficiency of the drive also.   **(20 Marks)**

6 a. A cone clutch with face angle 12.5° is to transmit 7.5kW at 900rpm. The width of face is half the mean radius and the normal pressure between the contact faces is not to exceed 0.09MPa. Assuming uniform wear and the coefficient of friction between contact faces as 0.2. Determine the main dimensions of the clutch and the axial force required to engage the clutch.   **(10 Marks)**

   b. A band brake shown in Fig.Q.6(b) uses a V belt. The pitch diameter of the V-grooved pulley is 400mm. The groove angle is 45° and the coefficient of friction is 0.3. Determine the power rating.   **(10 Marks)**
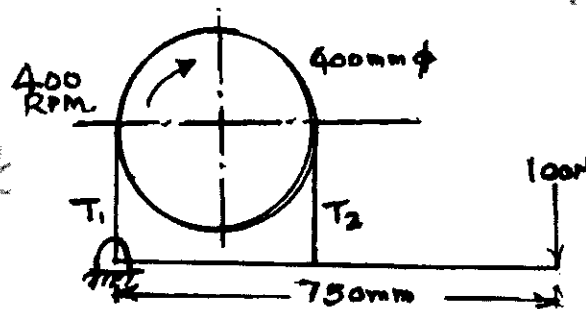

Fig.Q.6(b)

7 a. Explain the significance of bearing characteristic number in the design of sliding contact bearings.   **(06 Marks)**

   b. A turbine shaft 60mm in diameter rotates at a speed of 10000 rpm. The load on each bearing is estimated to be 2kN and the length of the bearing is 80mm. Taking radial clearance as 0.05mm and SAE-20 oil for lubrication determine the coefficient of friction, power loss, minimum film thickness and the oil flow rate. The temperature of the bearing is not to exceed 50°C.   **(14 Marks)**

8 a. Design a V-belt for the following data: motor power 80kW motor speed 1000 rpm. Driver pulley speed 600 rpm approximate center distance 1110mm. Coefficient of friction 0.3. The safe shear stress for V belt material is 4MPa.   **(12 Marks)**

   b. A 25mm 6 × 37 steel wire rope is used in a mine of 80m deep. The velocity of the cage is 2 m/s and the time required to accelerate the cage to the desired velocity is 10secs. The diameter of the drum is 1.25m. Determine the safe load that the hoist can handle by assuming a factor of safety of 8. Neglect the impact load on the rope.   **(08 Marks)**

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