

**Sixth Semester B.E. Degree Examination, Dec.2013/Jan.2014**  
**Design of Machine Elements – II**

Time: 3 hrs.

Max. Marks: 100

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

**PART – A**

- 1 a. Differentiate between straight beam and curved beam with suitable examples. (05 Marks)  
 b. A crane hook of trapezoidal section is shown in Fig. Q1 (b). Through the center of curvature, a load of 60 kN is applied on the hook. Determine the dimensions of the section, if the maximum stress is not to exceed 80 MPa. (15 Marks)

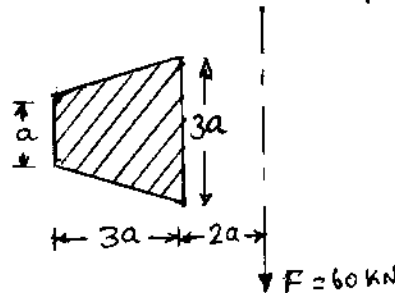


Fig. Q1 (b)

- 2 a. It is desired to assemble two cylinders having nominal diameters of 25 mm inner diameter, 50 mm outer diameter and 50 mm outer diameter and 50 mm inner diameter, 75 mm outer diameter with the tangential stress at the inner surfaces of the outer member limited to 83 MPa. Determine the interference and the tangential stresses at the inner and outer surfaces of the two members, in accordance with Birnie's equation. Take Poisson's ratio as 0.3 and  $E = 200 \text{ GPa}$ . (12 Marks)  
 b. The steam chest of a steam engine is covered by a flat rectangular plate of  $200\text{mm} \times 400\text{mm}$ . The plate is made of cast iron and is subjected to a steam pressure of 2 MPa. The plate is assumed to be uniformly loaded and supported at the edges. Determine the thickness of plate and its maximum deflection if the design stress is limited to 40 MPa. Take modulus of elasticity of cast iron as 100 GPa. (08 Marks)
- 3 a. A 100 mm outer diameter steel coil spring having 10 active coils of 12.5 mm diameter wire is placed over the free end of a cantilever spring. The length of steel cantilever spring is 750 mm having 6 graduated leaves 100 mm wide and 6.5 mm thick.  
 i) What force  $F$  if gradually applied to the top of the coil spring will cause the cantilever spring to deflect 25 mm?  
 ii) What will be the maximum shear stress in the coil spring? (10 Marks)  
 b. A Belleville spring is made of 2 mm sheet metal with an outside diameter of 110 mm and inside diameter of 55 mm. The spring is dished to a depth of 4 mm. The maximum stress is to be 600 MPa. Determine : i) Safe load carried by the spring. ii) Deflection iii) Stress produced at the outer edge of the spring and iv) Load for flattening the spring. (10 Marks)

- 4 A pair of spur gears for a crane hoist drive is to be made to the following specifications: 20° full depth involute tooth form, static stress for pinion material is 80 MPa, static stress for gear material is 55 MPa, number of teeth on pinion is 20, velocity ratio is 4 to 1, power to be transmitted by pinion is 4 kW at 200 rpm, and the service factor is 1.25. Take the face width  $l = 4 \pi m$ . i) What standard module and width of face will satisfy these conditions ii) Dynamic load, iii) Wear strength, if the load stress factor is 1.35. Is the design safe from the stand point of strength? (20 Marks)

**PART – B**

- 5 Two shafts at right angles are connected with a pair of level gears having  $14\frac{1}{2}$  composite type tooth form. The pinion is made of steel ( $\sigma_0 = 120\text{MPa}$ ) and the gear is made of cast iron ( $\sigma_0 = 80\text{MPa}$ ). The pinion having 26 teeth is to transmit 10 kW power at 1200 rpm. The velocity ratio is to be 2.5 to 1. The loads are steady and the gears are precision cut, heat treated to Brinell hardness of 200. Design the gears for strength. Also find the diameter of pinion shaft, if the allowable stress in the shaft material is limited to 50 MPa. The pinion overhangs a distance of 150 mm from the bearing. (20 Marks)
- 6 a. A cone clutch is used to transmit 20 kW power at 600 rpm. The coefficient of friction is 0.2 and the average pressure is limited to 0.35 MPa. The pitch cone angle is 15° and the outer diameter is limited to 300 mm. Assuming uniform wear, determine the dimensions of the clutch and the axial force required to engage the clutch. (10 Marks)
- b. A two way differential band brake is so designed that it can operate equally well in both clockwise and counter clockwise rotation of the brake drum. The ends of the band are attached so that the operating arms are 0.05 m each and the level length is 1 m. The diameter of the drum is 0.4 m and the coefficient of friction between the band and the drum is 0.3. The angle of contact of the band is 270° and the torque absorbed by the brake is 400 Nm. Calculate i) Force required at the end of the lever. ii) Width of 2 mm thick band, if the allowable stress in the band is 70 MPa. (10 Marks)
- 7 a. Explain the theory of hydrodynamic lubrication with suitable sketches. (05 Marks)
- b. Derive Petroff's equation for lightly loaded bearing. (05 Marks)
- c. A journal bearing 150 mm diameter and 300 mm long carries a radial load of 9 kN at 1200 rpm. The diametral clearance is 0.075 mm. If 6 kW is being wasted in friction, what is the viscosity of the oil being used at the operating temperature? Use McKee equation. (10 Marks)
- 8 a. An open belt drive is required to transmit 9.5 kW power from a pulley of 1.2 m diameter running at 200 rpm to another pulley of equal size. The coefficient of friction between the belt and pulley is 0.3. If the safe pull per meter width of belt is 14 kN, mass density of belt per meter length is 1 kg and the thickness of belt is 10 mm, determine the width of belt by taking centrifugal tension into account. Also find the stress on the slack side. (10 Marks)
- b. Select a suitable size of wire rope to life a cage of vertical mine hoist of 100 m deep. The cage weighs 5 kN and it has to lift 10 kN of ore at a speed of 120 m/min. The maximum speed is attained in one second. (10 Marks)

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