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06ME61

Sixth Semester B.E. Degree Examination, June / July 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.*
3. *Assume data suitably if necessary.*

PART – A

1 a. The u-section frame is to resist a straightening load of 125 kN shown in Fig. Q1 (a). The material of the frame has a permissible stress of 65 MPa. Determine the dimensions of the frame. **(12 Marks)**

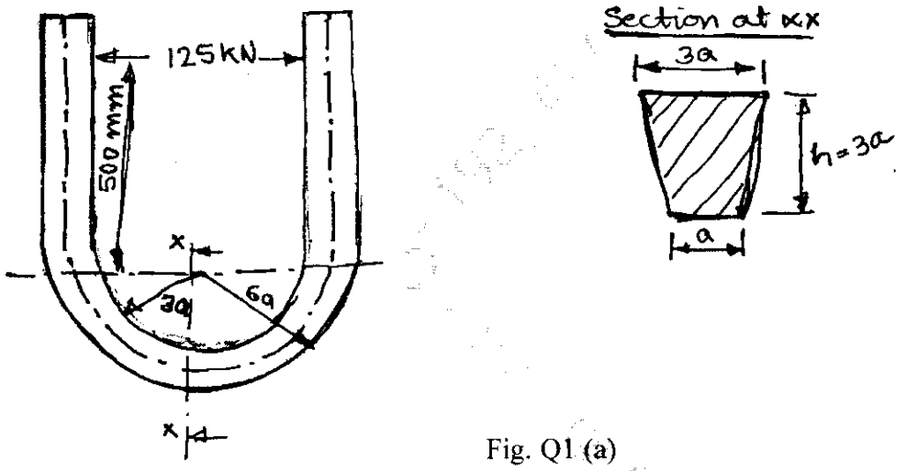

Fig. Q1 (a)

b. A compound cylinder is formed by shrinking an outer cylinder on the inner so that the radial pressure developed at the common surface is 84 MN/m^2 after shrinking the dimensions are as follows. Outer dia of the compound cylinder = 175 mm. Inside dia of compound cylinder = 75 mm. Outer dia of inside cylinder = 125 mm. According to Lame's equation show the variation of radial and hoop stresses in the two cylinders due to shrinkage. **(08 Marks)**

2 a. Design a helical compression spring for the following data:
Axial load on the spring = 1 kN ; Allowable shear stress of the spring material = 500 MPa
Mean coil diameter = 50 mm ; Spring rate = 20 kN/m;
Rigidity modulus of the material = 80 GPa. **(10 Marks)**

b. A helical compression spring of diameter 5.7 mm carries a fluctuating load. The spring index is 6 and the mean load on the spring is 533 N. Take the factor of the safety of 1.5. Find the permissible values of maximum and minimum loads. The ultimate strength of the material is 1620 MPa. The ultimate shear strength of the material is 0.4 times the ultimate strength and the endurance strength of the material is 0.23 times the ultimate strength. **(10 Marks)**

3 A compressor running at 300 rpm is driven by 15 kW at 1200 rpm motor through a pair of 20° full depth system spur gears. The center distance between gears is 380 mm. Motor pinion is made of 0.3% carbon forged steel (heat treated) and the gear is made of 0.2% carbon heat treated cast steel. Assuming medium shock conditions determine module, face width, number of teeth on pinion and gear and hardness. **(20 Marks)**

4 a. Explain virtual number of teeth in helical gears. **(04 Marks)**

b. A helical cast steel gear with 30° helix angle has to transmit 45 kW at 1500 rpm. If the gear has 24 teeth. Determine the necessary module, face width and the diameter for 20° full depth teeth. The stress may be taken as 55 MPa, face width may be taken as 4 times the normal pitch. The tooth factor or lewis form factor for 20° full depth teeth is given by, $y = 0.154 - \frac{0.912}{Z_e}$, where Z_e is number of teeth on equivalent spur gear. **(16 Marks)**

PART – B

5 a. A worm gear speed reducer unit is to be designed for a center distance of 200 mm. The worm is made of hardened steel and the gear is made of phosphor bronze. Transmission ratio is 10, speed of the worm is 1750 rpm. The gear has 20° stub involute teeth. Determine the input capacity for phosphor bronze gear of strength 55 MPa. **(14 Marks)**

b. Briefly explain the steps involved in the design of bevel gears. **(06 Marks)**

6 a. Derive an expression for the torque capacity of the cone clutch based uniform pressure theory and uniform wear theory. **(10 Marks)**

b. A multiple plate clutch is used to transmit 5 kW at 1440 rpm the inner and outer diameters of contacting surfaces are 50 mm and 80 mm respectively. The coefficient of friction and the average allowable pressure intensity for the lining may be assumed as 0.10 and 350 kPa respectively. Determine i) Number of friction plates and pressure plates ii) Axial force required to transmit power iii) The actual average pressure iv) Actual maximum pressure intensity after wear. **(10 Marks)**

7 a. A double shoe brake shown in Fig. Q7 (a) . The braking torque required is 1200 N-m. The brake drum is 200 mm in diameter and the coefficient of friction between the shoes and the drum is 0.3. Find the operating force P and the size of the shoe if the permissible pressure does not exceed 1.5 MPa. Assume the length of the shoe to be twice that of its width. The analysis may be made considering it as a short shoe.

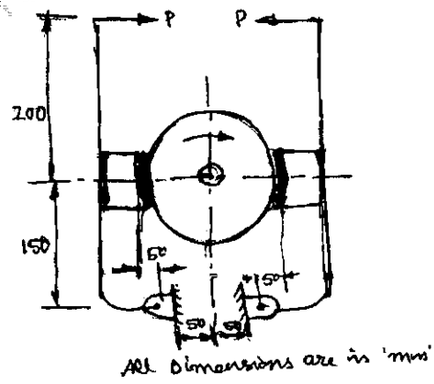

Fig. Q7 (a)

(10 Marks)

b. A Single V-belt is used to transmit power from a grooved pulley of pitch diameter 200 mm running at 1500 rpm to a flat pulley of diameter 600 mm. The center distance between the pulleys is 1000 mm. The mass of the belt is 0.3 kg/m. The co-efficient of friction between the belt and the pulley is 0.25. The V-belt groove angle is 38°. If the allowable tension T1 in the belt is 800 N, determine (i) The power transmission capacity of the belt.
(ii) The initial tension required in the belt. **(10 Marks)**

8 a. Explain, (i) Principle of hydrodynamic lubrication. (ii) Bearing modulus.
(iii) Write the properties of lubricating oils. **(07 Marks)**

b. Write the characteristics of bearing materials. **(03 Marks)**

c. A 75 mm long full journal bearing of diameter 75 mm supports a radial load of 12 kN at a shaft speed of 1800 rpm. Assume ratio of diameter to the diametral clearance as 1000. The viscosity of the oil is 0.01 Pas at the operating temperature, determine
(i) Sommer field number (ii) The coefficient of friction (iii) Amount of heat generated. **(10 Marks)**

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