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06ME61

Sixth Semester B.E. Degree Examination, December 2010
Design of Machine Elements – II

Time: 3 hrs. Max. Marks:100

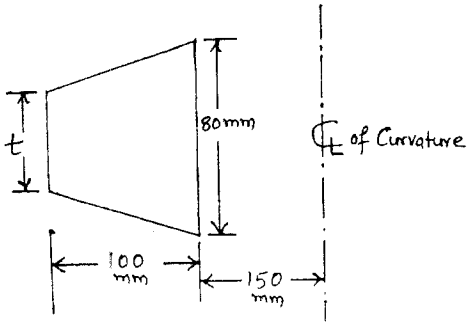
Note: *1. Answer any FIVE full questions, selecting at least TWO questions from each part.*
2. Use of design data handbook is permitted.
3. Missing data, if any, may suitably be assumed with justification.

PART – A

1 a. Derive an expression for normal stresses due to bending at the extreme fibres on the cross section of a curved machine member. **(08 Marks)**

b. Determine the value of 't' in the cross section of a curved machine member shown in Fig.1(b), so that the normal stresses due to bending at extreme fibres are numerically equal. Also determine the normal stresses so induced at extreme fibres due to a bending moment of 10 kN-m. **(12 Marks)**

Fig.1(b).



2 a. A cast steel cylinder of 350 mm inside diameter is to contain liquid at a pressure of 13.5 N/mm^2. 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 hoop stress in the material is limited to 55 MPa.
ii) Calculate the minimum thickness necessary of the cover plates if the working stress is not to exceed 65 MPa. **(08 Marks)**

b. A shrink fit assembly, formed by shrinking one cylinder over another, is subjected to an external pressure of 60 N/mm^2. Before the fluid is admitted, the internal and external diameters of the assembly are 120 mm and 200 mm respectively and the diameter at the junction is 160 mm. If after shrinking on, the contact pressure at the junction is 8 N/mm^2, determine using Lame's equations, the stresses at inner, mating and outer surfaces of the assembly after the fluid has been admitted. **(12 Marks)**

3 a. A semi elliptical laminated spring has effective length of 1 m. The spring has to sustain a load of 75 kN. The spring has 3 full length leaves and 16 graduated leaves. If the leaves are prestressed such that the stress induced in all the leaves is same and are limited to 400 MPa, when maximum load is applied. The width of the leaves is 9 times the thickness. Assume E = 200 GPa. Determine :
i) The width and thickness of the leaves.
ii) The initial space that has to be provided between full length leaves and the graduated leaves before the band is applied.
iii) Load on the clip to close the initial gap. **(10 Marks)**

b. A load of 2 kN is dropped axially on a close coiled helical spring from a height of 250 mm. The spring has 20 effective turns and it is made of 25 mm diameter wire. The spring index is 8. Find the maximum shear stress induced in the spring and the amount of compression produced. Take G = 82.7 GPa. **(10 Marks)**

4 a. State the advantages of gear drives when compared to chain or belt drives. **(04 Marks)**

b. Design a helical gear pair to transmit a power of 15 kW from a shaft rotating at 1000 rpm to another shaft to be run at 360 rpm. Assume involute profile with a pressure angle of 20°. The material for pinion is forged steel SAE 1030 whose σ_o = 172.375 MPa and the material for the gear is cast steel 0.20% C untreated with σ_o = 137.34 MPa. The gears operate under a condition of medium shocks for a period of 10 hrs per day. Check for dynamic load, if load factor C = 580 N/mm and also for wear load. **(16 Marks)**

PART – B

5 Design a pair of bevel gears to connect two shafts at 60°. The power transmitted is 25 kW at 900 rpm of pinion. The reduction ratio desired is 5:1. The teeth are 20° full depth involute and pinion has 24 teeth. Check the design for dynamic and wear considerations. **(20 Marks)**

6 a. Design a single plate clutch having both sides effective form the following data :
Power transmitted = 30 kW; speed of shaft = 1500 rpm;
Allowable lining pressure = 0.147 MPa;
Maximum diameter of clutch = 300 mm; service factor = 1.5;
Number of springs = 9;
Compression of spring during engagement = 2.5 mm. **(12 Marks)**

b. Determine the torque that may be resisted by the single block brake shown in Fig.6(b) below for a coefficient of friction 0.3. **(08 Marks)**

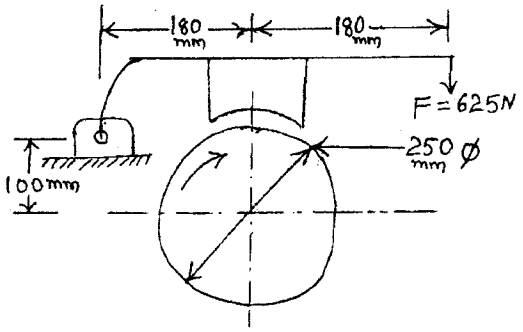


Fig.6(b).

7 a. Explain mechanism of hydrodynamic journal bearing. **(04 Marks)**

b. A full journal bearing 50 mm in diameter and 50 mm long operates at 1000 rpm and carries a load 5 kN. The radial clearance is 0.025 mm. The bearing is lubricated with SAE 30 oil and the operating temperature of oil is 80°C. Assume the attitude angle as 60°, determine :
i) Bearing pressure ; ii) Sommerfeld number; iii) Attitude ; iv) Minimum film thickness; v) Heat generated ; vi) Heat dissipated if the ambient temperature is 20°C and vii) Amount of artificial cooling if necessary. Use McKnee's and Pederson's equations. **(16 Marks)**

8 a. A 25 mm 6 x 37 steel wire rope is used in a mine of 80 m deep. The velocity of the cage is 2 m/sec, and the time required to accelerate the cage to the desired velocity is 10 secs. The diameter of the drum is 1.25 m. Determine the safe load that the hoist can handle by assuming a factor of safety as 8. Neglect the impact load on the rope. **(12 Marks)**

b. A leather belt 125 mm wide and 6 mm thick, transmits power from a pulley 750 mm diameter which runs at 500 rpm. The angle of the lap is 150° and the coefficient of friction between the belt and the pulley is 0.3. If the belt density is 1000 kg/m^3 and the stress in the belt is not to exceed 2.75 N/mm^2, find the power that can be transmitted by the belt. Also find the initial tension in the belt. **(08 Marks)**

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