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10ME62

Sixth Semester B.E. Degree Examination, Dec.2015/Jan.2016

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 data hand book permitted.***
3. ***Missing data, if any, may be suitably assumed.***

PART – A

1 a. A ring is made from a 75mm diameter bar. The inside diameter of the ring is 100mm. For the load shown in figure Q1(a), Calculate the maximum shear stress in the bar and specify its location. **(10 Marks)**

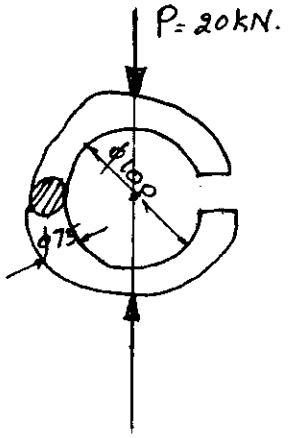

Fig Q1 (a)

b. An engine's chest is covered by a flat rectangular head of 200mm × 300mm dimensions. The plate is made of grey cast iron FG150 with ultimate stress of the material is 150N/mm^2, supported at the edges and subjected to a uniform pressure of 1.5N/mm^2. Determine the thickness of the head for a factor of safety 5. **(10 Marks)**

2 a. A 'V' belt is to be arranged between two shafts whose centers are 3000mm. The driving pulley is of 850mm effective diameter and is to be supplied with 75kW at 960 rpm. The follower pulley is to run at 480rpm. Determine the number of belts required for the following particulars :
Area of belt section – 400mm^2
Weight of belt – 0.01 N/cm^3
Safe working tensile stress – 2.1 N/mm^2
Coefficient of friction – 0.27
Groove angle of pulley - 40°
Also find the initial tension required in each belt. **(12 Marks)**

b. A 20mm 8 × 19 steel wire rope is used with a hoisting drum of 1m diameter to lift a load of 20kN. The depth of mine is 800m and the acceleration is 3m/sec^2. Determine the number of ropes required using a factor of safety 5. Neglect weight of skip. **(08 Marks)**

3 a. Design a valve spring of a petrol engine for the following operating conditions.
Spring load when the valve is open – 400N
Spring load when the valve is closed – 250N
Maximum inside dia of spring – 25mm
Length of spring when the valve is open – 40mm
Length of spring when the valve is closed – 50mm
Maximum permissible shear stress – 400MPa **(10 Marks)**

b. i) Define nipping in the leave springs. **(02 Marks)**

ii) A locomotive spring has an overall length of 1100mm and sustain a load of 75kN at its centre. The spring has 3 full length leaves and 15 graduated leaves with a central band of 100mm. All the leaves are stressed at 0.4 GPa when fully loaded. The ratio of total spring depth to width is 2. Determine
i) Width and thickness of leaves ii) nipping
iii) What load is exerted on the band after the spring is assembled? **(08 Marks)**

4 a. Derive the Lewis equation for the beam strength of a spur gear tooth. Also list the assumptions. **(03 Marks)**

b. A 55kW motor running at 450rpm is geared to a pump by means of a double helical gearing. The forged steel pinion on motor shaft has a PCD of around 200mm and it drives a good grade C.I gear over the pump shaft at 120rpm. The allowable stress for both pinion and gear material should be taken as 224 N/mm^2 and 56 N/mm^2 respectively. Assuming $14\frac{1}{2}^\circ$ form teeth with $\beta = 20^\circ$ and $Z_1 = 24$. Design the gears. **(17 Marks)**

PART – B

5 a. Explain with a sketch, the formative number of teeth of bevel gear. **(06 Marks)**

b. A two teeth right hand worm transmits 2kW at 1500rpm to a 36 teeth wheel. The module of the wheel is 5mm and the pitch diameter of the worm is 60mm. The normal pressure angle is 14.5°. The coefficient of friction is found to be 0.06.
i) Find the centre distance, the lead and lead angle.
ii) Determine the forces.
iii) Determine the efficiency of the drive. **(14 Marks)**

6 a. A multiple clutch with steel and bronze is to transmit 8kW at 1440rpm. The inner diameter of the contact is 80mm and the outer diameter of contact is 140mm. The clutch plate operates in oil with expected coefficient of friction of 0.1 and allowable pressure of 0.35MPa. Assume uniform wear theory. Determine the number of steel and bronze plates, axial force required, average pressure, actual maximum pressure. **(10 Marks)**

b. A 400mm radius brake drum contacts a single shoe as shown in Fig.Q6(b) and sustains 200N – m toque at 500rpm. For a coefficient of friction 0.25, determine
i) Normal force on the shoe.
ii) Required force F to apply the brake for clockwise rotation.
iii) Required force F to apply the brake for counterclockwise rotation.
iv) The dimension 'C' required to make the brake self locking, assuming the other dimensions remains the same.
v) Heat generated. **(10 Marks)**

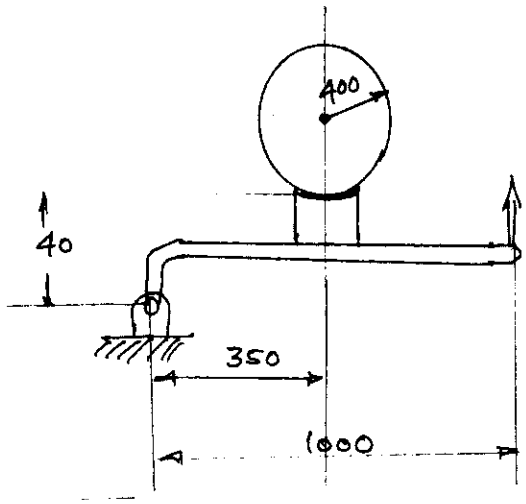

Fig. Q6 (b)

7 a. Explain the following :
   i) Hydrodynamic theory of lubrication.
   ii) Bearing characteristics number and bearing modulus.
   iii) Sommerfield number. **(08 Marks)**

b. A 75mm long full journal bearing of diameter 75mm supports a radial load of 12kN at the shaft speed of 1800 rev/min. Assume ratio of diameter to the diametral clearance as 1000. The viscosity of oil is 0.01 Pas at operating temperature. Determine the following:
   i) Sommerfield number
   ii) The coefficient of friction based on Mckee's equation
   iii) Amount of heat generated
   iv) Power loss due to friction. **(12 Marks)**

8 a. The following data is given for the piston of a four stroke diesel engine:
Cylinder bore – 250mm
Maximum pressure – 4MPa
Bearing pressure at small end of connecting rod = 15MPa
Length of piston pin in bush of small end = 0.45D
Ratio of inner to outer dia of piston pin = 0.6
Mean diameter of piston boss = 1.4 × outer dia of pin
Allowable bending stress for piston pin = 84N/mm^2.
Calculate
   i) Outer dia of the piston pin
   ii) Inner dia of piston pin
   iii) Mean dia of piston boss
   iv) Check for bending stress **(10 Marks)**

b. Determine the dimensions of cross section of the connecting rod for a diesel engine with the following data :
Cylinder bore = 100mm
Length of connecting rod = 350mm
Maximum gas pressure = 4MPa
Factor of safety = 6. **(10 Marks)**

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