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10AU63

Sixth Semester B.E. Degree Examination, June/July 2016
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 design data hand book is allowed.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. List out the differences between the straight and curved beam and also sketch the stress distribution pattern in the curved beams and compare it with the straight beams. **(05 Marks)**

b. Compute the combined stresses at the inner and outer fibers in the critical cross section of a crane hook which is required to lift load upto 25 kN. The hook has trapezoidal cross section with parallel sides 60 mm and 30 mm, the distance between them being 90 mm. The inner radius of the hook is 100 mm. The load line is nearer to the inner surface of the hook by 25 mm than the centre of curvature at the critical section. **(15 Marks)**

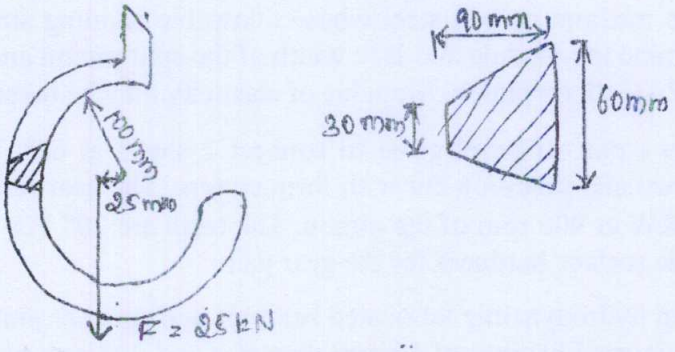

Fig. Q1(b)

2 a. A cast iron cylindrical pipe of outer diameter 300 mm and inside diameter 200 mm subjected to an internal pressure of 20 N/mm^2 and external fluid pressure is 5 N/mm^2. Determine the tangential and radial stresses at the inner, middle and outer surface. Also sketch the tangential and radial stresses distribution across its thickness. **(10 Marks)**

b. A shrink fit assembly formed by shrinking one cylinder over another is subjected to an internal fluid 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 diameter at the junction is 160 m. If after shrinking, the contact pressure at the junction is 8 N/mm^2, determine using Lame's equations, the tangential stresses at inner, mating and outer surfaces of the assembly after the fluid has been admitted. **(10 Marks)**

3 a. Derive an expression for the stress induced in a helical spring, with usual notation. **(06 Marks)**

b. Design a spring for an elevator shaft at the bottom of which 8 identical springs are set in parallel to absorb the shock of the elevator incase of failure. Weight of the elevator is 60 kN and counter weight of elevator is 20 kN. Elevator has a free fall of 1.5 m from rest. The spring is made of 25 mm diameter rod. Determine the maximum stress in each spring if the spring index is 6. Each spring has 15 active turns. Take G = 84 GPa. **(14 Marks)**

4 a. A plate clutch of maximum diameter 600 mm has max lining pressure of 0.35 MPa. The power to be transmitted at 400 rpm is 135 KW and $\mu = 0.3$. Find the inside diameter and spring force required to engage the clutch. If the springs with spring index 6 and the material of the spring is steel with safe shear stress 600 MPa is used. Find the wire diameter if 6 springs are used. **(10 Marks)**

b. A single block brake with a torque capacity of 15 Nm is shown in Fig. Q4(b). The coefficient of friction is 0.3 and the maximum pressure on the brake lining is $1 N/mm^2$. The width of the block is equal to its length. Calculate :

i) Actuating force ii) resultant hinge-pin reaction iii) dimensions of block iv) rate of heat generated if brake drum rotates at 50 rpm. **(10 Marks)**

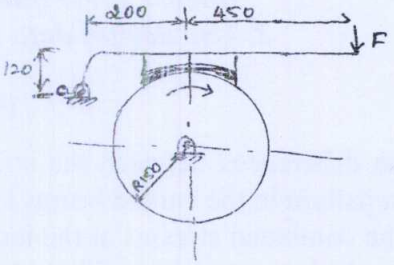

Fig. Q4(b)

PART – B

5 a. Explain formative number of teeth in helical gears. **(04 Marks)**

b. A pair of carefully cut spur gears with 20°FD involute profile is used to transmit 12 KW at 1200 rpm of pinion. The gear has to rotate at 300 rpm. The material used for both pinion and gear is medium carbon steel whose allowable bending stresses may be taken as 230 MPa. Determine the module and face width of the spur pinion and gear. Suggest suitable hardness. Take 24 teeth on pinion. Modulus of elasticity may be taken as 210 GPa. **(16 Marks)**

6 Design a pair of bevel gears to connect 2 shafts at 60°. The gears are alloy steel of case hardened and precision cut with form cutters. The gear ratio is 5 : 1. The power transmitted is 30 KW at 900 rpm of the pinion. The teeth are 20° FD. The pinion has 24 teeth. Suggest suitable surface hardness for the gear pair. **(20 Marks)**

7 a. Explain hydrodynamic lubricated bearings and squeeze journal bearing. **(04 Marks)**

b. A full journal bearing of 50 mm diameter and 100 mm along has a bearing pressure of $1.4 N/mm^2$. The speed of the journal is 900 rpm and the ratio of journal diameter to the diameter clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75°C may be taken as 0.011 kg/ms. The room temperature is 35°. Find : i) The amount of artificial cooling required

ii) The mass of lubricating oil required if the difference between the outlet and inlet temperature of the oil is 10°C. Take specific heat of oil as 1850 J/kg/°C. **(06 Marks)**

c. Design a journal bearing for a centrifugal pump from the following data. Load on journal = 20000 N, speed and journal = 900 rpm, type of oil is SAE 10 for which the absolute viscosity at 55°C = 0.017 kg/m sec. Ambient temperature for oil is 15.5°C, the maximum bearing pressure of the pump = $1.5 N/mm^2$. **(10 Marks)**

8 a. A V-bell is to transmit 20 KW from a 250 mm pitch diameter sheave operating at 1500 rpm to a 900 mm diameter flat pulley. The centre distance between input and output shafts is 1 m. The groove angle is 40° and coefficient of friction is 0.2 for both pulley and sheaves combinations. The cross section of the belt is 38 mm wide at the top and 19 mm wide at the bottom by 25 mm deep. Each belt weights 11 kNm^3 and allowable tension per belt is 1000 N. How many belts are required? **(10 Marks)**

b. Select a 6 × 19 steel rope to lift 15 kN of debris from a tunnel of 200 m deep. The bucket weights 8 kN. The velocity of the rope is 100m/min to be attained in 20 secs. What will be the max load on the rope when there is a slack of 10 m in the rope? **(10 Marks)**

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