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10AU63

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. ***Assume suitable data if missing.***
3. ***Design data hand book is permitted.***

PART – A

1 a. Derive an expression for normal stresses due to bending at the extreme fibers on the cross section of a curved beam member. **(06 Marks)**

b. Determine the safe load F that the frame of a punch press as shown in figure Q1 (b) can carry considering the cross section along A – A for an allowable tensile stress of 100MPa. What is the stress at the outer fiber for the above load? What will be the stress at the inner fiber, if the beam is treated as the straight beam for the above load? **(14 Marks)**

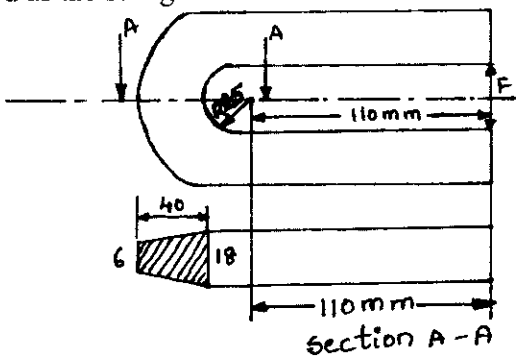

Fig. Q1 (b)

2 a. A hydraulic cylinder 400mm bore operates at a maximum pressure of $5N/mm^2$. The piston rod is connected to the load and the cylinder to the frame through hinged joints. Design (1) cylinder, (2) piston rod (3) Hinge pin and (4) Flat end cover. The allowable tensile stress for cast steel cylinder and end cover is 80MPa and for pinion rod is 60MPa. **(10 Marks)**

b. A shrink fit assembly, formed by shrinking one tube over another, is subjected to an internal pressure of 60MPa. Before the fluid is admitted, the internal and external diameters of the assembly are 120mm and 200mm and the diameter at the junction is 160mm. If after shrinking on, the contact pressure at the junction is 8MPa, determine using Lame's equations, the stresses at the inner mating and outer surfaces of the assembly after the fluid has been admitted. **(10 Marks)**

3 a. Derive an expression for shearing stress induced in a helical spring subjected to a compressive load, P with suitable stress diagrams. **(06 Marks)**

b. A semi – elliptical laminated vehicle spring to carry a load of 6000N is to consist of seven leaves 65mm wide, two of the leaves extending the full length of the spring. The spring is to be 1.1m in length and attached to the axle by two U – bolts 80mm apart. The bolts hold the central portion of the spring so rigidly that they may be considered equivalent to a band having a width equal to the distance between the bolts. Assume design stress for spring material as 350MPa. Determine i) Thickness of leaves ii) Deflection of spring iii) Diameter of eye iv) Length of leaves and v) Radius of which leaves should be initially bent. Take $E = 210 \times 10^3 N/mm^2$. **(14 Marks)**

4 a. A cone clutch has a semi cone angle of 12° to transmit 10kW at 750rpm. The width of the face is one fourth of the mean diameter of friction lining. If the normal intensity of pressure between the contacting surface is not to exceed 0.85 bar, assuming uniform wear criterion and taking $\mu = 0.2$. Calculate dimensions of clutch. Also find the axial force while running i.e., at the beginning of engagement. **(08 Marks)**

b. A double block brake is shown in Fig Q4 (b). the drum rotates at 200rpm when the applied force is 1000N and $\mu = 0.25$.
Determine i) Braking torque ii) Power lost as heat iii) Amount of heat generated.

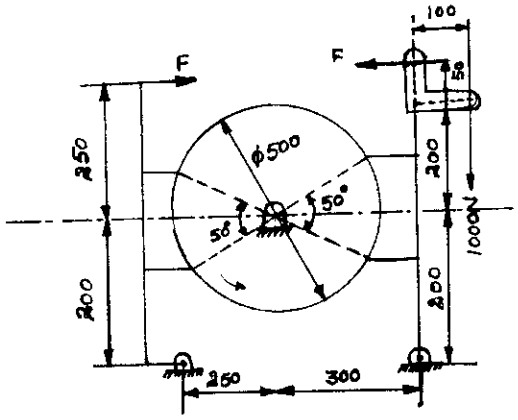

Fig. Q4(b)

(12 Marks)

PART – B

5 Design a pair of helical gears for transmitting 22kW. The speed of driver gear is 600rpm. The helix angle is 30° and profile is corresponding to 20° full depth system. The driver gear has 24 teeth. Both the gears are made of cast steel with allowable static stress as 50MPa. Assume face width parallel to the axis as 4 times the circular pitch and the overhang for each gear as 150mm. The allowable shear stress for the shaft material may be taken as 50MPa. The form factor may be taken as $0.154 - \frac{0.912}{T_E}$ where T_E is the equivalent number of teeth. The velocity factor may taken as $\frac{350}{(350+V)}$, where V is pitch line velocity in m/min. the gears are required to be designed only against bending failure of the teeth under dynamic conditions. **(20 Marks)**

6 A pair of bevel gears connects two shafts at right angles and transmits 9kW. Determine the required module and gear diameters for the following specifications.

Particulars	Pinion	Gear
Number of teeth	21	60
material	Semi-Steel	Frey Cast Iron
Allowable static stress	85 MPa	55MPa
Speed	1200rpm	420rpm
Tooth profile	$14\frac{1}{2}^\circ$ composite	$14\frac{1}{2}^\circ$ composite
Young's Modulus	210×10^3 N/mm^2	84×10^3 N/mm^2

Assume load stress factor as 0.107N/mm^2, flexural endurance limit as 84MPa and surface endurance limit as 630MPa. Check the gears – for dynamic and wear loads. **(20 Marks)**

7 a. Derive Petroff's equation for coefficient of friction for Hydrodynamic bearing with simple diagram and mention the assumptions. **(05 Marks)**

b. Design a Journal bearing for centrifugal pump running at 1200rpm. Diameter of Journal is 100mm and load on bearing is 15kN. Take $\frac{L}{d} = 1.5$, bearing temperature 50°C and ambient temperature 30°. Find whether artificial cooling is required? **(15 Marks)**

8 a. Design a suitable cross – belt drive, for a flat belt the following data is given
Speed of motor = 1500rpm
Speed of driven pulley = 300rpm
Power to be transmitted = 10kW
Weight density of leather = 10×10^{-6} N/mm^3
Smaller pulley diameter to thickness of belt ratio = 20
Centre distance = 3m
Allowable stress in the belt = 2.5MPa
Velocity of belt drive = 15m/sec
Load factor = 1.2
Coefficient of friction = 0.3. **(10 Marks)**

b. Select a wire rope to lift a load of 10kN through a height of 600m from a mine. The weight of bucket is 2.5kN. The load should attain a maximum speed of 50 m/min is 2 seconds. **(10 Marks)**

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