Sixth Semester B.E. Degree Examination, June/July 2018
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 machine design data hand books permitted.*

PART – A

1   a.   What are the differences between straight beam and curved beams?   (03 Marks)
    b.   List any three cross sections commonly used in curved beams such as in crane hooks.
                                                                                (02 Marks)
    c.   A crane hook of trapezoidal cross section with circular centre line of curvature is used to carry a load of 90 kN. The face 90 mm side is the concave side of beam and has a radius of curvature of 70 mm. The depth of beam is 115 mm and the other parallel side of the section is 25 mm. Determine the maximum stress induced in the critical section of beam.
                                                                                (15 Marks)

2   a.   List the assumptions made in deriving Lame's equation.   (03 Marks)
    b.   The cylinder head of a steam engine is held in position by 10 bolts. The diameter of cylinder is 400 mm and the maximum pressure of steam in the cylinder is 1 MPa. A copper gasket is used to make the joint leak proof. Determine the standard size of bolt required by taking the design tensile stress for bolt material equal to 90 MPa.   (17 Marks)

3   a.   A loaded narrow gauge car weighing 15 kN and moving at a velocity of 1 m/sec is brought to rest by a buffer consisting of 2 helical steel springs of square section. The mean diameter of coil is 6 times the side of square section. In bringing the car to rest, the springs are to be compressed 100 mm. Taking the shear stress for the material of the spring = 350 MPa, determine, (i) Load on each spring   (ii) Side of square section and mean coil diameter (iii) Number of active coils. Use G = 82.7 GPa.   (08 Marks)
    b.   A semi-elliptical spring is 1 metre long and is to support a load of 50 kN. The spring has 15 leaves out of which 3 are full length leaves. The width of central band is 100 mm. All the leaves are to be stressed to 400 MPa. The ratio of total depth to width of plates is 3. Taking E = 210 GPa, determine, (i) The width and thickness of leaves (ii) The initial gap that is to be provided between full length leaves and graduated leaves before assembly. (iii) The load exerted on the band after assembly.   (12 Marks)

4   a.   In a simple band brake used on a brake drum of 600 mm diameter, one end of the band is attached to the fulcrum, while the other end is attached to the lever at a distance of 600 mm from the fulcrum on the lever which is 1200 mm long. The brake is used to absorb 10 kW at 1000 rpm of drum. Taking coefficient of friction between drum and band as 0.3, determine
    (i)   The minimum effort required to operate the brake and the direction of rotation for minimum effort.
    (ii) The area of cross section of band assuming 40 C8 $\left(\sigma_{ut} = 600\,\text{MPa}\right)$ as material of lever. Use factor of safety 4.
    (iii) The dimensions of rectangular cross section of lever taking depth equal to thrice width and material of lever same as that of band.   (10 Marks)
    b.   A multidisc clutch is required to transmit 25 kW at 1400 rpm. The maximum and minimum diameters of discs are 300 mm and 100 mm respectively. Assuming coefficient of friction as 0.2, pressure between contact surfaces = 0.08 MPa, determine,
    (i)   The axial force required to engage clutch.
    (ii) The number of friction surfaces and
    (iii) The number of discs on the driver and driven shafts.   (10 Marks)

PART – B

5   Design a pair of cast steel gears to transmit 15 kW at 1440 rpm of pinion. The desired transmission ratio is 4 : 1. The teeth have $14\frac{1}{2}^{\circ}$ involute profile. The diameter of the pinion is to be restricted to 80 mm. Use face width = 10 m (m = module). Design the gears for largest number of teeth. Use $\sigma_0 = 191.295$ N/mm^2 for pinion and $\sigma_0 = 137.34$ N/mm^2 for gear.   **(20 Marks)**

6   a.   Write expressions used for formative number of teeth on gear and pinion of bevel gears.
   (02 Marks)

   b.   Design a pair of right angle bevel gears to transmit 10 kW at 1200 rpm of pinion. The gear is to run at 420 rpm. The pinion is made of steel $(\sigma_0 = 191.295$ N/mm$^2)$ and Gear is of cast iron $(\sigma_0 = 103.005$ N/mm$^2)$. The number of teeth on pinion is 21 and teeth are of 14.5 involute profile.   **(18 Marks)**

7   a.   A journal bearing 150 mm in diameter, 225 mm long supports a load of 8900 N at 1200 rpm If the radial clearance is 0.075 mm and the bearing wastes 1495 watts in friction, what is the viscosity of oil in centipoise at the operating temperature?   **(08 Marks)**

   b.   Select suitable ball bearings to carry radial load of 3000 N and thrust load of 2000 N. The service imposes light shock and the bearings will be in use for 3 years at 10 hours/day. The speed of shaft is 1200 rpm. Based on strength, the shaft diameter is 50 mm.   **(12 Marks)**

8   a.   Select a V-belt drive to transmit 8 kW from a shaft running at 1000 rpm to a parallel shaft to be run at 400 rpm. Limit the pitch diameter of smaller sheave to 150 mm.   **(12 Marks)**

   b.   Select suitable size of wire rope required to lift the cage of a vertical mine hoist 100 m deep The cage weighs 5 kN and has to lift 15 kN of ore.   **(08 Marks)**

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