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Sixth Semester B.E., Degree Examination, June 2018**DESIGN OF MACHINE ELEMENTS – 2 Model Question Paper - 1**

Time: 3 hours Max Marks: 80

1. Answer five full questions choosing one full question from each part.
2. Assume any missing data.
3. Use of Design Data Hand Books is permitted.

Module -1

- 1a Derive equation for bending stress in a curved beam subjected to bending moment. (06 Marks)
- b A crane hook made of trapezoidal cross section with 100 mm as inner side, 60 mm as outer side and the depth of 90 mm is to lift a load of 10 kN. The inner radius of curvature is 90 mm. Determine the maximum tensile, compressive and shear stresses induced in the hook. (10 Marks)

OR

- 2a A CI cylinder of inner and outer diameters of 300 mm and 380 mm, carries a fluid under pressure of 6 MPa. Find the tangential and radial stresses across the wall at every 10 mm. Plot the stress distribution across the wall. (08 Marks)
- b A 400 mm outside diameter and 200 mm inside diameter steel hub is press fitted on to a steel shaft of diameter 200 mm. The tangential stress at inside of inner cylinder is to be limited to 90 MPa. The hub length is 300 mm. Modulus of elasticity is 210 GPa. Poisson ratio is 0.3. Find and sketch the tangential and radial stresses induced. (08 Marks)

Module -2

- 3a A 12 mm thick flat belt is required to transmit 12 kW from a pulley of 200 mm diameter running at 900 rpm to another pulley to run at 500 rpm. The allowable stress for belt material is 2.1 MPa. Coefficient of friction is 0.3 and center distance between pulleys is 1.8 meters. Find the width and length of the belt. (08 Marks)
- b Select a V belt drive to transmit 18 kW from a pulley of diameter 100 mm rotating at 1500 rpm to another pulley to run at 750 rpm. The center distance is 1 m. (08 Marks)

OR

- 4a Design a helical compression spring for a spring loaded safety valve for the following data:
Operating pressure: 1 MPa.
Max Pressure when the valve blows off freely: 1.1 MPa.
Max lift of the valve: 6 mm.
Diameter of the valve seat: 100 mm.
Allowable shear stress: 300 MPa. $G = 80 \text{ GPa}$.
Spring index: 6 (08 Marks)

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- b A truck spring has an overall length of 1.2 m. The width of central band is 200 mm. It carries a central load of 60 kN. The spring has 3 full length and 12 graduated leaves. The allowable stress is 450 MPa. The ratio of total depth to width is 2. Take $E=210$ GPa. Determine the width and thickness of the leaves, the camber and the load exerted on the band. (08 Marks)

Module -3

- 5a Derive Lewis equation for the tangential tooth load for a spur gear (04 Marks)
b Design a pair of steel spur gears ($\sigma_o=138$ MPa) to transmit 12 kW at 1500 rpm of pinion to a gear at a velocity ratio of 3:1. The center distance is to be 300 mm. The teeth are 20° stub involute. (12 Marks)

OR

- 6 Design a pair of helical gears to transmit 8 kW at 2000 rpm of steel pinion ($\sigma_o=120$ MPa) having 24 teeth to a high grade Cast Iron gear ($\sigma_o=75$ MPa) to run at 500 rpm. The teeth are 20° FDI. Helix angle is 18° . (16 Marks)

Module -4

- 7a Design a single plate clutch to transmit 9 kW at 600 rpm. The outside dia of the plates is twice the inside diameter. The coefficient of friction is 0.3 and allowable pressure on friction lining is 0.2 MPa. (08 Marks)
b Design a simple band brake operating on a drum diameter of 450 mm. The angle of contact is 210° . Coefficient of friction is 0.36. Length of lever is 1.2 m. One end of the band is attached to the pivot and the other end is attached to lever at a distance of 300mm from the pivot. Find the operating force, size of the band and size of rectangular cross section of the lever. (08 Marks)

OR

- 8 Design a worm and worm wheel drive to transmit 4 kW at 2000 rpm of a hardened steel worm ($\sigma_o=200$ MPa) to a phosphor bronze worm wheel ($\sigma_o=100$ MPa). The velocity ratio is 25. The teeth are 20° FDI. (16 Marks)

Module -5

- 9a Derive Petroff equation for coefficient of friction in a journal bearing. (06 Marks)
b. A 75 mm long full journal bearing of diameter 75 mm supports a radial load of 12 kN at a shaft speed of 1800 rpm. The diametral clearance ratio is 0.001. The viscosity of oil is 0.01 PaS. Determine
i) Sommerfeld's number,
ii) Coefficient of friction
iii) Amount of heat generated
iv) Minimum oil film thickness and
v) Quantity of oil flow through the bearing. (10 Marks)

OR

- 10a Enumerate the advantages and disadvantages of rolling contact bearings compared to journal bearing. (06 Marks)
b Select a deep groove ball bearing required to for a shaft of diameter 45 mm to withstand a radial load of 6 kN and a thrust load of 3 kN at a speed of 300 rpm. The bearing works for 8 hours per day for 3 years. (10 Marks)

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