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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Sixth Semester, B.E. - Mechanical Engineering

Semester End Examination; May/ June - 2019

Design of Machine Elements - II

Time: 3 hrs *Max. Marks: 100*

Note: *i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

ii) Use of Design handbook attested by concerned authority is permitted.

iii) Missing data, if any, if it is required can be assumed suitably.

iv) Show the calculations clearly indicating relevant steps.

UNIT - I

1. A curved beam with circular centerline has a trapezoidal cross section and is subjected to pure bending in its plane of symmetry. The face 100 mm is the concave side of the beam and is at a distance of 100 mm from the centre of curvature. The depth of the trapezoidal is 100 mm. Find the proper value of the other parallel side, if the extreme fibre stresses are numerically equal. If this section carries a couple that develops a maximum fibre stress of 90 MPa. Find the magnitude of this couple. Sketch the diagram. — 20

2 a. Derive Shear stress, Deflection equations for helical coiled springs. — 10

b. A truck spring has three full length and 9 graduated leaves. The span is 1.1 m and width of central band is 150 mm. The load on springs is 9000 N. The allowable stress is 500 MPa in all the leaves. The deflection under load is 72 mm. Design the spring. Assume E = 206×10^3 MPa. — 10

UNIT - II

3. A 100 mm inside and 150 mm outside sleeve is press fitted on to a shaft of 100 mm diameter? The contact pressure is not to exceed 60 MPa. The modulus of elasticity of material is 210 GPa and poissons ratio is 0.28. Determine; — 20

   i) Tangential stresses at inner and outer surfaces of sleeve and outside diameter of shaft

   ii) The radial stress in the sleeve and the shaft

   iii) The original diameters of the shaft and hub before press fit

   iv) The total interference

4 a. Derive Lame's equation for thick cylinder. — 8

b. A thick cylinder 120 mm inner diameter and 180 mm outer diameter carries fluid under pressure of 9 MPa. Find the tangential and radial stresses across the wall and sketch the distribution. — 12

UNIT - III

5. Design a pair of spur gears to transmit 18 kW at 300 rpm of pinion. The velocity ratio is 6:1. The number of teeth on pinion is 20, pressure angle is 20° full depths involutes and both the gear and pinion are made of same steel material. Assume medium shocks and 10 hrs/day services, face width is 10 times module, allowable static strength of both the gears is 450 MPa. — 20

Contd….2

6. Two shafts inclined at 60° are connected by a pair of bevel gears to transmit 9 kW at 900 rpm of 24 teeth cast steel pinion having allowable static strength of 138 MPa. The gear is made of high grade cast iron having allowable static strength of 103 MPa run at 300rpm. The teeth are 14½° involutes form. Design the gears completely. Assume medium shocks 10 hrs/day services, face width is one-third of slant height of cone (R). 20

UNIT - IV

7 a. Design a single plate clutch to transmit power of 12 kW at 1500 rpm. The space limits the outside diameter of the clutch to 270 mm. Assume uniform pressure $\mu = 0.4$ and $P = 0.2$ MPa, $\tau_S = 65.72$ MPa, $I = 2$. 10

b. A cone clutch has a cone angle of 24° and is to transmit 12 kW at 1200 rpm. The mean diameter of friction lining is 300 mm. the normal intensities of pressure between contact surface is not to exceed 1.5 bar. Coefficient of friction is 0.24. Design the clutch. Assume $\tau_S = 65.72$ MPa. 10

8 a. A single block brake with drum diameter 350 mm is as shown in Fig. Q8(a).The angle of contact is 90° coefficient of friction is 0.33. Determine the safe power that can be absorbed at 1440 rpm.

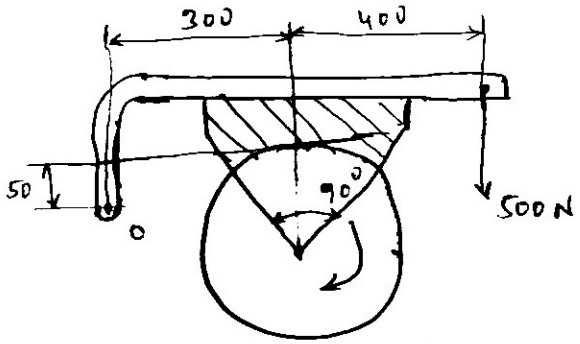

Fig Q.8(a) 8

b. A single band brake as shown in Fig. Q8(b) is to be designed to stop the rotation of a shaft transmitting a power of 45 kW at a rated speed of 500 rpm selecting suitable materials, determine;

i) Dimensions of the rectangular cross section of the band

ii) Dimensions of rectangular cross sections of the brake lever

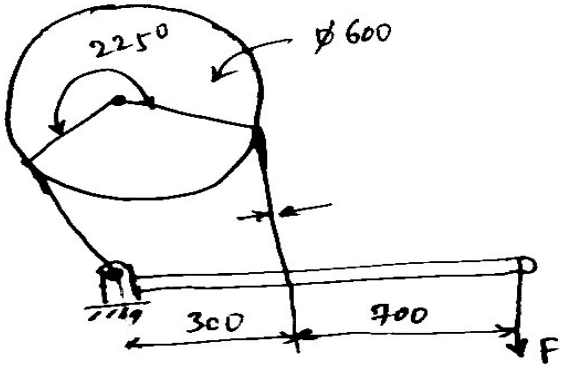

Fig Q.8(b). 12

Contd….3

UNIT - V

9 a. Derive Petroff's equation for co-efficient of friction in bearings. 10

b. Explain the following:

i) Bearing modulus ii) Sommerfeld's number 10

iii) Hydro dynamic lubrication iv) Boundary lubrication

10. Design a full journal bearing subjected to support a load of 7.5 kN at 1000 rpm. The journal is made of hardened steel and bearing of babbit material.

Abundance of oil is supplied by oil rings. The oil viscosity is 300 saybots seconds at 40°C and specific growity of oil is 0.915 at 15.5°. The operating temperature of oil film is 75° and a clearance of 0.001mm/mm of diameter is allowed. Assume ambient temperature is 30°C, $\frac{L}{d}=1.5$, 20

K = 0.0273 for heavy construction and well ventilated correction for end leakage $\Delta\mu$ = 0.002

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