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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 - 2018

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 Data Handbook allowed. iii) Any missing data, if any, suitably assumed.

UNIT - I

1 a. Derive the bending stress equation for curved beam. 6

b. Differentiate between curved beam and straight beam. 4

c. A ring is made from a 75 mm diameter bar. The inside diameter of the rings is 100 mm. For the load shown in Fig.Q1(a). Calculate the maximum shear stress in the bar and specify the location. 10

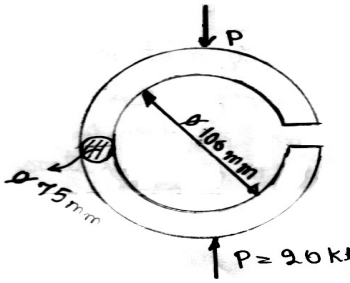


Fig Q.1(c)

2 a. Derive an expression for the stress induced in a helical spring. 7

b. Write a note on Wahl stress correction factor. 3

c. A semi-elliptical leaf spring has a span of 1.8 m. The spring carries a helical spring upon which is imposed an impact of 3 kN-m. The laminated spring has 8 graduated and three full lengths leaves each 60 mm wide and 6 mm thick. The coil spring has 9 coil of 12.5 mm wire diameter and spring index of 7. Find stresses induced in each spring. 10
Take G = 80×10^3 MPa, E = 206×10^3 MPa.

UNIT - II

3 a. Discuss the concept of auto fre Hage. 7

b. A CI cylindrical pipe of outside diameter 300 mm and inside diameter 200 mm is subjected to an internal fluid pressure 20 MPa and external fluid pressure of 5 MPa. Determine the tangential and radial stresses at the inner, middle and outer surface. Sketch the tangential and radial stress distribution across its thickness. 13

4 a. Derive Clavarino's equation for thickness of wall of cylindrical pressure vessel. 8

b. An engine's chest is covered by a flat rectangular head of 200 mm×300 mm dimensions. The plate is made by grey CIFG150 with ultimate stress of the material is 150 MPa. Supported at the edges and subjected to a uniform pressure of 1.5 MPa. Determine the thickness of the head for factor of safety is 5. 12

Contd…2

UNIT - III

5. A pair of spur gears has to transmit 20 kW from a shaft rotating at 100 rpm to a parallel shaft which is to rotate at 310 rpm. Number of teeth on pinion is 31 with 20° full depth involute tooth form. The material for pinion is steel SAE 1040 untreated with allowable static stress 206.81 MPa and material for the gear is cast steel 0.2% C untreated with allowable static stress 137.34 MPa. Design the gears. 20

6. Design pair of bevel gears to connect two shafts at 90°. The power transmitted is 25 kW at 900 rpm of pinion. The reduction ratio is 5:1. The teeth are 20° full depth involute and pinion has 24 teeth. Check the design for dynamic and wear conditions. The material of both pinion and gear is forged steel 0.3% C heat treated. 20

UNIT - IV

7 a. Determine the dimensions of a simple cone clutch to transmit 20 kW at 1000 rpm. The minimum diameter is to be 30 mm and cone clutch angle 20°. Assume $\mu = 0.2$ and permissible pressure = 0.1 MN/m^2. Also determine axial force required to engage clutch. 10

b. A multiple clutch with steel and bronze is to transmit 8 kW at 1440 rpm. The inner diameter of the contact is 80 mm and the outer diameter of contact is 140 mm. The clutch plate operates in oil with expected coefficient of friction of 0.1 and allowable pressure of 0.35 MPa. Assume uniform wear theory. Determine number of steel and bronze plates, axial force required. 10

8 a. A differential band brake shown in Fig. Q.8(a) operates on a drum diameter of 500 mm. The drum rotates at 300 rpm in counter clockwise direction and absorbs 36 kW, $\mu = 0.25$. Determine;

i) Force '*F*' required to operate the brake

ii) Width of band required for this brake if thickness is 5 mm and allowable tensile stress on band material is 72 N/mm^2

iii) Design the lever, if the maximum force is twice that of calculated force. Use C30 steel of ultimate stress is 540 MPa and factor of safety is 4 and also depth equal to thrice the width. 10

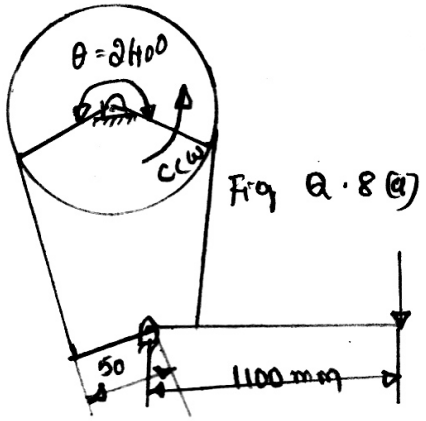


Fig Q.8(a)

Contd…3

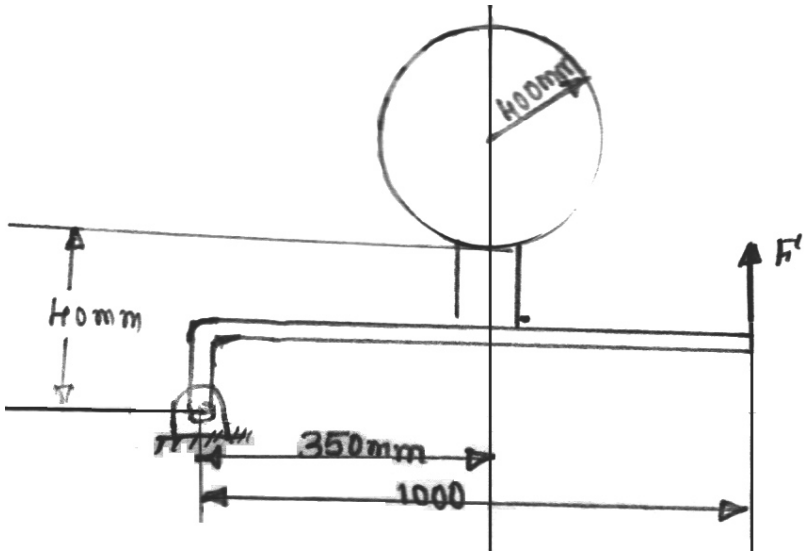
b. A 400 mm radius brake drum contacts a single shoe as shown in Fig.Q.8(b) and sustain 200 N-M torque at 500 rpm for coefficient of friction 0.25. Determine;

i) Normal force on the shoe

ii) Force 'F' required to apply the brake for clockwise and anticlockwise rotation

iii) The dimension 'G' required to make the brake self braking, assuming the outer dimension remains the same

iv) Heat generated



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UNIT - V

9 a. Derive Petroff's equation for lightly loaded bearing. 8

b. A fan thermal bearing 50 mm in diameter and 50 mm long operates at 1000 rpm and carries a load of 5 kN. The radial clearance is 0.025 mm. The bearing lubricated with SAE 30 oil and the operating temperature of oil 80°C. Determine;

i) Bearing pressure

ii) Summer fled number

iii) Altitude

iv) Minimum heat generated and heat decapitated, if the ambient temperature 20°C

v) Amount of artificial cooling, if necessary. 12

10 a. Explain hydrodynamic theory of lubrication and significance of the bearing characteristics number in the design of journal bearing. 8

b. Design a full journal bearing subjected to 6 kN at 1000 rpm of the journal. The journal is of hardened steel and bearing is of Babbitt material. The bearing is operated with SAE 40 oil at 70°C and ambient temperature is 30°C. Also determine the amount of artificial cooling required. 12

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