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10ME52

Fifth Semester B.E. Degree Examination, Dec.2016/Jan.2017
Design of Machine Elements – I

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting atleast TWO questions from each part.*
2. Use of design data handbook is permitted.

PART – A

1 a. Draw the stress-strain diagram for a ductile material and show the salient points on them. **(05 Marks)**

b. What are the factors to be considered for selection of material for a machine component? **(05 Marks)**

c. A point in a structural member subject to plane stress is shown in Fig.Q1(c). Determine the following :
(i) Normal and tangential stress intensities on plane MN inclined at an angle of 45°.
(ii) Principal stresses and their direction
(iii) Maximum shear stress and the direction of the planes on which it occurs. **(10 Marks)**

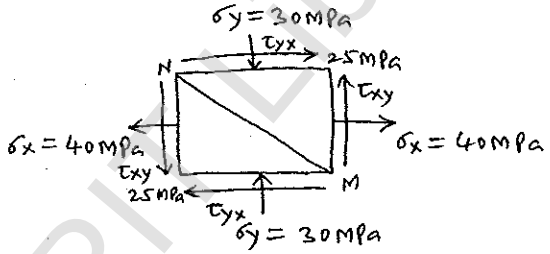

Fig.Q1(c)

2 a. State and explain the theories of failure :
(i) Maximum principal stress theory.
(ii) Maximum shear stress theory. **(06 Marks)**

b. What is stress concentration? Explain the factors affecting the stress concentration. **(06 Marks)**

c. An unknown weight falls through 15 mm on to a collar rigidly attached to the lower end of a vertical bar 2 metres long and 500 sq. mm section. If the maximum instantaneous extension is 2 mm, what is the corresponding stress and the value of unknown weight? Take E = 200GPa. **(08 Marks)**

3 a. Explain briefly the following :
(i) High cycle and low cycle fatigue (ii) Endurance limit. **(04 Marks)**

b. A simply supported beam has a concentrated load at the centre which fluctuates from a value of P to 4P. The span of the beam is 500 mm and its cross-section is circular with a diameter of 60 mm. Taking for the beam material an ultimate stress of 700 MPa, a yield stress of 500 MPa, endurance limit of 330 MPa for reversed bending, and a factor of safety of 1.3, calculate the maximum load of P. Take a size factor of 0.85, a surface finish factor of 0.9 and fatigue stress concentration factor of 1. **(16 Marks)**

4 a. Explain the stresses induced in a screw fastening subjected to static dynamic and impact loading. **(12 Marks)**

b. A wall bracket is attached to the wall by means of four identical bolts, two at A and two at B, as shown in Fig.Q4(b). Assuming that the bracket is held against the wall and prevented from tipping about the point C by all four bolts and using an allowable tensile stress in the bolts as 35 N/mm^2, determine the size of the bolts on the basis of maximum principal stress theory. **(08 Marks)**

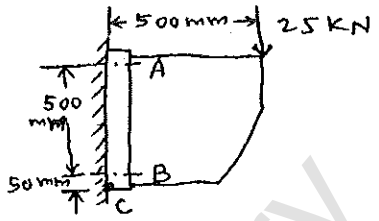

Fig.Q4(b)

PART – B

5 A mild steel shaft transmits 20 kW at 200 r.p.m. It carries a central load of 900 N and is simply supported between the bearings 2.5 metres apart. Determine the size of the shaft, if the allowable shear stress is 42 MPa and the maximum tensile or compressive stress is not to exceed 56 MPa. What size of the shaft will be required, if it is subjected to gradually applied loads? **(20 Marks)**

6 a. Design a knuckle joint to transmit 120 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression. **(10 Marks)**

b. Design a cast iron flange coupling for a mild steel shaft transmitting 90 kW at 250 r.p.m. The allowable shear stress in the shaft is 40 MPa and the angle of twist is not to exceed 1° in a length of 20 diameters. The allowable shear stress in the coupling bolts is 30 MPa. **(10 Marks)**

7 a. A double riveted lap joint with zig-zag riveting is to be designed for 13 mm thick plates. Assume σ_t = 80 MPa; τ = 60 MPa ; σ_c = 80 MPa. State how the joint will fail and find the efficiency of the joint. **(10 Marks)**

b. A welded joint as shown in Fig.Q7(b) is subjected to an eccentric load of 2 kN. Find the size of weld, if the maximum shear stress in the weld is 25 MPa. **(10 Marks)**

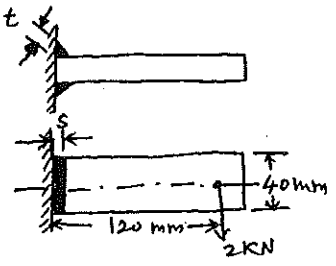

Fig.Q7(b)

8 a. Explain self locking and overhauling in power screws. **(06 Marks)**

b. A vertical two start square threaded screw of 100 mm mean diameter and 20 mm pitch supports a vertical load of 18 kN. The nut of the screw is fitted in the hub of a gear wheel having 80 teeth which meshes with a pinion of 20 teeth. The mechanical efficiency of the pinion and gear wheel drive is 90 percent. The axial thrust on the screw is taken by a collar bearing 250 mm outside diameter and 100 mm inside diameter. Assuming uniform pressure conditions, find minimum diameter of pinion shaft and height of nut, when coefficient of friction for vertical screw and nut is 0.15 and that for the collar bearing is 0.20. Take τ = 56 MPa and P_b = 1.4 MPa. **(14 Marks)**

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