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06ME52

Fifth Semester B.E. Degree Examination, December 2011
Design of Machine Elements – I

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Use of design hand book is permitted.
3. Missing data may be suitably assumed.

PART – A

1 a. Briefly explain the important mechanical properties of metals. **(06 Marks)**

b. Define standards and codes. **(04 Marks)**

c. A cantilever beam of circular cross section is loaded as shown in Fig.Q.1(c). Determine the maximum and minimum normal stresses and maximum shear stress at point A and B. **(10 Marks)**

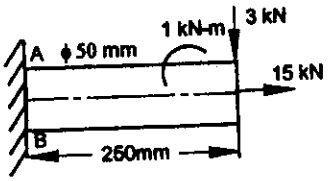

Fig.Q.1(c)

2 a. Briefly explain maximum normal stress theory and maximum shear stress theory. State when they are used. **(06 Marks)**

b. Give any three examples of stress raisers and show how the stress concentration can be reduced in these cases. **(07 Marks)**

c. An unknown weight falls through 10mm on a collar rigidly attached to the lower end of a bar 3m long and 600mm^2 in section. If the maximum instantaneous extension is 2mm, what is the corresponding stress and the value of unknown weight? Take E = 200 GPa. **(07 Marks)**

3 A cold drawn steel cantilever member shown in Fig.Q.3 is subjected to a transverse load at its end that varies from 50 N to 150 N and an axial load varies from 100N (compression) to 500 N (tension). Determine the required diameter at the change of section for infinite life using a factor of safety of 2. The material has an ultimate strengths of 550 MPa and yield strength of 470 Mpa. Take a notch sensitivity factor for the fillet as 0.9. **(20 Marks)**

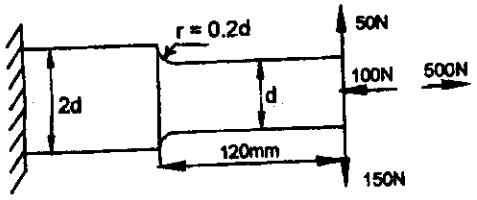

Fig.Q.3

4 a. A bolt carries a tensile load of 8 kN and tightening load is 3 kN. It is made of steel having allowable tensile stress of 120 Mpa. Find its size. A soft copper gasket is used. **(06 Marks)**

b. A bracket is bolted as shown in Fig.Q.4(b). All the bolts are identical and have yield strength of 400 Mpa. Determine the size of bolts assuming factor of safety as 3. **(14 Marks)**

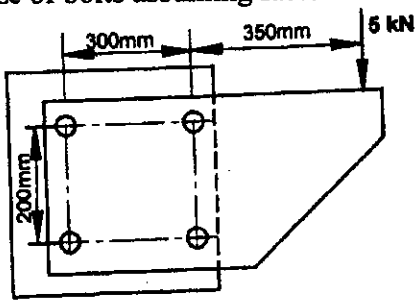

Fig.Q.4(b)

PART – B

5 A horizontal piece of commercial shafting is supported by two bearings 1.5m apart. A keyed gear, 20° involute and 175 mm diameter, is located 400 mm to the left of the right bearing and is driven by a gear directly behind it. A 600 mm diameter pulley is keyed to the shaft 600 mm to the right of the left bearing and drives a another pulley by means of a belt drive inclined at 45° to the horizontal below the shaft and in front of it. The tension ratio of the belt is 3:1. The drive transmits 45 kW at 330 rpm cw when viewed from right side. The allowable shear stress for shaft material is 40 Mpa. The combined shock and fatigue factors for torsion and bending are 1.5 and 2.0 respectively. Draw the moment diagrams and calculate the necessary shaft diameter. **(20 Marks)**

6 a. Design and sketch the assembly of a cotter joint to connect two rods, subjected to an axial pull of 600 kN. The material selected for the joint has the following permissible stresses : 300 MPa in tension, 220 MPa in shear and 450 MPa in crushing. **(12 Marks)**

b. A cast iron protective type flange coupling is used to connect two shafts of 80 mm diameter. The shaft runs at 250 rpm and transmits a torque of 4300 N-m. The permissible shear stress for shaft and bolt materials is 50 MPa and permissible shear stress for flange is 8 MPa. Design the bolts, hub and flange for the coupling. **(08 Marks)**

7 a. Design a triple riveted longitudinal double strap butt joint with unequal straps for a boiler. The inside diameter of the congest. Course of the drum is 1.3 m. The joint is to be designed for a steam pressure of 2.4 MPa. The working stresses to be used are : σ_t = 77 MPa, τ = 62 MPa and σ_c = 120 MPa. Assume the efficiency of the joint as 81%. The longer pitch in outer row is twice the pitch In inner row and the inner rows are zig – zag. **(12 Marks)**

b. A bracket as shown in Fig.Q.7(b) carries a load of 10 kN. Find the size of the weld if the allowable shear stress is not to exceed 80 MPa. **(08 Marks)**

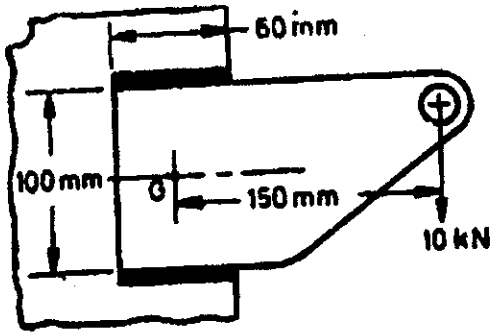

Fig.Q.7(b)

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

b. A sluice gate weighing 600 kN is raised by means of two square threaded screws. The coefficient of collar friction is 0.03 and coefficient of thread friction is 0.14. The outer diameter of the collar is 100 mm and inner diameter is 50 mm. The gate is raised at a rate of 0.6 m/min. The permissible stress of the screws material in tension and compression is 80MPa and that in shear is 60 MPa. Design the screw and nut, check for the stresses induced. Also determine the speed of screw and power required at the motor to raise the gate, assuming an efficiency of 75% for reduction drive. The permissible bearing pressure is 15 MPa. **(14 Marks)**

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