R09

Code No: 55019

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, March - 2017
DESIGN OF MACHINE MEMBERS-I
(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) What are the factors to be considered for the selection of materials for the design of machine elements? Discuss.

b) The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of bolt required according to
i) Maximum principal stress theory
ii) Maximum shear stress theory
iii) Maximum principal strain theory
iv) Maximum strain energy theory
v) Maximum distortion energy theory
Take permissible tensile stress at elastic limit = 100 MPa and poisson's ratio = 0.3. [7+8]

2.a) Illustrate how the stress concentration in a component can be reduced.

b) A machine component is subjected to a flexural stress which fluctuates between + 300 MN/m^2 and – 150 MN/m^2. Determine the value of minimum ultimate strength according to (i) Gerber relation (ii) Modified Goodman relation (iii) Soderberg relation. Take yield strength = 0.55, Ultimate strength, endurance strength = 0.5, Ultimate strength and factor of safety = 2. [7+8]

3.a) A bracket is welded to the side of a column and carries a vertical load P, as shown in the Figure 1. Evaluate P so that the maximum shear stress in the 10 mm fillet welds is 80 MPa.

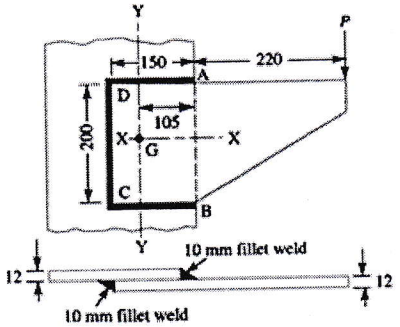

Figure 1

b) A steam boiler is to be designed for a working pressure of 2.5 N/mm^2 with its inside diameter 1.6 m. Give the design calculations for the longitudinal and circumferential joints for the following working stresses for steel plates and rivets:
In tension = 75 MPa; In shear = 60 MPa; In crushing = 125 MPa. Draw the joints to a suitable scale. [7+8]

4. Determine the size of the bolts and the thickness of the arm for the bracket as shown in Figure 2, if it carries a load of 40 kN at an angle of 60^0 to the vertical. The material of the bracket and the bolts is same for which the safe stresses can be assumed as 70, 50 and 105 MPa in tension, shear and compression respectively. [15]

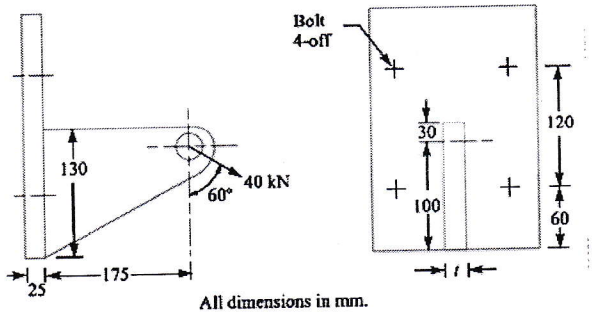

Figure 2

5.a) Draw a cotter joint to connect two mild steel rods for a pull of 30 kN. The maximum permissible stresses are 55 MPa in tension; 40 MPa in shear and 70 MPa in crushing. Draw a neat sketch of the joint designed.

b) How are the keys classified? Draw neat sketches of different types of keys and state their applications. [7+8]

6. A hoisting drum 0.5 m in diameter is keyed to a shaft which is supported in two bearings and driven through a 12 : 1 reduction ratio by an electric motor. Determine the power of the driving motor, if the maximum load of 8 kN is hoisted at a speed of 50 m/min and the efficiency of the drive is 80%. Also determine the torque on the drum shaft and the speed of the motor in r.p.m. Determine also the diameter of the shaft made of machinery steel, the working stresses of which are 115 MPa in tension and 50 MPa in shear. The drive gear whose diameter is 450 mm is mounted at the end of the shaft such that it overhangs the nearest bearing by 150 mm. The combined shock and fatigue factors for bending and torsion may be taken as 2 and 1.5 respectively. [15]

7. Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15 kW at 200 r.p.m. and having an allowable shear stress of 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14 MPa. [15]

8.a) Classify springs according to their shapes. Draw neat sketches indicating in each case whether stresses are induced by bending or by torsion.

b) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 MPa and modulus of rigidity 84 kN/mm^2, find the axial load which the spring can carry and the deflection per active turn. [7+8]

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