Code: 9A03504

R9

B.Tech III Year I Semester (R09) Supplementary Examinations, May 2013

DESIGN OF MACHINE ELEMENTS - I

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 (a) What is meant by toughness and how is it measured?

(b) Explain the terms: (i) Strength. (ii) Elasticity. (iii) Resilience.

2 A short cast iron column of hollow circular section with 250 mm outside diameter and 150 mm inside diameter carries a vertical load of 400 kN acting at a point 100 mm from the axis of the column. Find: (i) the normal and bending stresses induced in the column. (ii) If the resultant stress, throughout the cross-section is to be compressive what should be the maximum value of the distance between the axis and the load.

3 (a) Distinguish between endurance strength and ultimate strength.

(b) Determine the size of a piston rod subjected to a total load having cyclic fluctuation from 150 kN (compression) to 25 kN (tension). The endurance limit is 360 MPa and yield strength is 400 MPa. Take factor of safety = 1.5; surface finish factor = 0.88 and stress concentration factor = 2.25.

4 A locomotive boiler of 1.8 m internal diameter is required to generate steam at 1.4 MPa gauge. Calculate the thickness of the shell plate and design the triple riveted longitudinal double butt strap joint with unequal straps. The allowable stresses are 77 MN/m^2 in tensile, 60 MN/m^2 in shear and 135 MN/m^2 in compression. The efficiency of triple-riveted longitudinal butt joint is 84%.

5 The external load applied to a bolted joint fluctuates between zero and 6.24 kN. The bolt is tightened with an initial load of 5.8 kN. The root area of the bolt is 105 x 10^{-6} m^2. The ratio of the deflection per N of load for the bolt to that for the members is 3.

(i) Determine the maximum and minimum bolt loads.

(ii) Determine the average stress and the variable stress, assuming a stress concentration factor of 2.8 which includes surface and size effects.

(iii) Plot the Soderberg working-stress diagram and determine if the bolt is safely loaded for a factor of safety of 1.8. The material has a yield point of 276 MPa, and an endurance limit in reversed axial loading of 138 MPa.

6 Two rods having 30 mm x 30 mm square cross-section are connected using a gib and cotter. Calculate the leading dimensions of the joint so as to have the strength of the joint same as the strength of the rods in tension. For all the parts of the joint take the allowable stresses as follows:

Tensile strength = 120 N/mm^2, Shear strength = 70 N/mm^2 and Compression strength = 240 N/mm^2.

7 (a) Explain the difference between shaft, axle and spindle.

(b) A shaft transmits 75 KW power at 300 r.p.m. The distance between the two bearings is 3000 mm. It is subjected to torsion only. Calculate the diameter of the shaft, (i) for steady loading and (ii) for suddenly applied load with minor shocks. Take the allowable shear stress for the shaft material as 35 N/mm^2.

8 A flange coupling connects two 50 mm diameter lengths of commercial shafting. The coupling flanges are bolted together with four bolts of the same material as the shaft. The bolts are set in clearance holes. The diameter of the bolt circle is 240 mm and the flange thickness is 22 mm.

(i) Determine the minimum bolt diameter required to transmit the same torque that the shaft can transmit.

(ii) What power may be transmitted at 200 rev/min under steady load conditions?

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