R18/R16

Code No: 155AX/135AG

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, March - 2021

DESIGN OF MACHINE MEMBERS - I

(R18 - Mechanical Engineering; R16 - Mechanical Engineering)

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

Answer any five questions

All questions carry equal marks

1.a) Explain different theories of elastic failure and discuss the factor of safety.

b) A round bar, of length L, tapers uniformly from radius r_1 at one end to radius r_2 at the other. Show that the extension produced by a tensile axial load P acting at the smaller end is $PL/(2\pi E r_1^2)$. [8+7]

2.a) What is fatigue stress concentration factor? Describe its significance.

b) A smooth cantilever beam of circular cross section made of hot rolled steel is subjected to an axial load which varies from 7 kN in tension to 5 kN in compression. It is also subjected to a transverse load at the free end which varies from +8 kN to – 6 kN. The length of the cantilever is 400 mm. The material properties are σ_u = 500 MPa, σ_y = 300 MPa. Factor of safety may be taken as 2. Find the diameter of the beam for a reliability of 90 %. [7+8]

3.a) A cylinder head is held on the cylinder by 8 numbers of bolts. The inner diameter of the cylinder is 350 mm. The pressure inside the cylinder varies from zero to a maximum pressure of 2.5 MPa. The ultimate tensile stress and yield stress are 630 MPa and 380 MPa respectively. The bolts are tightened with initial preload of 1.5 times the steam load. A copper asbestos gasket is used to make the joint leak proof. Take factor of safety is 2.5. Neglect stress concentration factor. Find the size of the bolt.

b) Explain the design of bolt subjects to uniform loading. [7+8]

4.a) What is a cotter joint? Why is cotter provided with a taper, and why is the taper provided only on one side?

b) A rectangular sunk key 14 mm wide, 10 mm thick and 75 mm long is required to transmit 1200 N-m torque from a 50 mm diameter solid shaft. Determine whether the length is sufficient or not, if the permissible shear stress and crushing stress are limited to 56 MPa and 168 MPa respectively. [7+8]

5. Design a bushed-pin type flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 rpm. The overall torque is 20% more than mean torque. Material properties are as follows:

a) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively.

b) The allowable shear stress for cast iron is 15 MPa.

c) The allowable bearing pressure for rubber bush is 0.8 MPa.

The material of the pin is same as that of shaft and key. [15]

6.a) Prove that a square key is equally strong in crushing and shearing.

b) A cantilever beam of square section supports an electric motor weighing 1000 N at a distance of 400 mm from the fixed end. If the allowable stress of beam material is 100 N/mm^2, Determine section of beam. [8+7]

7.a) Find the diameter of a solid steel shaft to transmit 20 kW at 200 r.p.m. The ultimate shear stress for the steel may be taken as 360 MPa and a factor of safety as 8. If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5.

b) What do you mean by preferred numbers? Explain with the help of an example. [8+7]

8.a) Describe the design procedure of a knuckle joint subjected to a normal loading.

b) What are different applications of flexible coupling? [8+7]

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