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10ME52

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Design of Machine Elements – I

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of Design Data hand book is permitted.***

PART – A

1 a. Draw the engineering stress – strain diagram and explain all the salient point marked on it. **(10 Marks)**

b. A point in a structural member subjected to plane stress is shown in Fig Q1(b). Determine the following :
i) Normal and tangential stress intensities on a plane inclined at 45°
ii) Principal stress and their directions. **(10 Marks)**

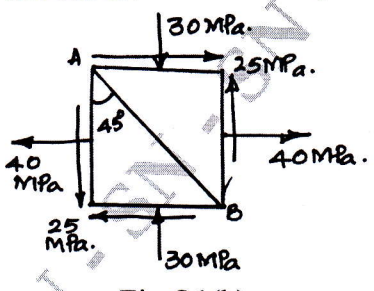

Fig Q1(b)

2 a. Define factor of safety and list four factors to be considered in the selection of factor of safety. **(04 Marks)**

b. Determine the torque transmitted by the stepped shaft shown in Fig Q2(b). If the maximum shear stress is limited to 60MPa **(08 Marks)**

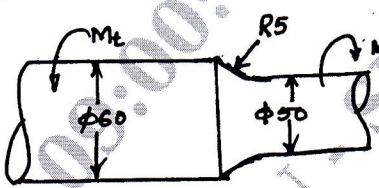

Fig Q2(b)

c. An unknown weight falls through 10mm on a collar rigidly attached to the lower end of a vertical bar 3m long and 600mm^2 in section. The maximum instantaneous extension is 2mm. What is the corresponding stress and the value of unknown weight. Take E = 206GPa. **(08 Marks)**

3 A steel cantilever member shown in Fig Q3 is subjected to an axial load that varies from 500N compression to 1000N tension and to a transverse load at its free end that varies from 100N up and 200N down. Determine the required diameter of the section using a factor of safety 2. The strength properties of the material are σ_u = 550MPa, σ_y = 480Mpa, σ_{-1} = 270MPa. Neglect the column action and notch effect. **(20 Marks)**

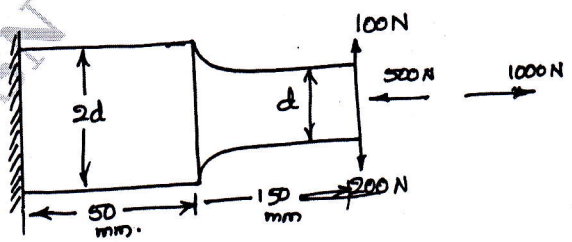

Fig Q3

4 a. Explain the types of stresses to be considered for design of bolts with static loading. **(10 Marks)**

b. An M 20 × 2 steel bolt of 100mm long is subjected to impact load. The energy absorbed by the bolt is 2 N-m.

i) Determine the stress in the shank of the bolt if there is no threaded portion between the nut and the bolt head.

ii) Determine the stress in the shank if the entire length of the bolt is threaded

Take E for steel = 206.8 GPA. **(10 Marks)**

PART – B

5 A shaft 600mm between bearings supports a 500mm diameter pulley 250mm to the right of the left hand bearing and the belt derives a pulley directly below another pulley 380mm dia is located 130mm to the right of the right hand bearing and the belt is driven from a pulley to the right horizontally. The coefficient of friction is 0.3 maximum tension in the belt is 5500N. Find the shaft diameter, the permissible normal and shear stresses are 56MPa and 42MPa respectively. Angle of wrap of belt on each pulley is 180°. **(20 Marks)**

6 a. Design a Knuckle joint to connect two mild steel rods to sustain an axial pull of 150kN. The pin and the rods are made of same material. Take working stresses in the material as 80MPa in tension, 40MPa in shear and 120MPa in crushing. **(10 Marks)**

b. Find the length and thickness of a sunk key for shaft of 100mm diameter. Assume that the shear resistance of the material of the key is the same as that of the shaft. Take the width of the key as 25mm and the shear stress is equal to 0.4 times the crushing stress. **(10 Marks)**

7 a. Explain in brief, the failures of Riveted joints. **(10 Marks)**

b. The Fig Q7(b) shows as horizontal steel bar 12mm thick, loaded in tension and welded to a vertical support. Find the load p that will induce a shear stress of 60MPa in the welds.

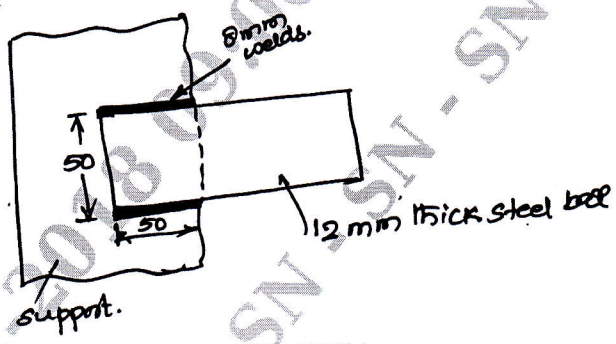

Fig Q7(b) **(10 Marks)**

8 a. Derive an expression for maximum efficiency of a square threaded screw and show that for self locking screw the efficiency is always < 50%. **(10 Marks)**

b. A double threaded power screw with trapezoidal ISO thread is used to raise a load of 300kN. The nominal diameter is 100mm and the pitch is 12mm. Take coefficient of friction is 0.15. Neglecting collar friction. Find :

i) Torque required to raise the load

ii) Torque required to lower the load

iii) Efficiency of the screw. **(10 Marks)**

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