Third Semester B.E. Degree Examination, Dec.2018/Jan.2019
Strength of Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Explain : i) Poisson's ratio ii) Young's modulus iii) Hooke's law iv) Factor of safety. **(04 Marks)**

b. Derive an equation for the deformation of a tapering rectangular bar of uniform thickness. **(06 Marks)**

c. A mild steel bar of 25mm diameter and 200mm gauge length has an extension of 0.15mm under a load of 75KN. Load at the elastic limit is 160KN and maximum load is 250 KN. Total extension is 55mm. Diameter at the fracture is 18.5mm. Find i) Elastic limit stress ii) Young's modulus iii) Percentage elongation iv) Percentage reduction in the area. **(10 Marks)**

2 a. Define : i) Volumetric strain ii) Thermal stresses iii) Principle of super position iv) Shear modulus. **(04 Marks)**

b. Derive the relation between Young's modulus and Modulus of rigidity. **(06 Marks)**

c. A mild steel rod 20mm in diameter passes centrally through a copper tube of 20mm internal diameter and thickness of 2.5mm. The composite section is 1m long and their ends are rigidly connected. If a load of 40KN acts on the rod, determine the stresses in the two metals and their extension. Young's modulus given that for steel $E_s = 2 \times 10^5$ N/mm^2 and for Copper $E_c = 1.047 \times 10^5$N/mm^2. **(10 Marks)**

3 a. What are principal stresses and principal planes? **(06 Marks)**

b. At a point in a section of a beam, there is a shear stress of 50MN/m^2 and a tensile stress of 80MN/m^2. Find the principal stresses in magnitude and direction. **(14 Marks)**

4 a. Explain the terms :
i) Hogging moment ii) Sagging moment iii) Point of contraflexure. **(06 Marks)**

b. Draw SFD and BMD for the beam loaded as shown in fig.Q.4(b), indicating salient values. Locate the point of contraflexure if any. **(14 Marks)**

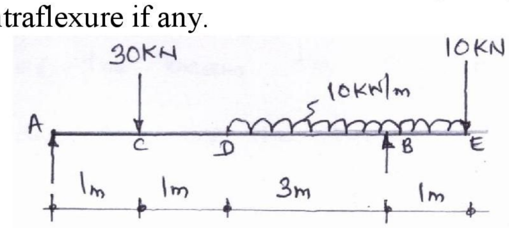


Fig.Q4(b)

PART – B

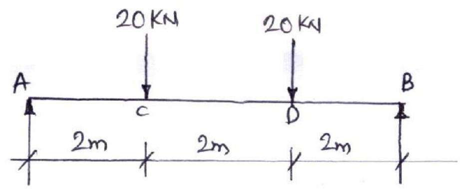
5 a. What do you mean by pure bending? Explain. State the assumptions made in the theory of pure bending. **(08 Marks)**

b. A beam of I – section has an overall depth of 250mm. The flanges are 125mm wide and 12.5mm thick. The web is 5mm thick. The beam rests freely on two supports 6m apart. Find the maximum point load that may applied at the centre of span without producing maximum flange stress not more than 80 MN/m^2. **(12 Marks)**

6 a. Derive the expression $EI.\dfrac{d^2y}{dx^2} = M$, with usual notations. **(06 Marks)**

b. A beam of constant cross section is 6m long is freely supported at its ends. It is loaded with two point loads of 20KN each at 2m from each end. Find the ratio of deflection at the centre of the beam to deflection at a point under any one of the loads. **(14 Marks)**

Fig.Q6(b)



7 a. Derive the torsion equation for a circular shaft subjected to pure torsion. **(08 Marks)**

b. A Hollow circular shaft has a 50 mm outside diameter and 30mm internal diameter. An applied torque of 1.6KN-m is found to produce an angular twist of 0.4^0, measured on a length of 0.2m of the shaft. Calculate the modulus of rigidity. Also calculate the maximum power which can be transmitted by the shaft at 200 rpm, if the maximum allowable shearing stress is $65N/mm^2$. **(12 Marks)**

8 a. List the assumptions made in Euler's theory of columns. **(04 Marks)**

b. Derive the expression for Euler's buckling load for a column with both ends fixed. **(06 Marks)**

c. A cast iron column 10cm external diameter and 8cm internal diameter is 3m long. Calculate the safe load using Rankine's formula if i) Both end are hinged ii) Both ends are fixed. Assume $\sigma_c = 600N/mm^2$, $\alpha = \dfrac{1}{1600}$. Adopt a factor of safety = 3. **(10 Marks)**