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## Third Semester B.E. Degree Examination, June/July 2019 Mechanics of Materials

Time: 3 hrs.

Max. Marks: 80

**Note: Answer any FIVE full questions, choosing ONE full question from each module.**

### Module-1

- 1 a. Define the following :
  - i) Stress                      ii) Strain                      iii) Modulus of Elasticity
  - iv) Elastic limit    v) Modulus of rigidity    vi) Poisson's ratio. (06 Marks)
- b. A compound bar consists of steel rod of diameter 20mm rigidly fitted into a copper tube of internal diameter 20mm and thickness 5mm. if the bar is subjected to a load of 100kN, determine stresses developed in two materials. Take E of steel as 200 GPa and for copper as 120GPa. (10 Marks)

**OR**

- 2 a. Derive an expression for extension of uniformly tapering circular bar subjected to axial load. (08 Marks)
- b. A bar of 20mm diameter is tested in tension. It is observed that when a load of 37.7kN is applied the extension measured over a gauge length of 200mm is 0.12mm and construction on diameter is 0.0036mm. Find Poisson's ratio and elastic constants E, G and K. (08 Marks)

### Module-2

- 3 a. The stresses at a point in a component are 100MPa tensile and 50MPa compressive. Determine the magnitude of normal and shear stresses on a plane inclined at an angle of 30° to the axis of compressive stress. Also determine the magnitude and direction of resultant stress and magnitude of maximum shear stress. (09 Marks)
- b. Solve the above problem 3(a) by using Mohr circle method. (07 Marks)

**OR**

- 4 a. Calculate : i) change in length    ii) change in diameter    iii) change in volume of a thin cylindrical shell 1m diameter, 10mm thick and 5m long when subjected to internal pressure of 3MPa. Take E = 200GPa and Poisson's ratio  $\mu = 0.3$ . (09 Marks)
- b. Find the thickness of metal necessary for a cylindrical shell of internal diameter 160mm to withstand an internal pressure of 8MPa. The max hoop stress in the section is not exceed 35MPa. (07 Marks)

### Module-3

- 5 A simply supported beam of length 10m carries the uniformly distributed load and two point loads as shown in Fig Q5. Draw the shear force and Bending moment diagram for the beam. Also calculate the maximum bending moment.

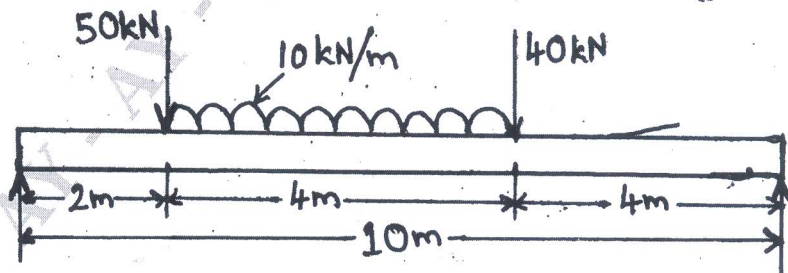


Fig Q5

1 of 2

(16 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

- 6 a. A beam is simply supported and carries a UDL of 40kN/m run over the whole span. The section of the beam is rectangular having depth as 500mm. If the maximum stress in the material of the beam is 120MPa and moment of inertia of the section is  $7 \times 10^8 \text{ mm}^4$ , find the span of the beam. (07 Marks)
- b. A cast iron beam of T-section as shown in Fig Q6(b) is simply supported on a span of 8m. The beam carries a UDL of 1.5 kN/m length on the entire span. Determine the maximum tensile and maximum compressive stresses.

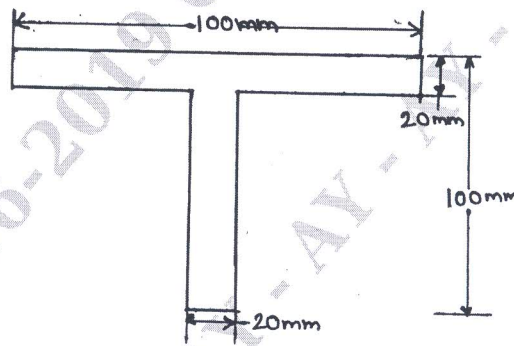


Fig Q6(b)

(09 Marks)

**Module-4**

- 7 a. A hollow shaft having an internal diameter 60% of its external diameter is to replace a solid shaft transmitting the same power at the same speed. Calculate the percentage saving in material, if the material to be used is also same. (08 Marks)
- b. Determine the diameter of a solid shaft to transmit 300kW at 250rpm. The maximum shear stress should not exceed 30MPa and twist should not be more than  $1^\circ$  in a shaft length of 2m. Take  $G = 100\text{GPa}$ . (08 Marks)

OR

- 8 a. Derive an expression for crippling load when both the ends of the column are hinged. (09 Marks)
- b. A column of timber section  $150\text{mm} \times 200\text{mm}$  is 6m long both ends being fixed. If the Young's modulus is 17.5 GPA determine :  
i) Crippling load    ii) Safe load for column if factor of safety = 3. (07 Marks)

**Module-5**

- 9 a. Define : i) Strain energy ii) Resilience iii) Proof resilience iv) Modulus of resilience. (04 Marks)
- b. Derive an expression for strain energy stored in a bar subjected to gradually applied axial load P. (08 Marks)
- c. State and explain Castigliano's first theorem. (04 Marks)

OR

- 10 a. State and explain the maximum principal stress theory. (04 Marks)
- b. Determine the diameter of bolt subjected to an axial pull of 9kN together with a transverse shear force of 4.5kN using  
i) Maximum principal stress theory  
ii) Maximum shear stress theory  
Given tensile stress =  $85\text{N/mm}^2$ , shear stress =  $50\text{N/mm}^2$ . (12 Marks)

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