CBCS SCHEME

USN | | | | | | | | | |

15MA34

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 terms:
i) Stiffness
ii) Hardness
iii) Resilience
iv) Toughness. **(06 Marks)**

b. Different portions of a stepped bar are subjected to the forces as shown in Fig.Q.1(b). Determine:
i) Stress induced in each portion
ii) Deformation in each portion
iii) Net deformation in the bar.
Take E = 200 GPa. **(10 Marks)**

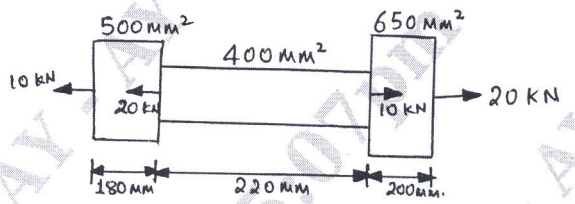

Fig.Q.1(b)

OR

2 a. When a 12mm diameter specimen is subjected to a tensile force of 20kN, a deformation of 0.3mm is observed over a gauge length of 150mm. Reduction in diameter is 0.0079mm. Determine:
i) Young's modulus
ii) Poisson's ratio
iii) Modulus of rigidity
iv) Bulk modulus. **(08 Marks)**

b. A stepped bar shown in Fig.Q.2(b) is fixed at its two ends rigidly. The bar is free of stress at 30°C. When the temperature is increased to 90°C determine:
i) Stress induced in steel and copper portions
ii) Displacement of the junction C
Take E_C = 100GPa E_S = 200GPa $\alpha_c = 1.8 \times 10^{-5}/°C$ $\alpha_s = 1.2 \times 10^{-5}/°C$ **(08 Marks)**

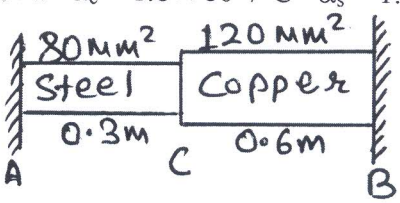

Fig.Q.2(b)

Module-2

3 A machine component is subjected to stress as shown in Fig.Q.3. Find normal and shear stresses on the section AB inclined at an angle of 60° with x-axis. Also find the resultant stress on the section. Verify the above results using Mohr's circle method. **(16 Marks)**

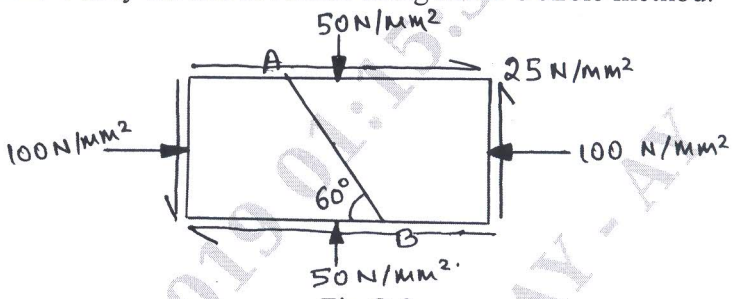

Fig.Q.3

OR

4 a. A thin cylindrical shell 1m in diameter and 3m long has a metal thickness of 10mm. It is subjected to an internal fluid pressure of 3MPa. Determine:

i) Circumferential and longitudinal stress
ii) Circumferential, longitudinal and volumetric strain
iii) Change in length, diameter and volume.

Assume $\mu = 0.3$ and $E = 210$ GPa. **(08 Marks)**

b. A thick cylindrical pipe of outside diameter 300mm and internal diameter 200mm is subjected to an internal fluid pressure of $20N/mm^2$ and external fluid pressure of $5N/mm^2$. Determine the maximum stress developed. Draw variation of hoop stress and radial stress across the thickness of the pipe. **(08 Marks)**

Module-3

5 Draw shear force and bending moment diagram for the beam shown in Fig.Q.5. Also compute point of controflexure if any. **(16 Marks)**

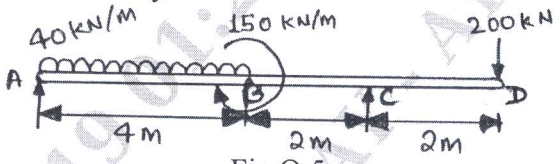

Fig.Q.5

OR

6 a. A cast iron bracket of I-section with equal flanges is as shown in Fig.Q.6(a). The beam carries a udl of 10kN/m on a span of 10m length. Determine the position of neutral axis, moment of inertia about the neutral axis and the maximum stress distribution. Also plot the variation of bending stress with respect to depth of the section. **(08 Marks)**

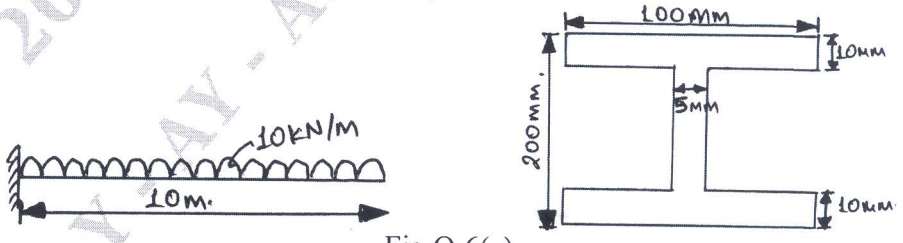

Fig.Q.6(a)

b. Show that shear stress distribution across a rectangular section is given by $\tau_{max} = 1.5\ \tau_{avg}$. **(08 Marks)**

Module-4

7 a. Define the following terms with expression:
i) Polar section modulus
ii) Torsional strength
iii) Torsional rigidity. **(06 Marks)**

b. A solid shaft is to transmit 192 kW at 450 rpm. Taking the allowable shear stress for the shaft material as 70MPa, find the diameter of solid shaft. What percentage of saving in weight would be obtained, if this shaft were to be replaced by a hollow shaft whose internal diameter is 0.8 times its external diameter? The length, material, power to be transmitted and speed are equal in both cases. Torsional strength of both solid and hollow shafts should be equal. **(10 Marks)**

OR

8 a. Develop Euler's buckling load formulae for the column whose both ends are hinged. **(08 Marks)**

b. A 1.5m long column has a circular cross section of 50mm diameter. One end of the column is fixed in direction and the other end is free. Taking factor of safety as 3, calculate the safe load using
i) Rankine's formula taking yield stress 560 N/mm^2 and $\alpha = 1/1600$
ii) Euler's formula, taking $E = 1.2 \times 10^5$ N/mm^2. **(08 Marks)**

Module-5

9 a. Determine the internal strain energy stored within an elastic bar subjected to an axial tensile force F. **(08 Marks)**

b. A tensile load of 50kN is applied to a circular cross-section bar of diameter 50mm and 4m long. If $E = 2 \times 10^5$ N/mm^2, determine:
i) Stretch in the rod
ii) Stress in the rod
iii) Strain energy absorbed by the rod when load is applied gradually and when load is applied suddenly. **(08 Marks)**

OR

10 a. A cantilever beam AB supports a udl of W per unit length as shown in Fig.Q.10(a). Determine the deflection using Castigliano's theorem. **(06 Marks)**

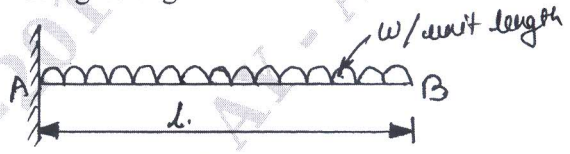

Fig.Q.10(a)

b. Define failure by yielding and failure by fracture. **(04 Marks)**

c. A shaft is loaded by a torque of 5 kN/m. The material has a yield point of 350 MPa. Find the required diameter using maximum shear stress story. Use factors of safety as 2.5. **(06 Marks)**

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