CBCS SCHEME

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15MN34

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

Time: 3 hrs. Max. Marks: 80

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



### Module-1

1 a. Define (i) Hooke's law (ii) Ductility (iii) Principle of super position (iv) Factor of safety **(04 Marks)**

b. Neatly draw the stress-strain diagram for mild steel indicating all salient points. **(04 Marks)**

c. A steel specimen of 12.5 mm diameter and 150 mm guage length is subjected to tensile test. It is observed that load at yield point is 43 kN and maximum load is 60 kN. A load of 16.4 kN is required to cause an elastic deformation of 0.1 mm. Find length of specimen is 190 mm and diameter of neck after fracture is 8 mm. Determine (i) Yield stress (ii) Ultimate stress (iii) Young's modulus (iv) Percentage of increase in length. **(08 Marks)**

**OR**

2 a. Derive an expression for deformation of uniformly tapering circular bar subjected to axial load. **(08 Marks)**

b. A stepped bar is subjected to the forces as shown in Fig. Q2 (b). Determine the stress induced in different portions and net deformation in the stepped bar. Take $E = 2\times10^5\ N/mm^2$. **(08 Marks)**

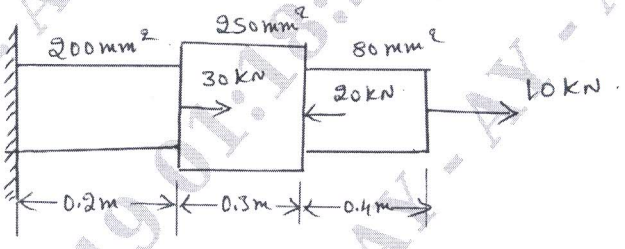


Fig. Q2 (b)

### Module-2

3 a. Derive an expression for relation between modulus of elasticity and modulus of rigidity and also modulus of elasticity and bulk modulus. **(08 Marks)**

b. The state of stress at a point in a strained material is shown in Fig. Q3 (b). Determine
(i) The direction of the principal planes.
(ii) Magnitude of principal stresses and
(iii) The magnitude of maximum shear stress and its direction.
Indicating all the above planes by sketch. **(08 Marks)**

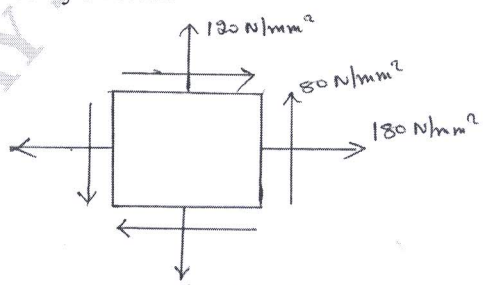


Fig. Q3 (b)

**OR**

4 a. Derive Lames equation for thick cylinders. **(08 Marks)**

b. A pipe of 400 mm internal diameter and 100 mm thickness contains a fluid at a pressure of 80 N/mm$^2$. Find the maximum and minimum hoop stresses across the section. Also sketch the radial and hoop stress distribution across the section. **(08 Marks)**

## Module-3

5 Draw the shear force and bending moment diagram for a Cantilever beam shown in Fig. Q5. **(16 Marks)**

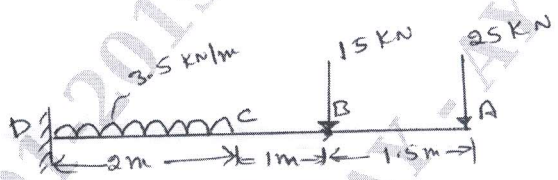


Fig. Q5

**OR**

6 Draw the shear force and bending moment diagram for a beam shown in Fig. Q6. **(16 Marks)**

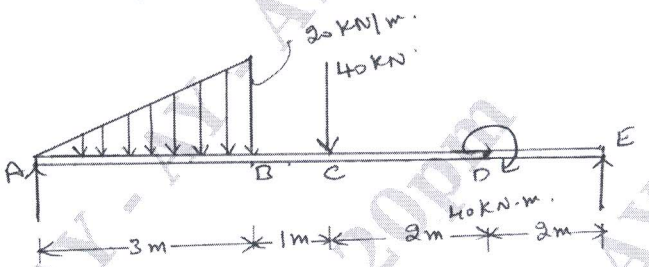


Fig. Q6

## Module-4

7 a. State the assumptions made in theory of simply bending and derive the relation between bending stress and radius of curvature. **(08 Marks)**

b. A beam having T section with its flanges (180mm×10mm) and web of (220mm×10mm) is subjected to sagging bending moment 15 KN-m. Determine maximum Tensile stress and Maximum compressive stress and their location in the section. Draw a sketch showing bending stress distribution. **(08 Marks)**

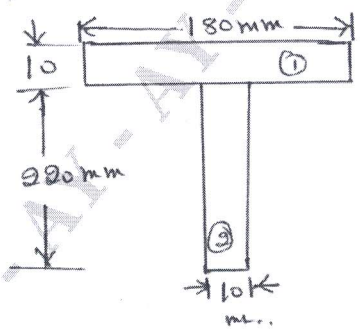


Fig. Q7 (b)

**OR**

8 a. Show that shear stress distribution along neutral axis is $\tau_{NA}$ is 1.5 times the average shear stress $\tau_{avg}$ for rectangular section. **(08 Marks)**

b. Find the expression for the slope and deflection of a cantilever of length L subjected to point load at its free end. **(08 Marks)**

## Module-5

9 a. Derive an expression for torsional equation with usual notations. **(06 Marks)**

b. Determine the diameter of solid shaft which will transmit 440 KW at 280 rpm. The angle of twist should not exceed 1 degree per metre length and maximum torsional shear stress is to be limited to 40 $N/mm^2$. Assume G = 84 $KN/mm^2$. **(10 Marks)**

**OR**

10 a. Derive an expression for the critical load in a column subjected to compressive load, when one end is fixed and other end is free. **(08 Marks)**

b. A 2 meters long column has square cross section of side 40 mm. Taking the factor of safety as 4. Determine the safe load for end conditions if

(i) Both ends are hinged.
(ii) One end is fixed and other end is free.
(iii) Both ends are fixed.
(iv) One end is fixed and other end is hinged.

Take E = 210 GPa. **(08 Marks)**

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