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III—Sem/MECH/2016 (W) (New)

STRENGTH OF MATERIAL

(Code : MET-301)

Full Marks : 70

Time : 3 hours

Answer any **five** questions

Figures in the right-hand margin indicate marks

1. (*a*) State Hooke's law. 2

(*b*) Two wires, one of steel and the other of copper, are of the same length and are subjected to the same tensile load. If the diameter of copper wire is 2 mm, find the diameter of the steel wire, if they are elongated by the same amount. Take E for steel as 200 GPa and that for copper as 100 GPa. 5

(*c*) A concrete column of 350 mm diameter is reinforced with four bars of 25 mm diameter. Find the stress in steel when the concrete is subjected to a stress of 4·5 MPa. Also find the safe load the column can carry. Take $E_s/E_c = 18$. 7

2. (*a*) Write the relation between three elastic constants. 2

(*b*) A steel bar of 4 m long and 25 mm in diameter is subjected to a suddenly applied load of 120 kN. Find the elongation and stress developed in the bar. Take E for steel as 210 GPa. 5

(*c*) An aluminium rod of 20 mm diameter is completely enclosed in a steel tube of 30 mm external diameter and both the ends of the assembly are rigidly connected. If the composite bar is heated

(Continued)

through 50 °C, find the stresses developed in the aluminium rod and steel tube. Take : 7

Modulus of elasticity for steel = 200 GPa

Modulus of elasticity for aluminium = 80 GPa

Coefficient of expansion for steel = $12 \times 10^{-6}/^{\circ}C$

Coefficient of expansion for aluminium = $18 \times 10^{-6}/^{\circ}C$

3. (*a*) Define hoop stress. 2

(*b*) Show that in the case of a thin cylindrical shell subjected to an internal fluid pressure, the tendency to burst lengthwise is twice as great as in a transverse section. 5

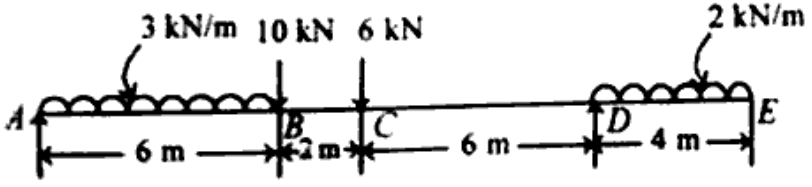
(*c*) A thin cylindrical shell 3 m long has 1 m internal diameter and 15 mm metal

thickness. Calculate the hoop stress and longitudinal stress. If the shell is subjected to an internal pressure of 1·5 MPa. Also calculate the changes in dimensions of the shell. Take $E = 200$ GPa and Poisson's ratio = 0·3. 7

4. (*a*) Define Bending stress. 2

(*b*) Derive the relationship $\frac{M}{I} = \frac{\sigma}{Y} = \frac{E}{R}$. 5

(*c*) Draw the shear force and bending moment diagram for the beam as shown in figure and indicate the numerical value of S.F and B.M at *A*, *B*, *C*, *D* and *E* sections. 7



5. (*a*) What is Principal Plane ? 2

(*b*) At a point in a strained material, the principal stresses are 100 MPa and 50 MPa both tensile. Find the normal and shear stresses at a section inclined at 60° with the axis of the major principal stress. 5

(*c*) Derive the formula for principal stresses on a body subjected to two direct stresses in two mutually perpendicular direction accompanied by a simple shear stress. 7

6. (*a*) What do you mean by eccentric loading ? 2

(*b*) Define buckling load. State formula for buckling load in column with various end conditions. 5