Total No. of printed pages = 5

**BES-402/SOM/4th Sem/2014/N**

# STRENGTH OF MATERIALS

Full Marks – 70

Pass Marks – 28

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer any *five* questions.

1. (a) Define stress and strain. 3

   (b) What do you mean by principal planes and principal stress ? 3

   (c) Explain the difference between 'primary strain' and 'secondary strain'. 5

   (d) Define Poisson's ratio. 2

   (e) Write the relation for the deformation of a body, when it is subjected to :

   (i) a tensile force and

   (ii) its own weight. 1

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2. (a) Prove : $\frac{\delta V}{V} = \epsilon \left(1 - \frac{2}{m}\right)$ 10

where, $\frac{\delta V}{V}$ = volumetric strain

$\epsilon$ = strain

$\frac{1}{m}$ = Poisson's ratio.

(b) Define the following : 2+2=4

(i) Bulk modulus

(ii) Modulus of rigidity.

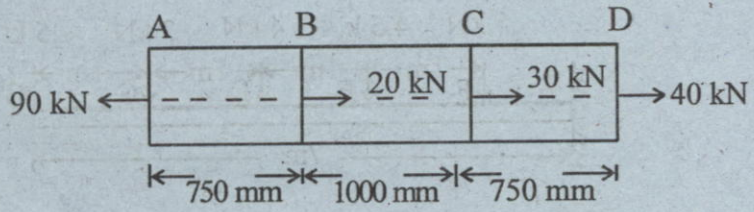
3. (a) Determine the changes in length, breadth and thickness of a steel bar 4m long, 30 mm wide and 20 mm thick, when subjected to an axial pull of 120 kN in the direction of its length. Take E = 200 GPa and Poisson's ratio 0.3. 7

(b) A steel bar 1.2m long, 50 mm wide and 40 mm thick is subjected to an axial pull of 150 kN in the direction of its length. Determine the change in volume of the bar. Take E = 200 GPa and m = 4. 7

4. (a) A steel plate has modulus of elasticity as 200 GPa and Poisson's ratio as 0.3. What is the value of bulk modulus for the steel plate ? 4

(b) An alloy specimen has a modulus of elasticity of 120 GPa and modulus of rigidity of 45 GPa. Determine the Poisson's ratio of the material. 4

(c) A steel bar of 600 $mm^2$ cross-sectional area is carrying loads as shown in Fig.

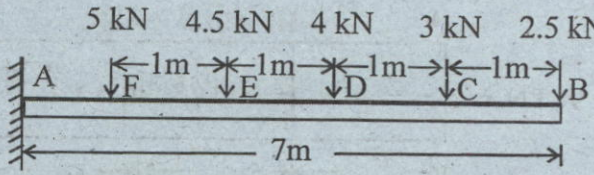



Determine the elongation of the bar. Take E for the steel as 200 GPa. 6

5. (a) The stresses at a point in a component are 150 MPa (tensile) and 30 MPa (compressive). Determine the magnitude of the normal and shear stresses on a plane inclined at an angle of 35° with tensile stress. Also determine the direction of the resultant stress and the magnitude of the maximum intensity of shear stress. (Use Analytical method). 7

(b) The stresses at point of a machine component are 100 MPa (tensile) and 50 MPa (compressive). Using Mohr's circle, find the intensities of normal, shear and resultant stresses on a plane inclined at an angle of $25^{\circ}$ with tensile stress. 7

6. (a) Draw shear force and bending moment diagrams for a cantilever beam of span 7m carrying point loads as shown in Fig. 7




(b) Explain briefly the relationship between shear force and bending moment at a section. 4

(c) Define the term 'torque'. 3

7. (a) A solid steel shaft is required to transmit a torque of 6.5 kN-m. What should be the minimum diameter of the shaft, if the maximum shear stress is 40 MPa ? 4

(b) A hollow shaft is to transmit 200 kW at 80 rpm. If the shear stress is not to exceed 60 MPa and internal diameter is 0.6 of the external diameter, find the diameters of the shaft. 6

(c) A circular shaft of 50 mm diameter is required to transmit torque from one shaft to another. Find the safe torque which the shaft can transmit, if the shear stress is not to exceed 40 MPa. 4