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BES-402/SOM/4th Sem/2016/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 the term 'strength of materials'. 2
- (b) What do you mean by fundamental units and derived units ? 3
- (c) Write S.I units of the following quantities :  
 $\frac{1}{2} \times 4 = 2$ 
  - (i) Pressure
  - (ii) Stress
  - (iii) Work done
  - (iv) Power.
- (d) State 'Parallelogram law of forces' and 'Polygon law of forces'. 4
- (e) What is principle of superposition ? Explain its uses.  $2+1=3$

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2. (a) Show that steel is more elastic than rubber. 4

(b) Derive a relation for the volumetric strain of a body. 10

$$\frac{\delta V}{V} = \epsilon \left( 1 - \frac{2}{m} \right)$$

3. (a) Explain clearly the terms 'bulk modulus' and 'modulus of rigidity.' 4

(b) Define the terms shear force and bending moments. 4

(c) What is a spring ? Explain its uses. 2+1=3

(d) What are the various types of springs ? 3

4. (a) An alloy bar 1m long and 200 mm<sup>2</sup> in cross section is subjected to a compressive force of 20 kN. If the modulus of elasticity for the alloy is 100 GPa, find the decrease in length of the bar. 5

(b) A hollow cast iron column has internal diameter of 200 mm. What should be the external diameter of the column, so that it can carry a load of 1.6 MN without the stress exceeding 90 MPa. 4

- (c) A copper rod, circular in cross-section, uniformly tapers from 40 mm to 20 mm in a length of 11m. Find the magnitude of force, which will deform it by 0.8mm.  
Take  $E = 100 \text{ GPa}$ . 5
5. (a) 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 changes in length, width and volume of the bar. Take  $E = 200 \text{ GPa}$  and  $m = 4$ . 7
- (b) For a given material, Young's modulus is 120 GPa and modulus of rigidity is 40 GPa. Find the bulk modulus and lateral contraction of a round bar of 50 mm diameter and 2.5m long, when stretched 2.5 mm. Take Poisson's ratio as 0.25. 7
6. (a) The stresses at a point in a component are 100 MPa (tensile) and 50 MPa (compressive). Find graphically the magnitude of the normal and shear stresses on a plane inclined at an angle of  $25^\circ$  with tensile stress. Also determine the resultant stress and magnitude of the maximum intensity of shear stress. 7

- (b) A cantilever beam 2m long carries point loads of 3 kN, 4 kN and 5 kN at 1m, 1.5m and 2m from the fixed end respectively. Draw the shear force and bending moment diagrams for the beam. 7

7. (a) A circular shaft of 80 mm diameter is required to transmit power at 120 rpm. If the shear stress is not to exceed 40 MPa, find the power transmitted by the shaft. 6

- (b) Write short notes on any *four* :  $2 \times 4 = 8$

- (i) Elasticity
- (ii) Poisson's ratio
- (iii) Volumetric strain
- (iv) Young's modulus
- (v) Triangle law of forces.