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BES-402/SOM/4th Sem/2017/N

STRENGTH OF MATERIALS

Full Marks – 70

Time – Three hours

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

Answer Part – A and any *five* from Part – B.

PART – A

1. Choose the correct answer : $1 \times 10 = 10$
- (a) If a force acts on a body, it sets up some resistance to the deformation. This resistance is known as
- (i) Stress
 - (ii) Strain
 - (iii) Elasticity
 - (iv) Modulus of elasticity

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(b) The term deformation per unit length is applied for

- (i) Stress
- (ii) Strain
- (iii) Modulus of elasticity
- (iv) None of these

(c) Modulus of elasticity is the ratio of

- (i) Stress to strain
- (ii) Stress to original length
- (iii) Deformation to original length
- (iv) All of these

(d) A composite section, contains 4 different materials. The stresses in all the different materials will be

- (i) Zero
- (ii) Equal
- (iii) Different
- (iv) In the ratio of their areas

(e) If a cantilever beam is subjected to a point load at its free end, then the shear force under the point load is

(i) Zero

(ii) Less than the load

(iii) Equal to the load

(iv) More than the load

(f) The bending moment at the free end of a cantilever beam carrying any type of load is

(i) Zero

(ii) Minimum

(iii) Maximum

(iv) Equal to the load

(g) If there is no load between two points, then the shear force

(i) Changes linearly

(ii) Remains same

(iii) Changes according to parabolic law

(iv) Changes according to cubic law

(h) When a closely coiled spring is subjected to an axial load, it is said to be under

- (i) Bending (ii) Shear
(iii) Torsion (iv) All of these

(i) Which of the following is not a scalar quantity ?

- (i) Length (ii) Mass
(iii) Volume (iv) Displacement

(j) Which of the following is not a vector quantities ?

- (i) Speed (ii) Force
(iii) Displacement (iv) Velocity

2. Fill up the blanks : $1 \times 10 = 10$

(a) A steel rod 1m long and 20 mm \times 20 mm in cross-section is subjected to a tensile force of 40 kN. If the modulus of elasticity for the rod material is 200 GPa, then the elongation of the rod will be _____.

(b) The centroid of triangle is the point of _____ of its medians.

- (c) The unit of power in SI system of units is _____.
- (d) The ratio of lateral strain to the linear strain is called _____.
- (e) A structural member which is acted upon by a system of external loads at right angles to its axis is known as _____.
- (f) The process of splitting up a force into components is called _____.
- (g) Torque transmitted by a solid shaft of diameter (D), when subjected to a shear stress (τ) is equal to _____.
- (h) A shaft revolving at N r.p.m. transmits torque (T) in kg-m. The power developed is _____.
- (i) The rate of change of velocity is called _____.
- (j) The moment of inertia of a circular section of diameter (d) is given by _____.

3. Answer right or wrong : 1×5=5

(i) The forces, which meet at one point, are known as collinear forces.

(ii) A carriage spring is used to absorb shocks.

(iii) The units of moment of a force may be kN/kg.

(iv) The deflection of a closely – coiled helical spring of diameter (D) subjected to an axial

load (W) is
$$\frac{64 WR^2 n}{Cd^4}$$

(v) The total change in length of a bar of different sections is equal to the average of changes in the lengths of different sections.

PART – B

4. (a) What are elastic constants? Define elastic limit. 2+1=3

(b) Distinguish between rigid and deformable bodies. 2

(c) Write the assumptions in the theory of simple bending. 4

5. (a) State 'Triangle law of forces' and 'Polygon law of forces'. 3

(b) A circular rod of 150 cm long and diameter 2 cm is subjected to an axial pull of 20 kN. If the modulus of elasticity of the material of the rod is 2×10^5 N/mm². Determine

(i) Stress

(ii) Strain

(iii) The elongation of the rod. 6

6. (a) An alloy bar 1m long and 200 mm² 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. 4

(b) The extension in a rectangular steel bar of length 400 mm and thickness 10 mm is found to 0.21 mm. The bar tapers uniformly in width from 100 mm to 50 mm. If (E) for the bar is 2×10^5 N/mm², determine the axial load on the bar. 5

7. (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 change in volume of the bar.

Take $E = 200 \text{ GPa}$ and $m = 4$. 4

- (b) What is the value of modulus of rigidity of a steel alloy, if its modulus of elasticity is 150 GPa and Poisson's ratio is 0.289? 5

8. (a) Classify the types of beam. 2

- (b) A cantilever AB 1.8m long carries a point load of 2.5 kN at its free end and a uniformly distributed load of 1 kN/m from A to B. Draw the shear force and bending moment diagrams for the beam. 7

9. (a) What do you mean by strength of a shaft? 2

- (b) The stresses at a point in a component are 150 MPa (tensile) and 70 MPa (compressive). Determine the magnitude of the normal and shear stresses (using Mohr's circle) on a plane inclined at an angle of 35° with tensile stress. Also determine the direction of the resultant stress. 7

10. (a) What are springs? Name the two important types of spring. 2+1=3

(b) A hollow shaft is to transmit 150 kW at 50 r.p.m. If the shear stress is not to exceed 50 MPa and internal diameter is 0.5 of the external diameter, find the diameters of the shaft. 6