

**BTECH**  
**(SEM III) THEORY EXAMINATION 2018-19**  
**STRENGTH OF MATERIALS**

*Time: 3 Hours**Total Marks:100**Notes: Assume any Missing Data.***SECTION A****1. Attempt all questions in brief. 2 x10 = 20**

- a. What do you mean by simple bending?
- b. Explain Poisson's ratio and its importance.
- c. What do you understand by principal planes and principal axes?
- d. What do you mean by the term "spring"? Write name various types of stresses induced in the spring material.
- e. Explain why stresses induced in the body is more in case of impact load than gradually applied load.
- f. Explain Hooke's law and differentiate between Young's modulus and modulus of rigidity.
- g. Explain Castigliano's theorem and its importance.
- h. What do you understand by theories of failures? Explain any one theory in brief.
- i. What do you mean by Buckling Load in case of column?
- j. What do understand by torsional rigidity and angle of twist?

**SECTION B****2. Attempt any three of the following: 10 x 3 = 30**

- a. Find reaction at supports of a continuous beam ABC when span length AB = 4 m and BC = 4 m. The span AB carries a point load of 20 kN at a distance of 1 m from support A and The span BC carries a uniformly distributed load having intensity of 8 kN/m.
- b. An open coiled helical spring has 12 turns wound to a mean diameter of 100 mm. The angle of the coils with a plane perpendicular to the axis of the coil is  $30^\circ$ . The wire diameter is 8 mm. Determine (a) The axial extension with a load of 80 N (b) The angle turned by the free end if free to rotate.  $E = 205 \text{ MPa}$  and  $G = 80 \text{ GPa}$ .
- c. A short column of rectangular section 200 mm X 300 mm carries a compressive load of 800 kN. The load is applied at a point (-50,100) considering the centroid of the section as the origin. Find the stresses at the four corners of the section.?
- d. Prove that the maximum shear stress is  $\frac{4}{3}$  times of the average shear stress in beam of circular section subjected to a shear force
- e. The span of simply supported and centrally loaded laminated steel spring is 650 mm. The central deflection of the spring does not exceed 40 mm for a proof load of 6 kN. The bending stress also does not exceed 360 MPa. Find the suitable values of width, thickness and the number of plates if they are available in multiples of 1mm for thickness and 5 mm for width. Also determine the radius to which the plates should be formed. Assume the width to be ten times the thickness  $E = 205 \text{ GPa}$ .

## SECTION C

3. Attempt any *two* parts of the following: 5 x 2 = 10

- (a) A steel rod 20 mm in diameter passes centrally through a steel tube of 25 mm internal diameter and 30 mm external diameter. The tube is 800 mm long and is closed by rigid washers of negligible thickness which are fastened by nuts threaded on the rod. The nuts are tightened until the compressive load on the tube is 20 kN. Calculate the stresses in the tube and the rod.

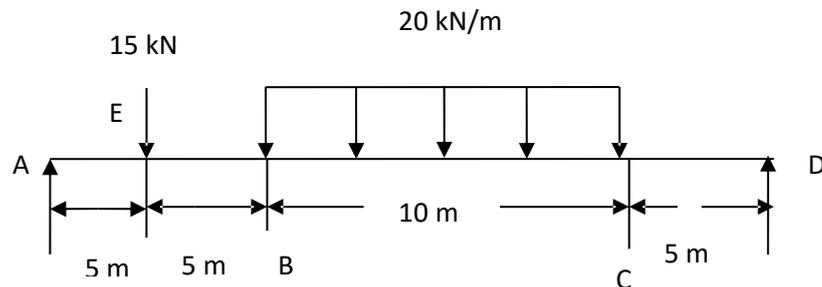
Find the increase in these stresses when one nut is tightened by one-quarter of a turn relative to the other. There are 4 threads per 10 mm. Take  $E = 2 \times 10^5 \text{ N/mm}^2$

- (b) An axial tensile load of 10 kN is applied to a 12 mm diameter bar. Determine the maximum shearing stress in the bar and the planes on which it acts. Find also the value of the normal stresses on these planes.
- (c) A load of 2 kN falls through 25 mm on to a stop at the end of a vertical bar 4 m long,  $600 \text{ mm}^2$  cross-sectional area and rigidly fixed at its other end. Determine the instantaneous stress and elongation of the bar.  
 $E = 200 \text{ GN/m}^2$ .

4. Attempt any *one* part of the following: 10 x 1 = 10

- (a) Determine the deflection at point B and C of the beam shown in figure.

Take  $E = 200 \text{ GPa}$ ,  $I = 19802.8 \text{ cm}^4$



- (b) A steel shaft is to be manufactured either as a solid circular bar or as a circular tube. The shaft is required to transmit a torque of 1200 N-m without exceeding neither an allowable shear stress of 40 MPa nor an allowable rate of twist of  $0.75^\circ/\text{m}$ . (The shear modulus of elasticity of the steel is 78 GPa.)
- (a) Determine the required diameter of the solid shaft.
- (b) Determine the required outer diameter of the hollow shaft if the thickness of the shaft is specified as one-tenth of the outer diameter.

5. Attempt any *one* part of the following: 10 x 1 = 10

- (a) A hollow circular section of steel, of outer diameter 200 mm and thickness 5 mm, has a length of 4 m, with both ends fixed. Find the Euler critical load if  $E = 200 \text{ GPa}$ . If the yield stress is 300 MPa, determine the length below which Euler's formula cannot be applied.
- (b) A closed coil helical spring has mean diameter of 75 mm, spring constant of 80 kN/m and 8 coils. What is the suitable diameter of spring wire, if maximum shear stress is not to exceed  $250 \text{ MN/m}^2$ ? Modulus of rigidity of spring wire material is  $80 \text{ GN/m}^2$ . What is the maximum load, the spring can carry?

6. Attempt any *one* part of the following:

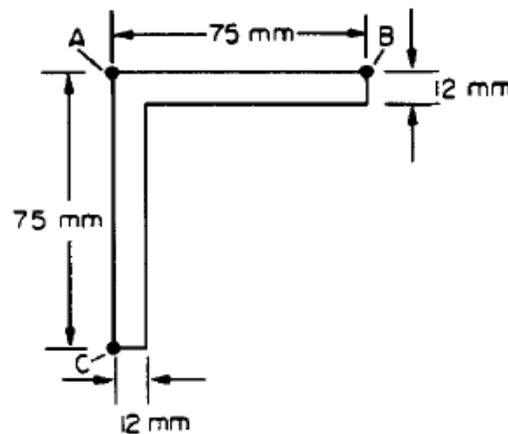
10 x 1 = 10

- (a) A cylindrical boiler drum has hemispherical ends. The cylindrical portion is 1.6 m long, 800 mm diameter and 20 mm thick. After filling it with water at atmospheric pressure, it is put on a hydraulic test and the pressure is raised to 12 MPa. Find the additional volume of water required to be filled in the drum at this pressure. Assume the hoop strain at the junction of cylinder and the hemisphere to be the same for both. Take  $E = 205 \text{ GPa}$ ,  $K = 2080 \text{ MPa}$  and Poisson's ratio = 0.3
- (b) A thick steel cylinder has inner and outer diameters as 120 mm and 180 mm respectively. It is subjected to an external pressure of 9 MPa. Find the value of the internal pressure which can be applied if the maximum stress is not to exceed 30 MPa. Draw the curves showing the variation of hoop and radial stresses through the material of the cylinder.

7. Attempt any *one* part of the following:

10 x 1 = 10

- (a) A 75 mm x 75 mm x 12 mm angle is used as a cantilever with the face AB horizontal as shown in figure. A vertical load of 3 kN is applied at the tip of the cantilever which is 1 m long. Determine the stresses at A, B and C.



- (b) What do you understand by term shear centre. Derive the relation to find shear centre for channel section.