**Roll No.** ☐☐☐☐☐☐☐☐☐☐☐☐ **Total No. of Pages : 02**

**Total No. of Questions : 09**

**B.Tech. (CE) (2011 Onwards) (Sem.–3)**

# STRENGTH OF MATERIALS

**Subject Code : BTCE-303**

**Paper ID : [A1133]**

**Time : 3 Hrs.** **Max. Marks : 60**

**INSTRUCTIONS TO CANDIDATES :**

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

## SECTION-A

**Q1. Answer briefly :**

a) Define stress. How are stresses classified?

b) What is Hooke's Law?

c) What do you mean by Anticlastic bending?

d) What are the assumptions made in the theory of pure torsion?

e) Compare between solid and hollow shafts.

f) What are the limitations of Euler's formula?

g) Explain various types of beams.

h) Define the term equivalent length. Discuss its uses.

i) Define polar modulus of the shaft section.

j) What is point of contraflexure?



## SECTION-B

Q2. The external and internal diameters of a hollow cylinder are 115mm and 90 mm respectively. When the cylinder is compressed by an axial force of 180 kN, the outer diameter of the cylinder increases by $115.5 \times 10^{-4}$ mm. Determine

a) The increase in the internal diameter

b) The increase in the wall thickness

c) Poisson's ratio of the material of the cylinder.

Q3. Two planes AB and BC which are at right angles carry shear stresses of intensity 17.5 $N/mm^2$ while these planes also carry a tensile stress of 70 $N/mm^2$ and compressive stress of 35 $N/mm^2$ respectively. Determine the principal planes and principal stresses. Also determine the maximum shear stress and the planes on which it acts.

Q4. The intensity of loading on a simply supported beam of 5 m span increases uniformly from 8 kN/m at the end to 16 kN/m at the other end. Find the position and magnitude of the maximum bending moment. Also draw Shear force and bending moment diagram.

Q5. A timber beam is freely supported on supports 6 m apart. It carries a UDL of 12 kN/m run and a concentrated load of 9 kN at 2.5 m from the left support if the stress in timber is not to exceed 8 $N/mm^2$, design a suitable section making the depth twice the width.

Q6. Find Euler's critical load for a hollow cylindrical cast iron column 200 mm external diameter and 25 mm thick, if it is 6m long and hinged at both ends. Take E= $8 \times 10^4$ $N/mm^2$. Compare Euler's critical load with the Rankine's critical load taking fc= 550 $N/mm^2$ and a=1/1600. For what length of the column would the critical loads by Euler's and Rankine's formula be equal?

## SECTION-C

Q7. Two rectangular plates, one of steel and other of brass each 37.5 mm by 10 mm are placed together to form a beam 37.5 mm wide and 20 mm deep on two supports 750 mm apart the brass component being on top of steel component. Determine the maximum central load if the plates are :

a) separate and can bend independently

b) firmly secured throughout their length. Permissible stresses for brass and steel are 70 $N/mm^2$ and 100 $N/mm^2$. Take $E_b$= $0.876 \times 10^5$ $N/mm^2$ and $E_s = 2.10 \times 10^5$ $N/mm^2$



Q8. A beam of length L is simply supported on two intermediate supports, moveable along the length, with equal overhangs on either side. The supports are so adjusted that the maximum bending moment is the minimum possible. Determine the position of the supports and draw the BMD and SFD for this position. The beam carries a UDL of w per unit length over the entire length.

Q9. A hollow shaft and a solid shaft are of same material and have the same length and have the same outer radius R. The inner radius of the hollow shaft is 0.6 R.

a) If both the shafts are subjected to the same torque, compare their maximum shear stress, angles of twist and weights.

b) Find also the strength to weight ratio for each shaft. (Note the strength to weight ratio is the ratio of the allowable torque to the weight of the shaft).