

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)**

CLASS: BTECH  
BRANCH: CIVIL

SEMESTER : III  
SESSION : MO/2022

SUBJECT: CE201R SOLID MECHANICS

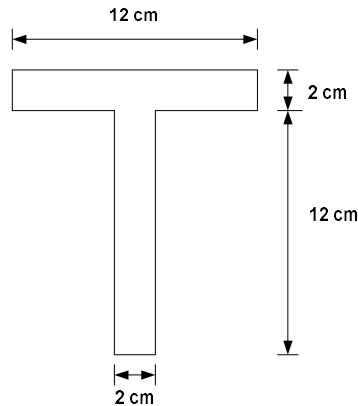
TIME: 3:00 Hours

FULL MARKS: 50

**INSTRUCTIONS:**

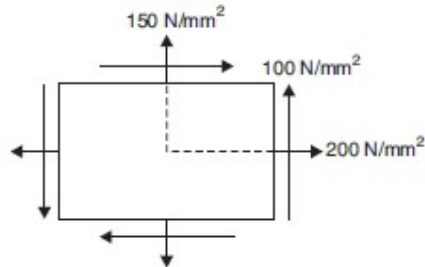
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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- Q.1(a) Draw the stress-strain plot for Mild steel bar and explain the term ductility with the help of this? [2]  
Q.1(b) Calculate the change in diameter of a short cast iron column when it carries a compressive load of 800 kN. The original diameter is 80 mm. Consider the value of  $E = 1 \times 10^5$  MPa and Poisson's ratio ( $\mu$ ) as 0.25. [3]  
Q.1(c) Define modulus of elasticity ( $E$ ) and Bulk modulus ( $K$ ) for a elastic material and derive the relationship between them with the help of Poisson's ratio ( $\mu$ ). [5]
- Q.2(a) What are the assumptions made while deriving the bending equation in pure bending case? [2]  
Q.2(b) Show that the variation of shear stress in rectangular section is parabolic? [3]  
Q.2(c) A beam has cross-section as shown in Figure, if the shear force acting on this is 25 kN, Determine and draw the shear stress distribution diagram across the Neutral axis. [5]



- Q.3(a) What is the polar moment of inertia for a hollow shaft 40 cm external diameter and 20 cm internal diameter? [2]  
Q.3(b) A solid shaft of 150 mm diameter is used to transmit torque. Find the maximum torque transmitted by the shaft if the maximum shear stress induced to the shaft is  $45\text{N/mm}^2$ . [3]  
Q.3(c) Derive the torsion equation for a circular shaft with the assumptions made to derive the equation? [5]
- Q.4(a) Write the relation between actual length and effective length for different end conditions. [2]  
Q.4(b) Drive the expression for crippling load when both the end of the column is hinged. [3]  
Q.4(c) Suppose the Euler's buckling load for a 4 m long slender steel column of uniform cross section fixed at both the ends is 1 kN. Find out the Euler buckling load for a 1 m long steel column with the same cross section with one end is fixed and the other end is free. [5]
- Q.5(a) Write short notes on [2]  
i. Maximum principal stress theory (Rankine's theory)  
ii. Maximum strain energy theory (St. venant's theory)

- Q.5(b) The state of stress at a point in a strained material is as shown in Figure. Determine [3]  
 (i) the direction of principal planes, (ii) the magnitude of principal stresses and  
 (iii) the magnitude of maximum shear stress.  
 Indicate the direction of all the above by a sketch



- Q.5(c) At a certain point in a strained material, the intensities of stresses on two planes at right angles to each other are  $20 \text{ N/mm}^2$  and  $10 \text{ N/mm}^2$  both tensile. They are accompanied by a shear stress of magnitude  $10 \text{ N/mm}^2$ . Find graphically, the location of principal planes and evaluate the principal stresses. [5]

::::22/11/2022::::E