

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

**CLASS: BTECH**  
**BRANCH: CIVIL**

**SEMESTER: III**  
**SESSION: MO/2024**

**SUBJECT: CE201 SOLID MECHANICS**

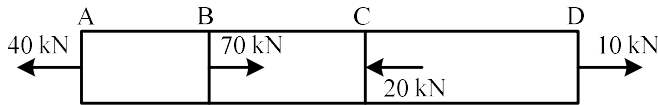
**TIME: 3 Hours**

**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) A brass bar, having cross sectional area of  $900 \text{ mm}^2$ , is subjected to axial forces as shown in the figure in which  $AB = 0.6 \text{ m}$ ,  $BC = 0.8 \text{ m}$ , and  $CD = 1.0 \text{ m}$ . Find the stress in portion BC and total elongation of the bar. Take  $E = 1 \times 10^5 \text{ N/mm}^2$ . [5] CO 1 BL 3



- Q.1(b) A railway is laid so that there is no stress in the rails at  $8^\circ\text{C}$ . Calculate [5] CO 2 BL 3
- i) the stress on the rails at  $50^\circ\text{C}$  if there is no allowance for expansion
  - ii) the stress in the rails at  $50^\circ\text{C}$  if there is an expansion allowance of 8 mm per rail
  - iii) the maximum temperature to have no stress in the rails if expansion allowance is 12 mm per rail.
- The rails are 30 m long. Take  $\alpha = 12 \times 10^{-6}/^\circ\text{C}$  and  $E = 2 \times 10^5 \text{ N/mm}^2$ .

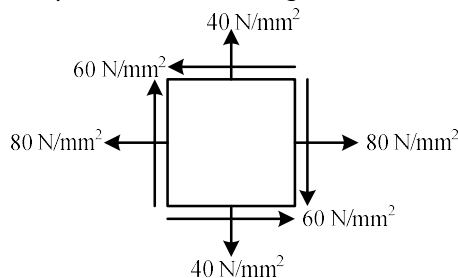
- Q.2(a) A simply supported timber beam of rectangular section is subjected to a uniformly distributed load of  $10 \text{ kN/m}$  over its entire span of 4m. If the depth of section is to be twice the breadth, and the stress in the timber is not to exceed  $8 \text{ N/mm}^2$ , find the dimensions of the cross section. [5] CO 5 BL 4

- Q.2(b) A simply supported timber beam of rectangular section (150 mm wide and 250 mm deep) is subjected to a uniformly distributed load of  $25 \text{ kN/m}$  over its entire span of 6m. Determine the average and maximum shear stress. Also, sketch the distribution of shear stress across the section. [5] CO 4 BL 3

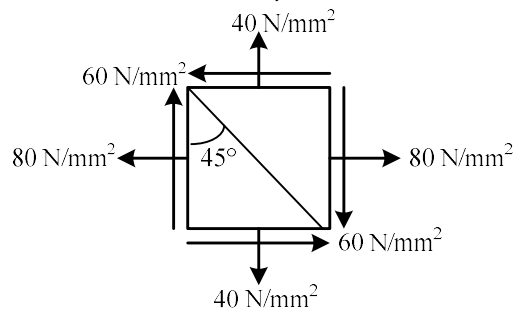
- Q.3(a) What are the assumptions made in deriving an expression for the shear stress produced in circular shaft subjected to torsion. [5] CO 4 BL 2

- Q.3(b) A hollow shaft of external diameter 120 mm transmits 300 kW power at 200 r.p.m. Determine the maximum internal diameter if the maximum stress in the shaft is not to exceed  $60 \text{ N/mm}^2$ . [5] CO 4 BL 3

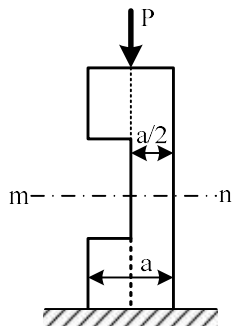
- Q.4(a) A rectangular block is subjected to a tensile stress of  $80 \text{ N/mm}^2$  on one plane (x-plane) and tensile  $40 \text{ N/mm}^2$  on plane at right angles to the former (y-plane). Each of the above stresses is accompanied by a shear stress of  $60 \text{ N/mm}^2$ . Find the magnitude of each of the principal stresses and the greatest shear stress. [5] CO 3 BL 3



- Q.4(b) Draw the Mohr's circle for the stress condition given in Q.4(a). Using the Mohr's circle [5] 3 3  
determines the normal and shear stresses on an oblique plane making an angle  $45^\circ$   
anticlockwise with the x-plane.



- Q.5(a) A short column of square cross-section has a notch cut in its side as shown in the figure. [5] 1 4  
Calculate the maximum compressive stress at the section mn due to centrally applied  
load P.



- Q.5(b) Derive the expression for the Euler's critical load for long column with one end fixed and [5] 5 2  
other end free.