Odd Mid Semester Examination for Academic Session 2025-26

COURSE NAME: B. TECH

SEMESTER: 3rd (SEC- A and B)

BRANCH NAME: CIVIL ENGINEERING

SUBJECT NAME: MECHANICS OF MATERIALS

FULL MARKS: **30**

TIME: **90 Minutes**

Answer **All** Questions.

The figures in the right-hand margin indicate Marks. *Symbols carry usual meaning. Assume any other suitable data if necessary*

Q1. Answer all Questions. [2 × 3]

a) What is stress? In what way does the shear stress differ from direct stress? - CO1

b) Define principal stresses. Write the relationship between maximum shear stress and principal stresses. - CO2

c) State the assumptions along with the expression for bending stress in pure bending of a beam. - CO3

Q2. - CO1

a) Find the force P acting at C in the bar shown in Fig. 1. Find the extension of the bar if E = 2 × 10^5 MPa. [4]

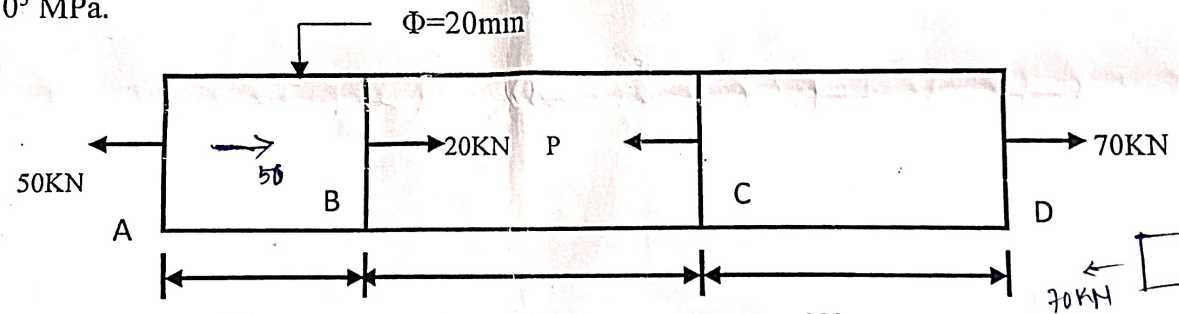

Fig.1

b) A bar of 15mm diameter, is acted upon by an axial load of 25KN. The change in diameter is measured as 0.004mm. Determine the Poisson's ratio, the modulus of elasticity if the value of modulus of rigidity is 80GPa. [4]

OR

a) Two vertical wires are suspended at a distance of 260mm apart. Their upper ends are firmly secured and their lower ends support a rigid horizontal bar which carries a load W. The left-hand wire has a diameter of 7mm and is made of copper and the right-hand wire has a diameter of 5mm and is made of steel. Both wires initially are 6m long. Determine the position of the line of action of W relative to copper wire, if due to W; both the wires extend by same amount. Also determine the load of each wire if W=3KN. Neglect the weight of the bar. Take E_{cu} = 120 GPa, E_s = 210 GPa. [6]

b) Two parallel walls 10m apart, are to be stayed together by a steel rod of 35mm diameter with the help of washers and nuts at the ends. The steel rod is passed through the metal plates and is heated. When its temperature is raised to 80°C, the nuts are tightened. Determine the pull in the bar when it is cooled to 20°C, if the ends do not yield. E_s = 205 [2]

GPa, $\alpha_s = 11 \times 10^{-6}/^{\circ}C$.

Q3. - CO2

At a point in a stressed material, the stresses are $\sigma_x = 90$MPa and $\sigma_y = 180$ MPa and τ_{xy} on planes parallel to the coordinate directions is 50 MPa. Find the magnitudes and directions of the principal stresses, maximum shear stress with the help of Mohr's circle and also verify the results analytically. [8]

OR

a) Explain in brief about Strain rosette. [3]

b) The readings of a strain gauge rosette inclined at 45° with each other are 5×10^{-6}, 4×10^{-6} and 1.9×10^{-6}, the first gauge being along x-axis. Determine the principal strains and principal stresses. Take $E = 210$GPa and $\upsilon = 0.3$. [5]

Q4. -CO3

A simply supported beam has a span of 4m and carries a uniformly distributed load of 250KN/m over the entire span. The cross section of the beam is a T-section, having flange width 200mm, thickness 50mm, web thickness 50mm and overall depth 250mm. Calculate the maximum shear force in the beam. Also draw the shear stress distribution for the section. [8]

OR

a) A simply supported beam having 150mm wide, 300mm deep and 6m length carries uniformly distributed load of 200KN/m. Determine the bending stress at the middle span and at distance of 60mm below the top surface. [4]

b) Two beams, one having square cross section ($a \times a$) and another circular cross-section with diameter d, are subjected to the same amount of bending moment. If the cross sectional area as well as the material of both the beams are the same, then which beam experiences more bending stress? [4]