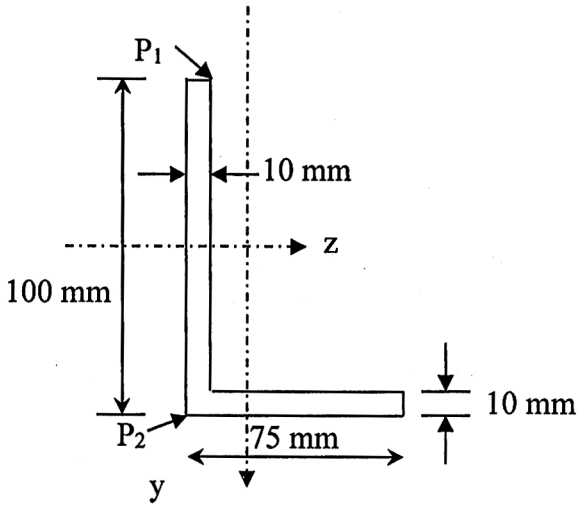
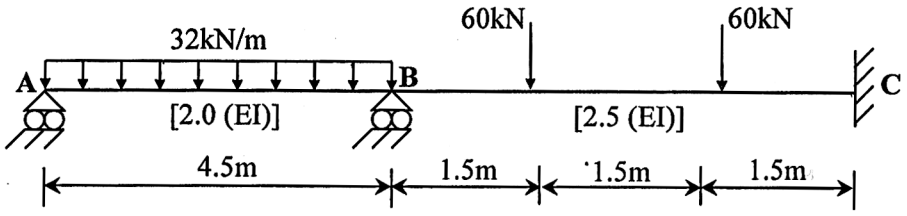
Ref. No. **Ex/CE/5/T/206/2024**

B.E. (CIVIL ENGINEERING) SECOND YEAR SECOND SEMESTER EXAM 2024

Subject: THEORY OF STRUCTURES - I

Time: Three hours **Full Marks: 100**

No. of Questions		Marks
	Answer any four questions	
Q1.	A cantilever beam of span of **1.35m** is subjected to uniformly distributed load of intensity **1.2N/m** acting vertically downward along the centroidal plane of the beam. The **'angle-shaped cross-section'** of the beam (shown in Fig. 1) has the following dimensions: width = **75mm.**, depth = **100mm.**, thickness of flange and web = **10mm.** Calculate i) the angle of inclination of principal axes and principal moments of inertia ii) the net vertical and horizontal deflections of the beam at free end if E = $2x10^5$ N/mm^2 and iii) the stress developed at points P_1 and P_2 (shown in Fig.1) of the cross-section at fixed end.	[25]
	 **Fig. 1**	
Q2.	Analyse the continuous beam **ABC** as shown in Fig.2 by using **'Three Moment Theorem'** and calculate the support reactions. Also draw the bending moment diagram and shear force diagram for this beam.	[25]
	 **Fig. 2**	

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No. of Questions		Marks
Q3.	a) Define **'kern area' or 'core area'** of short column. b) Derive the **'kern area' or 'core area'** of a **solid circular cross section** of diameter **90mm** of a short column. c) Calculate the failure load of a column of length **2.4m** and having **'Z-shaped cross-section'** as shown in Fig.3 if both ends of the column are **fixed**. Consider $E=2\times10^5$ N/mm^2 and $f_y = 250$N/mm^2. Apply Euler's column theory, if required.	[3+10 +12 = 25]
Q4.	a) A column **3.2m long** of **hollow circular** cross section of **external diameter = 150mm** and the **thickness = 12mm** is **fixed at both the ends**. The column carries an axial **compressive load of 90kN** at an **eccentricity of 18mm** from the axis of the column. Considering 'Secant Formula', find the maximum and minimum stress developed in the cross-section of column. Consider $E=2\times10^5$ N/mm^2. Also find the maximum eccentricity in order to have no tension anywhere in the cross-section.	[10+15 = 25]

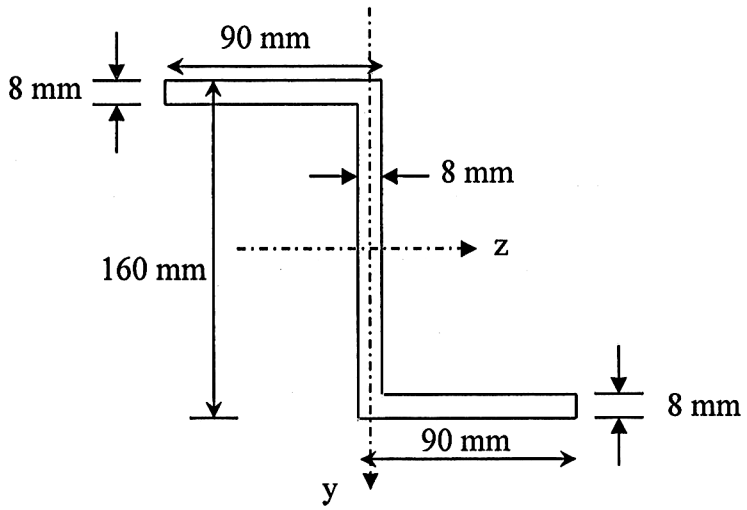

Fig. 3

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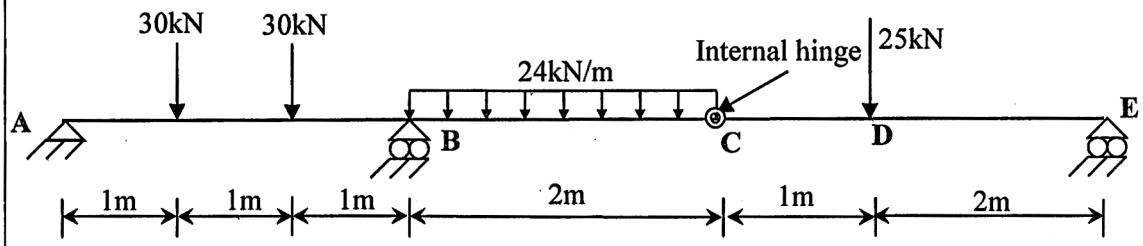
No. of Questions		Marks
	(Contd. from page 2)	
Q4. (contd.)	b) Draw the **influence line diagram** for the support reactions (R_A, R_B **and** R_E), shear force ($V_{left\ of\ D}$ **and** $V_{right\ of\ D}$) and bending moments (M_B **and** M_D) of the beam AE as shown in Fig.4. There is an **internal hinge at point C** as shown in figure. Using these influence line diagrams, find the magnitude of above mentioned forces and moments i.e. R_A, R_B, R_E, $V_{left\ of\ D}$, $V_{right\ of\ D}$, M_B **and** M_D caused by the given set of non-moving loads as shown in Fig.4.  **Fig. 4**	
Q5.	a) Write short note on 'unsymmetrical bending of beam'. b) How can the principal axes be located without doing any calculation for symmetric cross-section of the beam? c) What is the additional condition other than the equilibrium condition that is used for the analysis of the beam by 'Three moment theorem'? d) Draw 'Euler's column buckling' curve for a slender column. Why it is not applicable for columns having low slenderness ratio? e) What do you mean by effective length of column? Write the effective length of column of physical length 'L' if it is fixed at both ends. f) What is the utility of 'influence line diagram' in structural analysis? ===END===	[6+2+ 2+6+ 6+3 = 25]