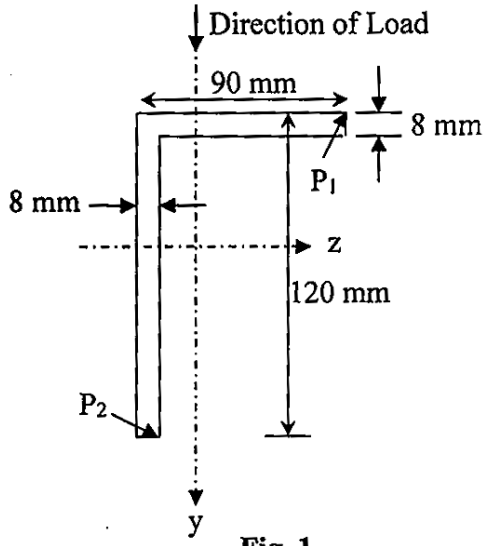
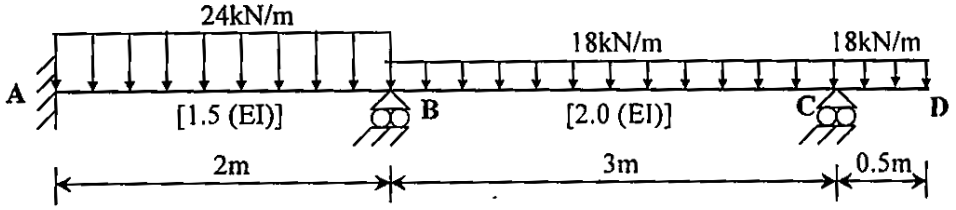
B.E. (CIVIL ENGINEERING) SECOND YEAR SECOND SEMESTER EXAM 2025

Subject: THEORY OF STRUCTURES - I

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

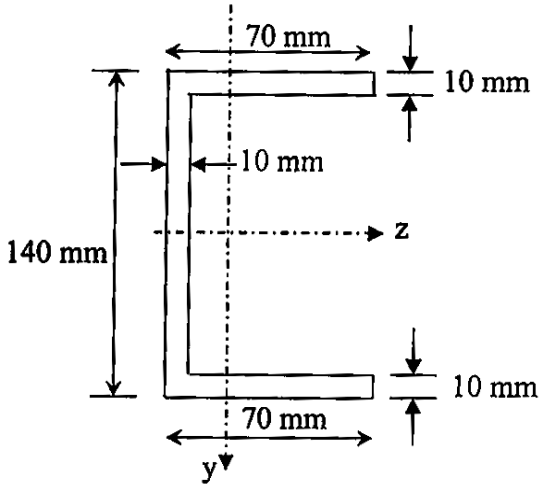
No. of Questions		Marks
	Answer any four questions	
Q1.	A **cantilever beam** of span of **2.0m** is subjected to uniformly distributed load of intensity **1.0N/m** acting vertically downward along the centroidal plane of the beam. The **angle-shaped cross-section** of the beam (shown in Fig. 1) has the following dimensions: width = **90mm.**, depth = **120mm.**, thickness of flange and web = **8mm.** 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 mid-span 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 mid-span.  **Fig. 1**	[25]
Q2.	Analyse the continuous beam **ABCD** 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.  **Fig. 2** (Contd. to page 2)	[25]

Ref. No. **Ex/CE/5/T/206/2025**

B.E. (CIVIL ENGINEERING) SECOND YEAR SECOND SEMESTER EXAM 2025

Subject: THEORY OF STRUCTURES - I

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

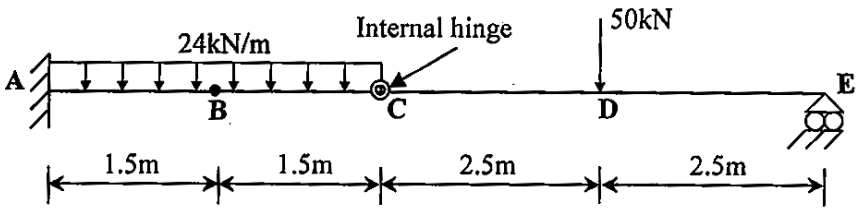
No. of Questions		Marks
	(Contd. from page 1)	
Q3.	a) Define **'kern area' or 'core area'** of short column. b) Derive the **'kern area' or 'core area'** of a **solid circular cross section** (of **diameter 150mm**) of a short column. If the diameter of the cross-section of the column is made **double i.e. 300mm,** then what will be the **change** (in percentage) **in the diameter of 'kern area' or 'core area'** of the same column? c) Calculate the failure load of a column of length **2.5m** and having **'Channel-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.  **Fig. 3**	[3+12 +10 = 25]
Q4.	a) A column **2.75m long** of hollow circular cross section with **500mm external diameter and 125mm thickness** is **fixed at bottom end and free at top.** The column carries an axial **compressive load of 220kN** at an **eccentricity of 20mm** 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. (Contd. to page 3)	[12+13 = 25]

Ref. No. **Ex/CE/5/T/206/2025**

B.E. (CIVIL ENGINEERING) SECOND YEAR SECOND SEMESTER EXAM 2025

Subject: THEORY OF STRUCTURES - I

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

No. of Questions		Marks
	(Contd. from page 2)	
Q4. (contd.)	b) Draw the **influence line diagram** for the support reaction (R_E), shear force (V_B) and bending moments (M_A **and** M_B) of the propped cantilever 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_E, V_B, M_A **and** M_B caused by the given set of non-moving loads as shown in Fig.4.	
		
	Fig. 4	
Q5.	a) How is the 'unsymmetrical bending of beams' related with the principal axis of the cross-section of the beam? b) What compatibility condition is considered in "Three moment theorem' method? c) Draw 'Euler's column buckling' curve for a slender column. How does it help to calculate the failure load of a column? d) Plot the buckled shape of ideal slender column fixed at bottom and free at top for 1st mode and 2nd mode of buckling and write the critical loads for that. e) What do you mean by effective length of column? Write the effective length of column of physical length 'L' if it is i) hinged at one end and fixed at other end and ii) free at one end and fixed at other end. f) What is 'influence line diagram'? In what kind of structures, the ILD are used?.	[4+2+5+6+5+3 = 25]

= = = E N D = = =