INTERNATIONAL UNIVERSITY OF EAST AFRICA

'Learning to Succeed'

FACULTY OF ENGINEERING

END OF SEMESTER EXAMINATIONS - APRIL 2025

PROGRAMME: BACHELOR IN CIVIL ENGINEERING

YEAR/SEM: YR. II/SEMESTER II

COURSE CODE: BCE 2202

COURSE NAME: STRUCTURAL ANALYSIS II

DATE: 15th/APRIL/2025

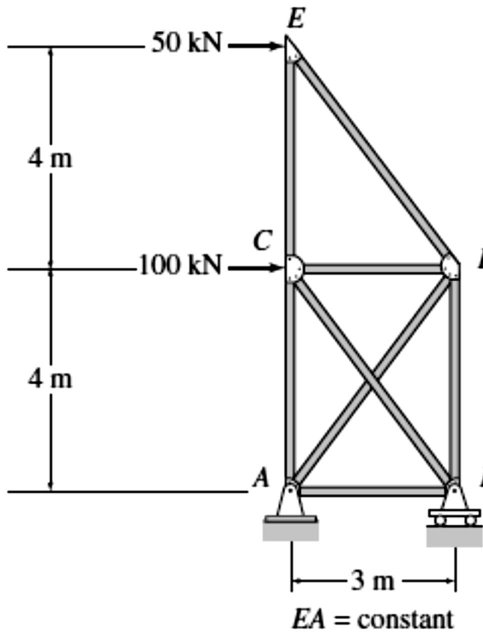
TIME: 9:00AM – 12:00PM

INSTRUCTIONS TO CANDIDATES:

- THIS EXAMINATION PAPER CONSISTS OF SIX QUESTIONS.
- ATTEMPT ANY FOUR QUESTIONS FOR FULL MARKS
- DO NOT OPEN THIS EXAMINATION UNTIL YOU ARE TOLD TO DO SO
- ALL ROUGH WORK SHOULD BE IN YOUR ANSWER BOOKLET
- THE TIME ALLOWED FOR THIS EXAMINATION IS STRICTLY THREE HOURS
- ON THE FIRST PAGE OF YOUR ANSWER BOOKLET
    - WRITE YOUR REGISTRATION NUMBER PROPERLY
    - WRITE THE COURSE NAME AND COURSE CODE
    - WRITE EXAMINATION VENUE
    - DO NOT WRITE, DROW OR SCRATCH ANYTHING ELSE ON THE FIRST PAGE
    - WRITING UNNECESSARY INFORMATION LIKE PHONE NUMBERS IN THE FIRST PAGE SHALL ANNUL YOUR EXAM
    - ANSWER BOOKLETS THAT DO NOT CARRY THE REQUIRED INFORMATION, OR THAT HAVE UNNECCESSAY WRITING IN THE FIRST PAGE SHALL NOT BE MARKED

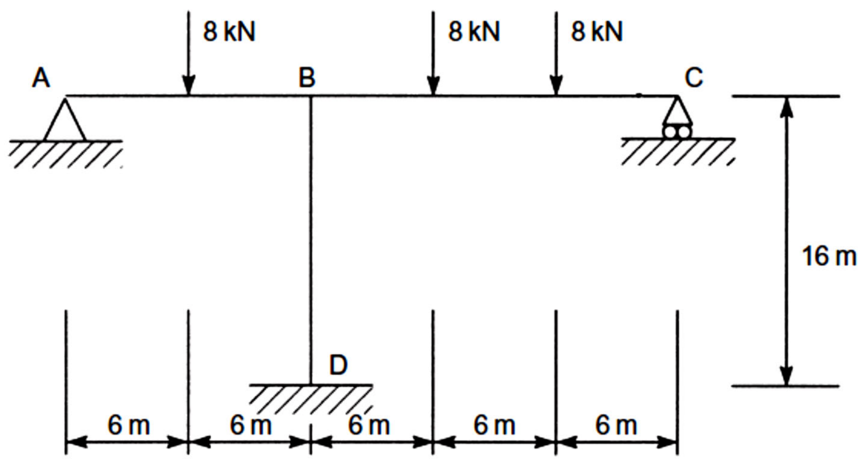
QUESTION ONE (25 Marks)

Determine the reactions and the force in each member of the truss shown in Fig. below using the method of consistent deformations - Force Method **(25 marks)**



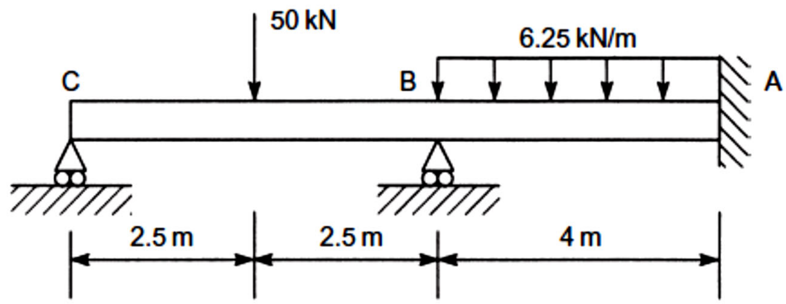
QUESTION TWO (25 Marks)

Calculate the end moments in the members of the frame shown in Fig. below using the Moment Distribution Method. The flexural rigidity of the members AB, BC and BD are 2EI,3EI and EI, respectively, and the support system is such that sway is prevented. **(25 marks)**



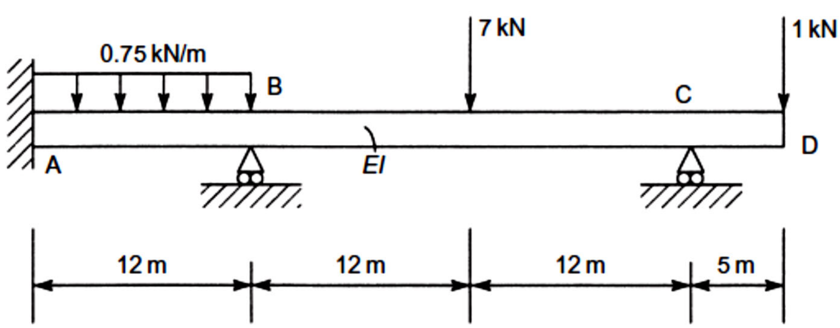
QUESTION THREE (25 Marks)

In the beam ABC shown in Fig. below the support at B settles by 10 mm when the loads are applied. If the second moment of area of the spans AB and BC are 83.4x10^6 mm^4 and 125.1x10^6 mm^4, respectively, and Young's modulus, E, of the material of the beam is 207000 N/mm^2, calculate the support reactions using the Slope Deflection Method. **(25 marks)**



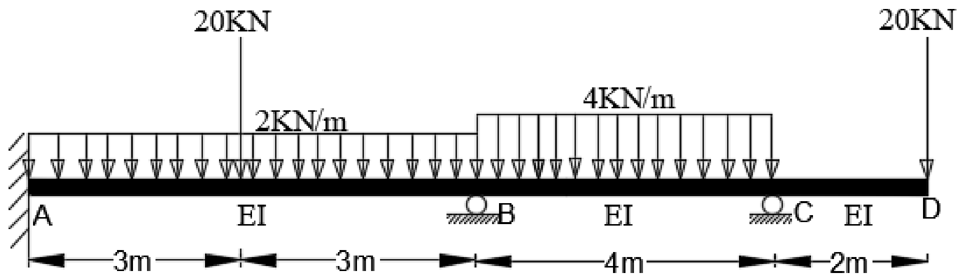
QUESTION FOUR (25 Marks)

Calculate the support reactions and moment in the continuous beam shown in Fig. below using the method of consistent deformations - Force Method; the flexural rigidity, EI, of the beam is constant throughout. **(25 marks)**



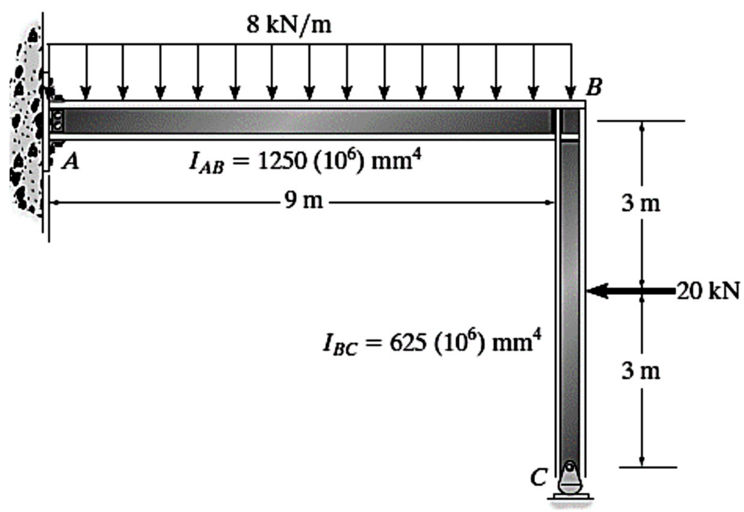
QUESTION FIVE (25 Marks)

Determine the moments and reactions for the continuous beam ABCD shown in Fig. below by slope deflection method and draw the shear force and bending moment diagrams. EI is constant. **(25 marks)**



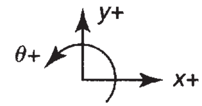
QUESTION SIX (25 Marks)

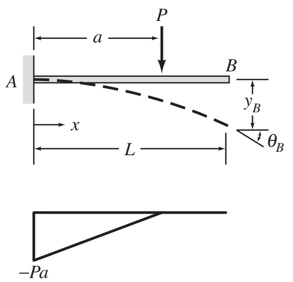
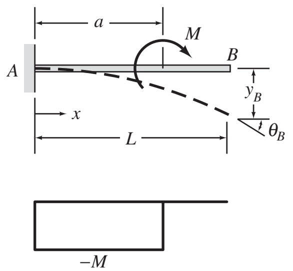
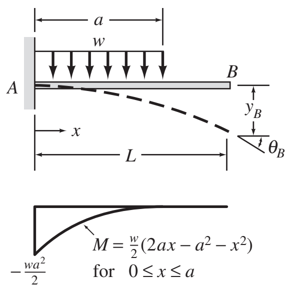
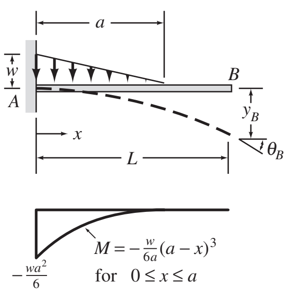
Using the *Moment distribution method*, determine the end moments and reactions, then draw the bending moment and shear diagrams for the beam shown in Fig. below. Support A is fixed and C is a pin. Given that, $E = 2 \times 10^5$ N/mm² **(25 marks)**

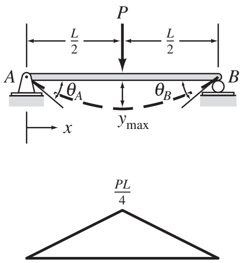


*********** GOOD LUCK *************

BENDING MOMENTS, SLOPES, AND DEFLECTIONS OF BEAMS UNDER VARIOUS LOADING CONDITIONS

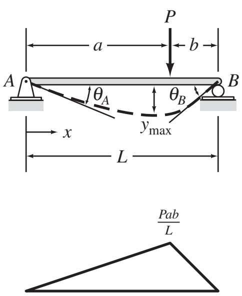


Beam, Loading, and Bending Moment Diagram	Equations for Slope and Deflection
	$0 \le x \le a$: $\theta = \frac{P}{2EI}(x^2 - 2ax)$ $y = \frac{P}{6EI}(x^3 - 3ax^2)$ $a \le x \le L$: $\theta = -\frac{Pa^2}{2EI}$ $y = \frac{Pa^2}{6EI}(a - 3x)$ $\theta_B = -\frac{Pa^2}{2EI}$; $y_B = -\frac{Pa^2}{6EI}(3L - a)$
	$0 \le x \le a$: $\theta = -\frac{Mx}{EI}$ $y = -\frac{Mx^2}{2EI}$ $a \le x \le L$: $\theta = -\frac{Ma}{EI}$ $y = \frac{Ma}{2EI}(a - 2x)$ $\theta_B = -\frac{Ma}{EI}$; $y_B = -\frac{Ma}{2EI}(2L - a)$
	$0 \le x \le a$: $\theta = \frac{w}{6EI}(3ax^2 - 3a^2x - x^3)$ $y = \frac{w}{24EI}(4ax^3 - 6a^2x^2 - x^4)$ $a \le x \le L$: $\theta = -\frac{wa^3}{6EI}$ $y = \frac{wa^3}{24EI}(a - 4x)$ $\theta_B = -\frac{wa^3}{6EI}$; $y_B = -\frac{wa^3}{24EI}(4L - a)$
	$0 \le x \le a$: $\theta = \frac{w}{24EIa}(x^4 - 4ax^3 + 6a^2x^2 - 4a^3x)$ $y = \frac{w}{120EIa}(x^5 - 5ax^4 + 10a^2x^3 - 10a^3x^2)$ $a \le x \le L$: $\theta = -\frac{wa^3}{24EI}$ $y = \frac{wa^3}{120EI}(-5x + a)$ $\theta_B = -\frac{wa^3}{24EI}$; $y_B = -\frac{wa^3}{120EI}(5L - a)$

<table>
<tr><th>Beam, Loading, and Bending Moment Diagram</th><th>Equations for Slope and Deflection</th></tr>
<tr><td>
</td><td>

$0 \le x \le \frac{L}{2}$:

$$\theta = \frac{P}{16EI}(4x^2 - L^2)$$
$$y = \frac{P}{48EI}(4x^3 - 3L^2x)$$
$$\theta_A = -\frac{PL^2}{16EI}; \quad \theta_B = \frac{PL^2}{16EI}$$
$$y_{\max} = -\frac{PL^3}{48EI}$$

</td></tr>
<tr><td>
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$0 \le x \le a$:

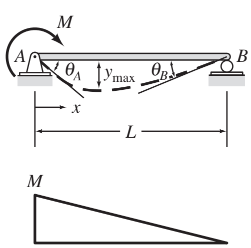
$$\theta = \frac{Pb}{6EIL}(3x^2 + b^2 - L^2)$$
$$y = \frac{Pb}{6EIL}(x^3 + b^2x - L^2x)$$

$a \le x \le L$:

$$\theta = \frac{Pa}{6EIL}[L^2 - a^2 - 3(L - x)^2]$$
$$y = \frac{Pa(L-x)}{6EIL}(x^2 + a^2 - 2Lx)$$
$$\theta_A = -\frac{Pb}{6EIL}(L^2 - b^2)$$
$$\theta_B = \frac{Pa}{6EIL}(L^2 - a^2)$$

For $a \ge b$:

$$y_{\max} = -\frac{Pb}{9\sqrt{3}EIL}(L^2 - b^2)^{3/2}$$
$$\text{at } x = \left(\frac{L^2 - b^2}{3}\right)^{1/2}$$

</td></tr>
<tr><td>
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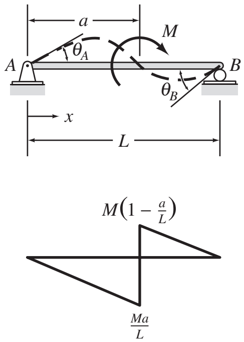
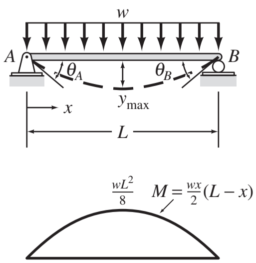
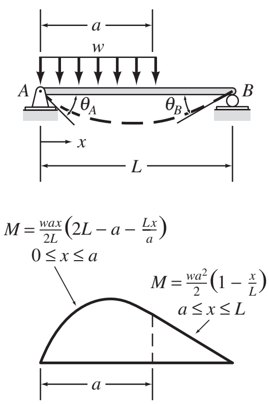
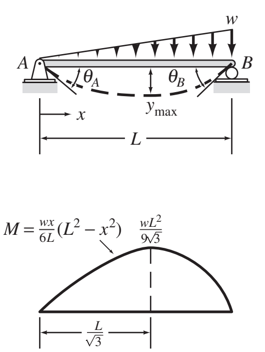
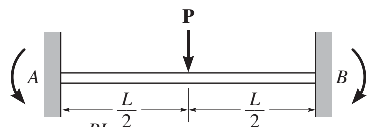
$$\theta = -\frac{M}{6EIL}(3x^2 - 6Lx + 2L^2)$$
$$y = -\frac{M}{6EIL}(x^3 - 3Lx^2 + 2L^2x)$$
$$\theta_A = -\frac{ML}{3EI}; \quad \theta_B = \frac{ML}{6EI}$$
$$y_{\max} = -\frac{ML^2}{9\sqrt{3}EI}$$
$$\text{at } x = L\left(1 - \frac{1}{\sqrt{3}}\right)$$

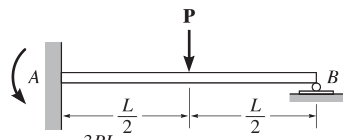
</td></tr>
</table>

Beam, Loading, and Bending Moment Diagram	Equations for Slope and Deflection
	$0 \le x \le a:$ $\theta = \frac{M}{6EIL}(-3x^2 + 6aL - 3a^2 - 2L^2)$ $y = \frac{M}{6EIL}(-x^3 + 6aLx - 3a^2x - 2L^2x)$ $\theta_A = \frac{M}{6EIL}(6aL - 3a^2 - 2L^2)$ $\theta_B = \frac{M}{6EIL}(L^2 - 3a^2)$
	$\theta = -\frac{w}{24EI}(4x^3 - 6Lx^2 + L^3)$ $y = -\frac{w}{24EI}(x^4 - 2Lx^3 + L^3x)$ $\theta_A = -\frac{wL^3}{24EI}$ $\theta_B = \frac{wL^3}{24EI}$ $y_{max} = -\frac{5wL^4}{384EI}$ at $x = \frac{L}{2}$
	$0 \le x \le a:$ $\theta = -\frac{w}{24EIL}[4Lx^3 - 6a(2L - a)x^2 + a^2(2L - a)^2]$ $y = -\frac{w}{24EIL}[Lx^4 - 2a(2L - a)x^3 + a^2(2L - a)^2x]$ $a \le x \le L:$ $\theta = -\frac{wa^2}{24EIL}(6x^2 - 12Lx + a^2 + 4L^2)$ $y = -\frac{wa^2}{24EIL}(L - x)(-2x^2 + 4Lx - a^2)$ $\theta_A = -\frac{wa^2}{24EIL}(2L - a)^2$ $\theta_B = \frac{wa^2}{24EIL}(2L^2 - a^2)$
	$\theta = -\frac{w}{360EIL}(15x^4 - 30L^2x^2 + 7L^4)$ $y = -\frac{w}{360EIL}(3x^5 - 10L^2x^3 + 7L^4x)$ $\theta_A = -\frac{7wL^3}{360EI}$ $\theta_B = \frac{wL^3}{45EI}$ $y_{max} = -0.00652\frac{wL^4}{EI}$ at $x = 0.5193L$

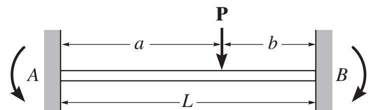
Fixed End Moments



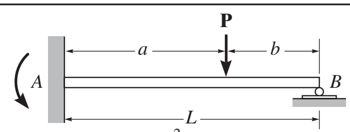
$(\text{FEM})_{AB} = \dfrac{PL}{8}$ $\quad (\text{FEM})_{BA} = \dfrac{PL}{8}$



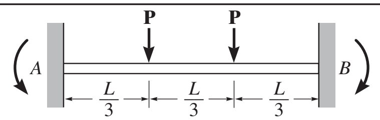
$(\text{FEM})'_{AB} = \dfrac{3PL}{16}$



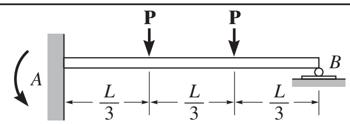
$(\text{FEM})_{AB} = \dfrac{Pb^2a}{L^2}$ $\quad (\text{FEM})_{BA} = \dfrac{Pa^2b}{L^2}$



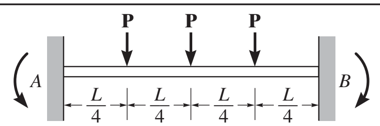
$(\text{FEM})'_{AB} = \left(\dfrac{P}{L^2}\right)\left(b^2a + \dfrac{a^2b}{2}\right)$



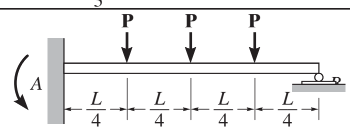
$(\text{FEM})_{AB} = \dfrac{2PL}{9}$ $\quad (\text{FEM})_{BA} = \dfrac{2PL}{9}$



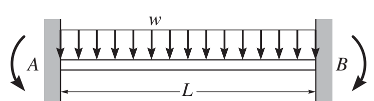
$(\text{FEM})'_{AB} = \dfrac{PL}{3}$



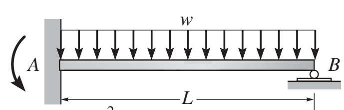
$(\text{FEM})_{AB} = \dfrac{5PL}{16}$ $\quad (\text{FEM})_{BA} = \dfrac{5PL}{16}$



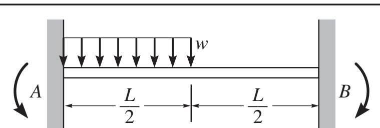
$(\text{FEM})'_{AB} = \dfrac{45PL}{96}$



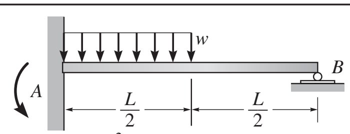
$(\text{FEM})_{AB} = \dfrac{wL^2}{12}$ $\quad (\text{FEM})_{BA} = \dfrac{wL^2}{12}$



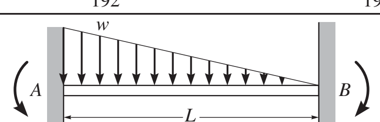
$(\text{FEM})'_{AB} = \dfrac{wL^2}{8}$



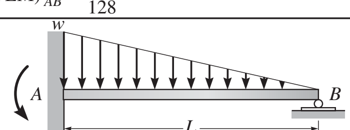
$(\text{FEM})_{AB} = \dfrac{11wL^2}{192}$ $\quad (\text{FEM})_{BA} = \dfrac{5wL^2}{192}$



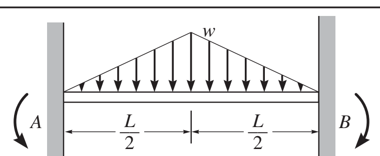
$(\text{FEM})'_{AB} = \dfrac{9wL^2}{128}$



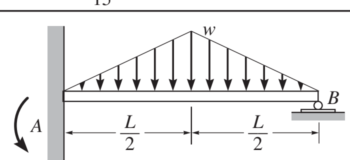
$(\text{FEM})_{AB} = \dfrac{wL^2}{20}$ $\quad (\text{FEM})_{BA} = \dfrac{wL^2}{30}$



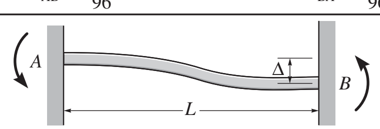
$(\text{FEM})'_{AB} = \dfrac{wL^2}{15}$



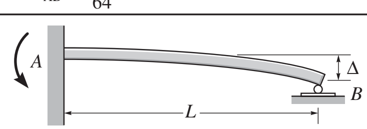
$(\text{FEM})_{AB} = \dfrac{5wL^2}{96}$ $\quad (\text{FEM})_{BA} = \dfrac{5wL^2}{96}$



$(\text{FEM})'_{AB} = \dfrac{5wL^2}{64}$



$(\text{FEM})_{AB} = \dfrac{6EI\Delta}{L^2}$ $\quad (\text{FEM})_{BA} = \dfrac{6EI\Delta}{L^2}$



$(\text{FEM})'_{AB} = \dfrac{3EI\Delta}{L^2}$