NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

STRUCTURAL ANALYSIS I

TCW 3102

Supplementary Examination Paper

JULY 2016

This examination paper consists of 6 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements:

Examiner's Name: Miss Diana Makweche/ Engineer Noreen Dube

INSTRUCTIONS

1. Answer all questions
2. Each question carries 25 marks
3. Use of calculators is permissible

MARK ALLOCATION

QUESTION	MARKS
1.	**25**
2.	**25**
3.	**25**
4.	**25**
TOTAL	**100**

QUESTION 1

(i) Given the deflected shapes of the structures in Figure Q1A, sketch the qualitative shear force and bending moment diagrams. [10]

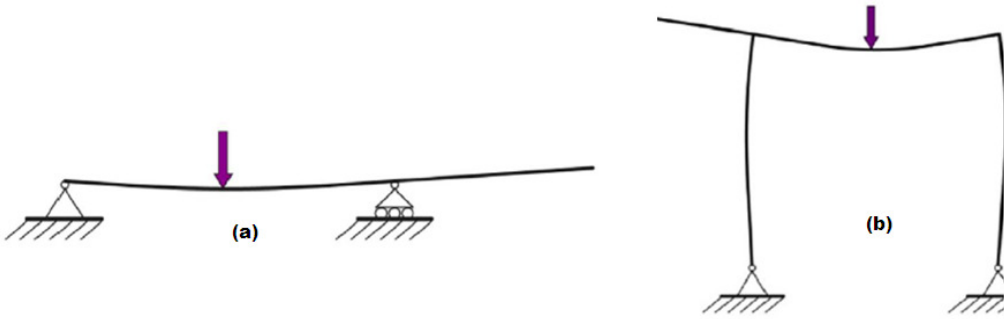


Figure Q1A

(ii) Figure Q1B shows a simply supported truss.
(a) Construct the influence line for member GD.
(b) Is member GD a primary or secondary member? [15]

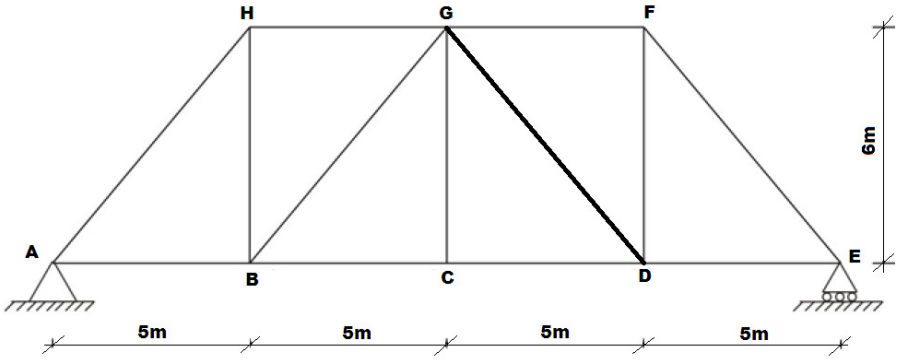


Figure Q2A

QUESTION 2

(i) Calculate the support reactions for the beam shown in Figure Q2 using the Flexibility Method. EI is constant. [25]

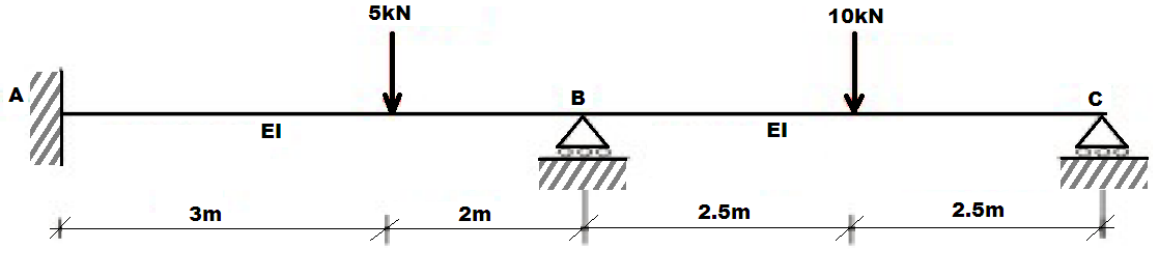


Figure Q2

QUESTION 3

(i) Using the Slope Deflection Method, draw the bending moment diagram for the continuous beam in Figure Q3. [25]

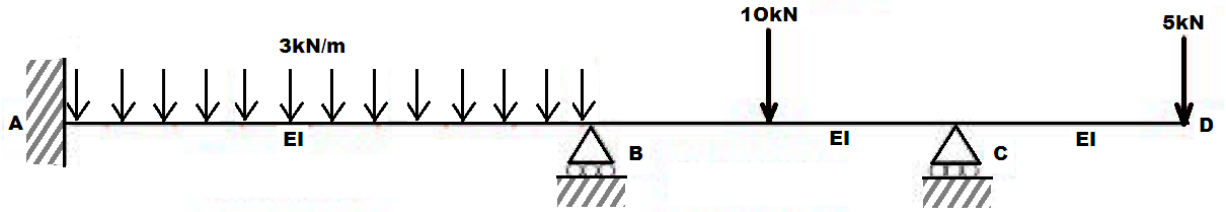


Figure Q3

QUESTION 4

Analyse the beam using the Stiffness Method. EI is constant. [25]

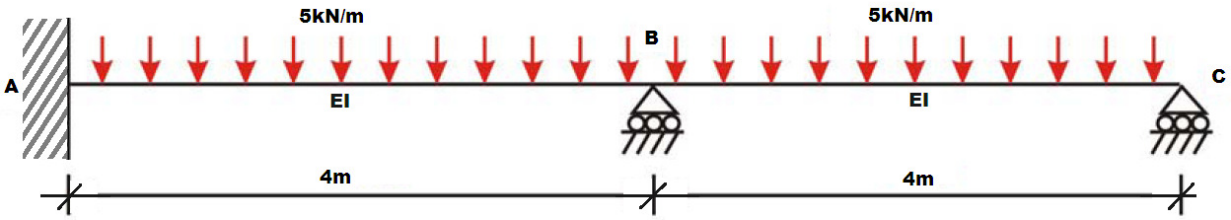
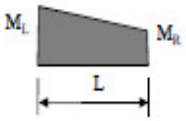
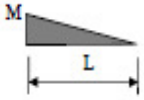
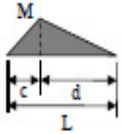
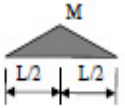
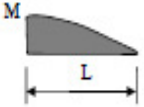
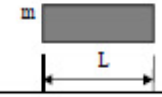
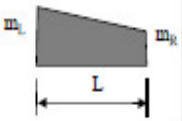
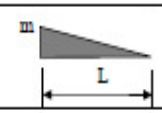
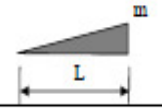
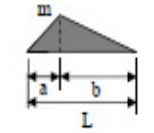
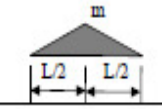


Figure Q4

To Evaluate Product Integrals of the Form: $\int_0^L mM\,dx$

							
	LmM	$\frac{L}{2}m(M_L + M_R)$	$\frac{L}{2}mM$	$\frac{L}{2}mM$	$\frac{L}{2}mM$	$\frac{L}{3}mM$	$\frac{2L}{3}mM$
	$\frac{L}{2}(m_L + m_R)M$	$\frac{L}{6}[m_L(2M_L + M_R) + m_R(M_L + 2M_R)]$	$\frac{L}{6}(2m_L + m_R)M$	$\frac{L}{6}\left[m_L\left(1+\frac{d}{L}\right) + m_R\left(1+\frac{c}{L}\right)\right]M$	$\frac{L}{4}(m_L + m_R)M$	$\frac{L}{12}(3m_L + m_R)M$	$\frac{L}{12}(5m_L + 3m_R)M$
	$\frac{L}{2}mM$	$\frac{L}{6}m(2M_L + M_R)$	$\frac{L}{3}mM$	$\frac{L}{6}m\left(1+\frac{d}{L}\right)M$	$\frac{L}{4}mM$	$\frac{L}{4}mM$	$\frac{5L}{12}mM$
	$\frac{L}{2}mM$	$\frac{L}{6}m(M_L + 2M_R)$	$\frac{L}{6}mM$	$\frac{L}{6}m\left(1+\frac{c}{L}\right)M$	$\frac{L}{4}mM$	$\frac{L}{12}mM$	$\frac{L}{4}mM$
	$\frac{L}{2}mM$	$\frac{L}{6}m\left[M_L\left(1+\frac{b}{L}\right) + M_R\left(1+\frac{a}{L}\right)\right]$	$\frac{L}{6}m\left(1+\frac{b}{L}\right)M$	$\frac{(L^2 - a^2 - c^2)}{6bc}LmM$ only for $a < c$	$\left(\frac{3L^2 - 4a^2}{12bL}\right)LmM$	$\frac{L}{12}m\left(1+\frac{b}{L} + \frac{b^2}{L^2}\right)M$	$\frac{L}{12}m\left(5-\frac{a}{L} - \frac{a^2}{L^2}\right)M$
	$\frac{L}{2}mM$	$\frac{L}{4}m(M_L + M_R)$	$\frac{L}{4}mM$	$\left(\frac{3L^2 - 4c^2}{12dL}\right)LmM$	$\frac{L}{3}mM$	$\frac{7L}{48}mM$	$\frac{17L}{48}mM$

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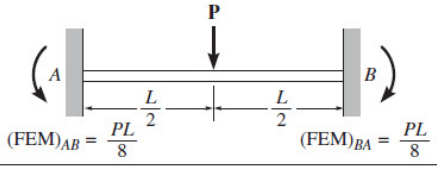
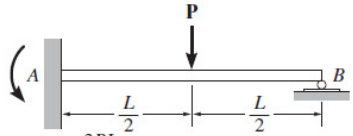
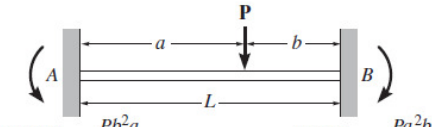
Fixed End Moments



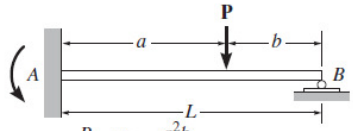
$(FEM)_{AB} = \frac{PL}{8}$ $(FEM)_{BA} = \frac{PL}{8}$



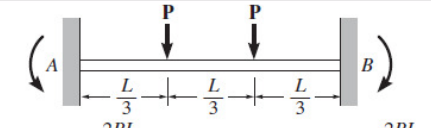
$(FEM)'_{AB} = \frac{3PL}{16}$



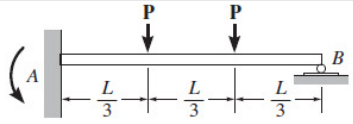
$(FEM)_{AB} = \frac{Pb^2a}{L^2}$ $(FEM)_{BA} = \frac{Pa^2b}{L^2}$



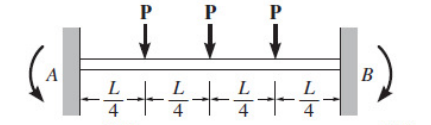
$(FEM)'_{AB} = (\frac{P}{L^2})(b^2a + \frac{a^2b}{2})$



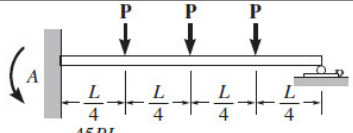
$(FEM)_{AB} = \frac{2PL}{9}$ $(FEM)_{BA} = \frac{2PL}{9}$



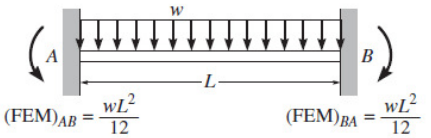
$(FEM)'_{AB} = \frac{PL}{3}$



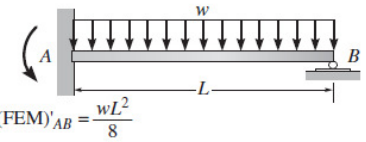
$(FEM)_{AB} = \frac{5PL}{16}$ $(FEM)_{BA} = \frac{5PL}{16}$



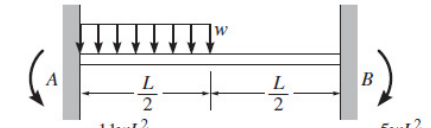
$(FEM)'_{AB} = \frac{45PL}{96}$



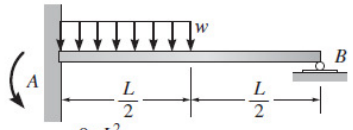
$(FEM)_{AB} = \frac{wL^2}{12}$ $(FEM)_{BA} = \frac{wL^2}{12}$



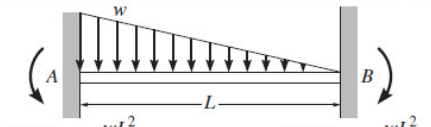
$(FEM)'_{AB} = \frac{wL^2}{8}$



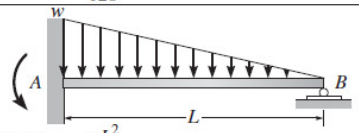
$(FEM)_{AB} = \frac{11wL^2}{192}$ $(FEM)_{BA} = \frac{5wL^2}{192}$



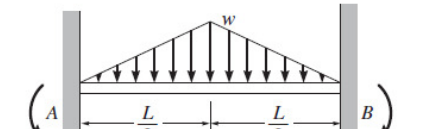
$(FEM)'_{AB} = \frac{9wL^2}{128}$



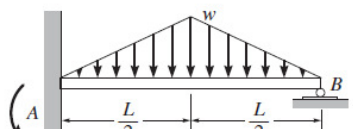
$(FEM)_{AB} = \frac{wL^2}{20}$ $(FEM)_{BA} = \frac{wL^2}{30}$



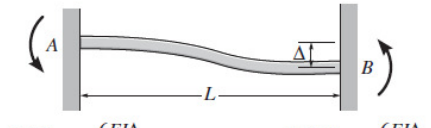
$(FEM)'_{AB} = \frac{wL^2}{15}$



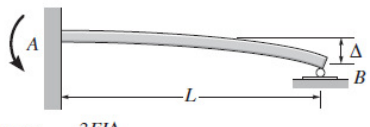
$(FEM)_{AB} = \frac{5wL^2}{96}$ $(FEM)_{BA} = \frac{5wL^2}{96}$



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



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



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

Slope Deflection Equations

$$M_N = 2Ek(2\theta_N + \theta_F - 3\psi) + (FEM)_N$$

$$M_N = 3Ek(\theta_N - \psi) + (FEM)_N$$