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 2015

This examination paper consists of 7 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements:

Examiner's Name: Miss Diana Makweche

INSTRUCTIONS

1. Answer any four (4) 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**
5.	**25**
TOTAL	**100**

QUESTION 1

(a) Qualitatively analyse the structures in Figure Q1A for:

(i) deflected shape
(ii) reactions
(iii) shear force diagram
(iv) bending moment diagram

Clearly indicate points of interest (i.e. inflexion points, regions of zero slope, straight portions/members, zones of tension, etc) [10]

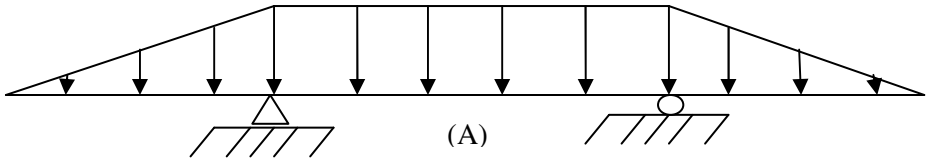


Figure Q1A

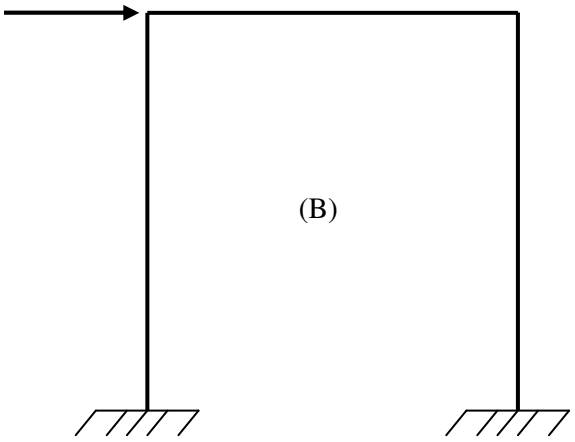


Figure Q1B

(b) In Figure Q1B above, if the horizontal force is 20kN. Find the principal values of the bending moment and shear force diagrams using any method. [15]

QUESTION 2

(a) Describe the application of influence lines in structural analysis. [3]

(b) Use the Muller-Breslau Method to sketch the influence lines for the reaction at A and shear at B of Figure Q2A. (Show relative values) [6]

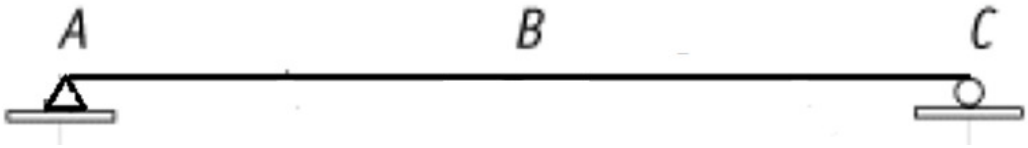


Figure Q2A

(b) For the structure in Figure Q2B, find the maximum positive shear at B due to the system of loads as it moves from right to left.[16]

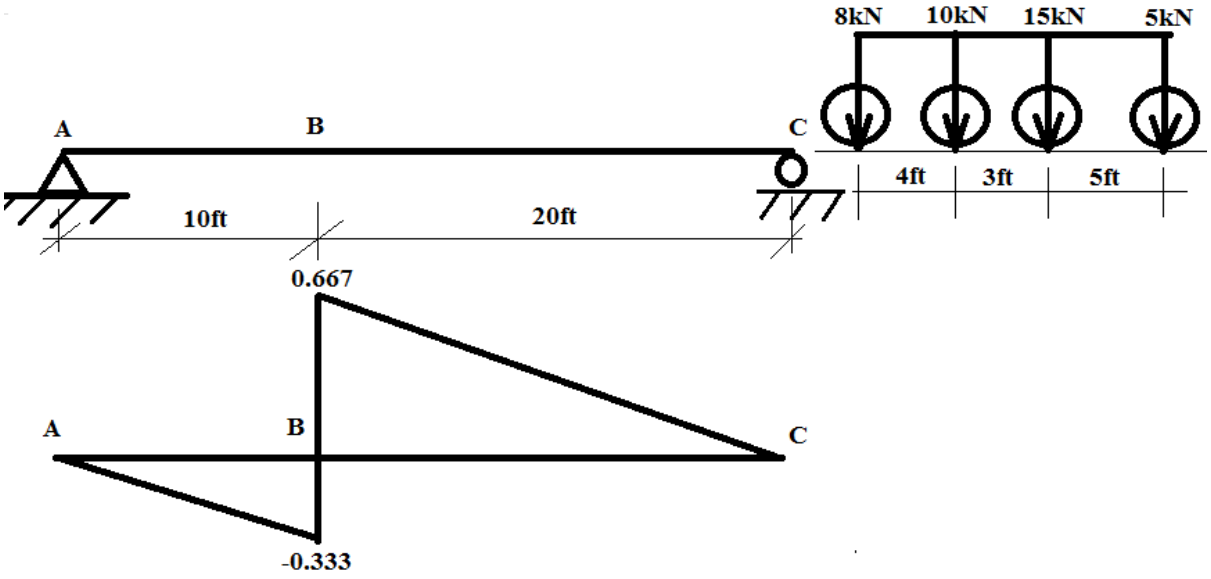


Figure Q2B

QUESTION 3

Analyse the beam shown in Figure Q3. The beam is pinned at A and sits on a roller support at B. Support C is fixed. Construct the bending moment diagram. [25]

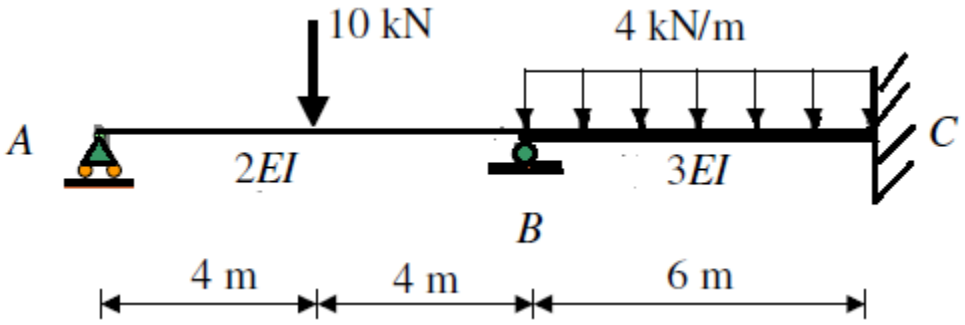


Figure Q3

QUESTION 4

Analyse the frame in Figure below. Draw the bending moment diagram. EI is constant. [25]

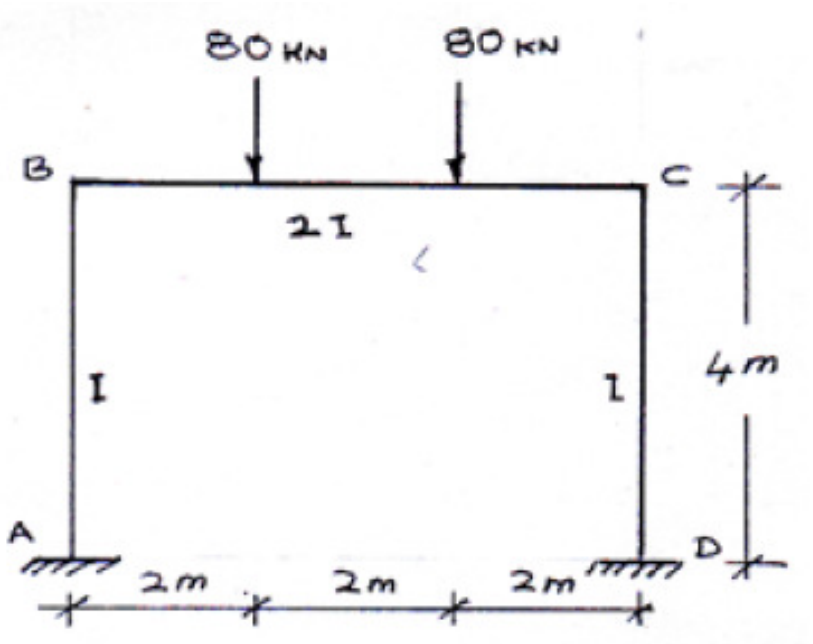


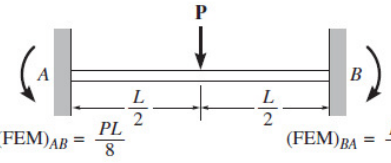
Figure Q4

To Evaluate Product Integrals of the Form: $\int_0^L mMdx$

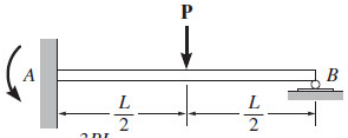
	M, L	M_L, M_R, L	M, L	M, c, d, L	M, L/2, L/2	M, L	M, L
m, L	LmM	$\frac{L}{2}m(M_L+M_R)$	$\frac{L}{2}mM$	$\frac{L}{2}mM$	$\frac{L}{2}mM$	$\frac{L}{3}mM$	$\frac{2L}{3}mM$
m_L, m_R, L	$\frac{L}{2}(m_L+m_R)M$	$\frac{L}{6}[m_L(2M_L+M_R)+m_R(M_L+2M_R)]$	$\frac{L}{6}(2m_L+m_R)M$	$\frac{L}{6}\left[m_L\left(1+\frac{d}{L}\right)+m_R\left(1+\frac{c}{L}\right)\right]M$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

TCW 3102

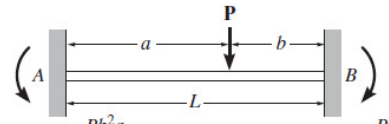
Fixed End Moments



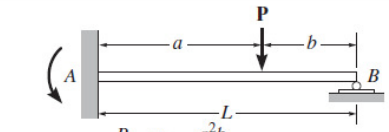
$(FEM)_{AB} = \frac{PL}{8}$ $(FEM)_{BA} = \frac{PL}{8}$



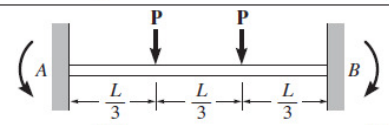
$(FEM)'_{AB} = \frac{3PL}{16}$



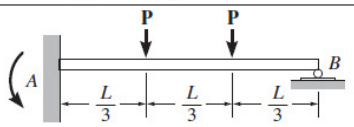
$(FEM)_{AB} = \frac{Pb^2a}{L^2}$ $(FEM)_{BA} = \frac{Pa^2b}{L^2}$



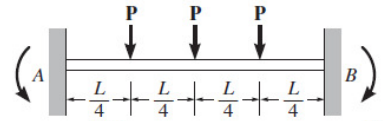
$(FEM)'_{AB} = (\frac{P}{L^2})(b^2a + \frac{a^2b}{2})$



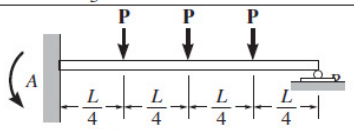
$(FEM)_{AB} = \frac{2PL}{9}$ $(FEM)_{BA} = \frac{2PL}{9}$



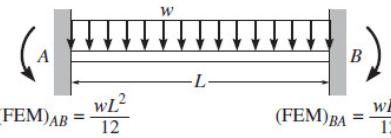
$(FEM)'_{AB} = \frac{PL}{3}$



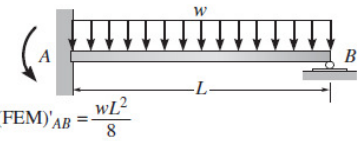
$(FEM)_{AB} = \frac{5PL}{16}$ $(FEM)_{BA} = \frac{5PL}{16}$



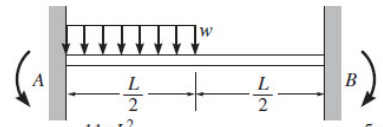
$(FEM)'_{AB} = \frac{45PL}{96}$



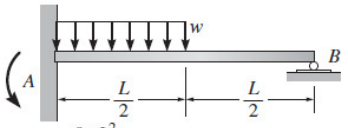
$(FEM)_{AB} = \frac{wL^2}{12}$ $(FEM)_{BA} = \frac{wL^2}{12}$



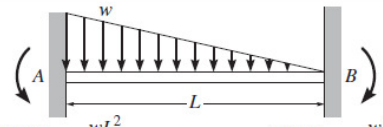
$(FEM)'_{AB} = \frac{wL^2}{8}$



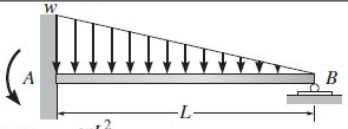
$(FEM)_{AB} = \frac{11wL^2}{192}$ $(FEM)_{BA} = \frac{5wL^2}{192}$



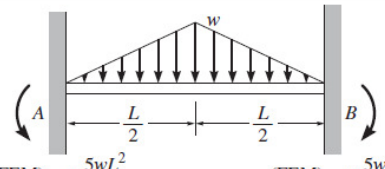
$(FEM)'_{AB} = \frac{9wL^2}{128}$



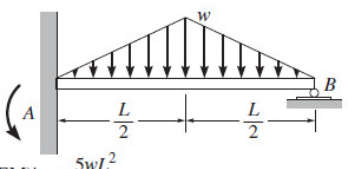
$(FEM)_{AB} = \frac{wL^2}{20}$ $(FEM)_{BA} = \frac{wL^2}{30}$



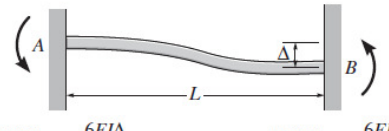
$(FEM)'_{AB} = \frac{wL^2}{15}$



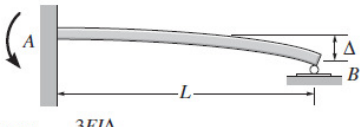
$(FEM)_{AB} = \frac{5wL^2}{96}$ $(FEM)_{BA} = \frac{5wL^2}{96}$



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



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



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

Slope Deflection Equations

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

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