NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF CIVIL AND WATER ENGINEERING

STRUCTURAL ANALYSIS 1

TCW/ECW2206

Supplementary Examination Paper

August 2024

This examination paper consists of 4 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: Graph Paper

**Examiner's Name: Mr T Madyangove/ Mr P. Nkomo**

INSTRUCTIONS

1. Answer any four questions
2. Each question carries 25 marks

MARK ALLOCATION

QUESTION	MARKS
1.	25
2.	25
3.	25
4.	25
5.	25
6.	25
TOTAL	100

QUESTION ONE

(a) Explain the following terms of static stability and instability of structures:

    (1) unstable structure   [1]

    (2) geometrically unstable structure   [1]

    (3) statically determinate structure   [1]

    (4) statically indeterminate structure.   [1]

(b) A simply-supported beam is shown in Figure 1(b) below. Use the moment –area method to determine the deflection (δ_B) at B and the slope (Θ_A) at A.

Modulus of elasticity E = 200×10^6 kN/m^2.

Second moment of area I = 50×10^6 mm^4.

Show all your workings.
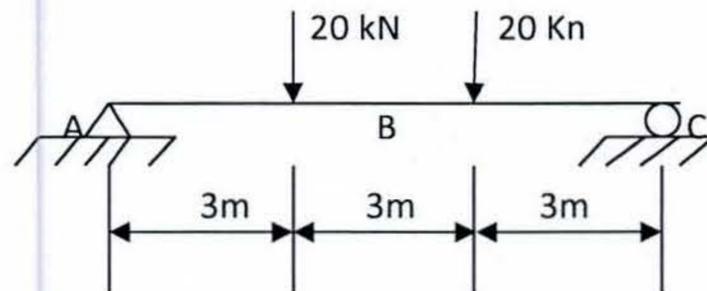
                                                                      [10]

Figure 1(b)

(c) For a portal frame shown in Figure 1(c), find the horizontal deflection, δ_H, and the rotation Θ_C at point C, using the method of virtual work.   [11]

Modulus of elasticity E = 200×10^6 kN/m^2

Second moment of area I = 800×10^6 mm^4.
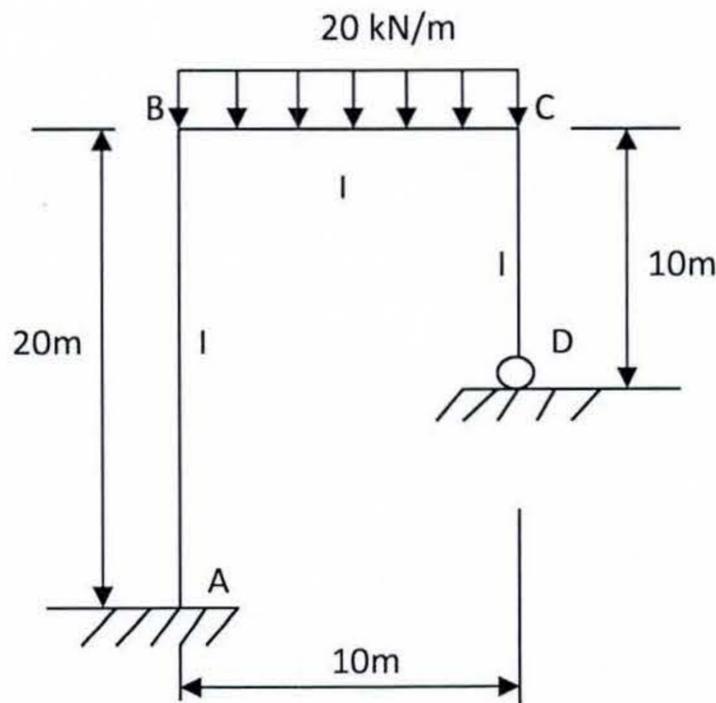

Figure 1(c)   TOTAL MARKS [25]

QUESTION TWO

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(a) What are influence lines in structural analysis? [2]

(b) Draw the influence lines for reaction V_A and V_B, moment at point D, for a beam ABC in Figure 2 (b), and find the maximum value of moment M_D due to a uniform load of intensity 5 kN/m, which can act over any part of the beam, and two concentrated loads of 10 kN each, with a fixed distance of 4 m between them. [23]
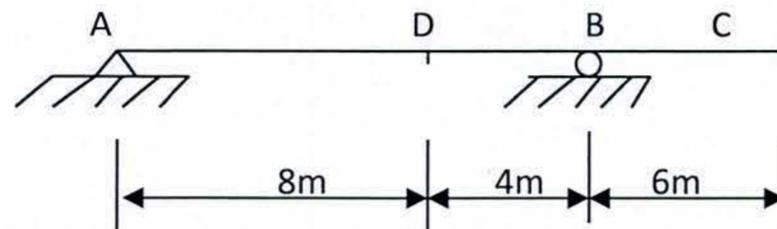

Figure 2(b)

TOTAL MARKS [25]

QUESTION THREE

Determine the member moments, the reactions using the slope-deflection method and draw bending-moment diagram for the portal frame shown in Figure 3 below.
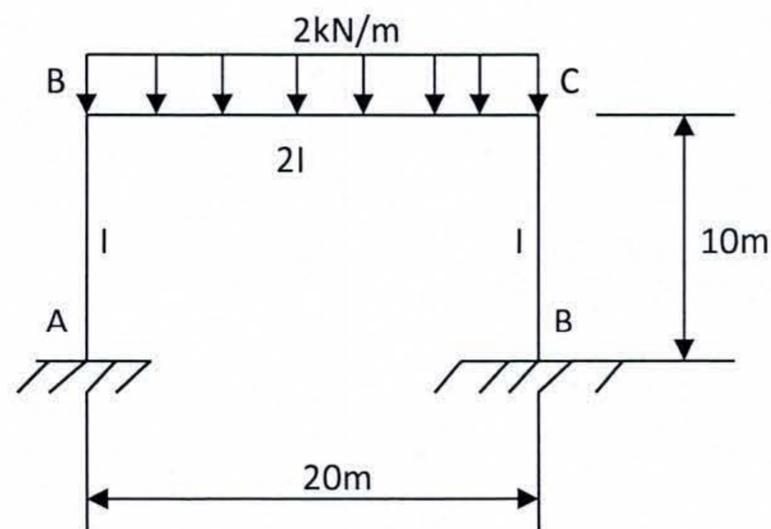

Figure (3)   TOTAL MARKS [25]

QUESTION FOUR

Determine the member moments, the reactions and draw the bending –moment diagram for the continuous beam shown in Figure 4 below, using the moment-distribution method. I = constant.

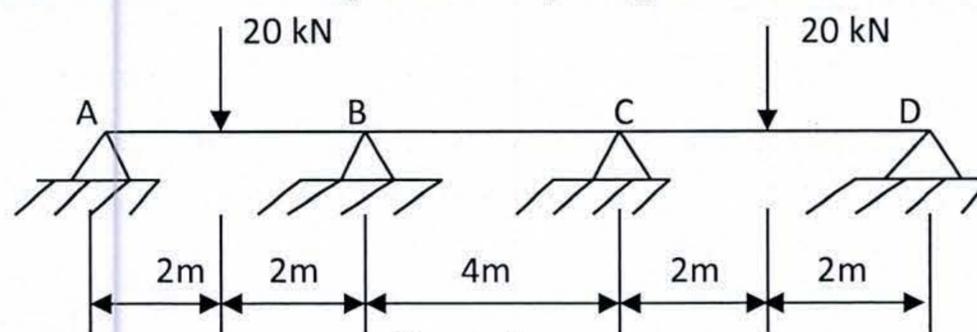**Figure 4**   TOTAL MARKS [25]
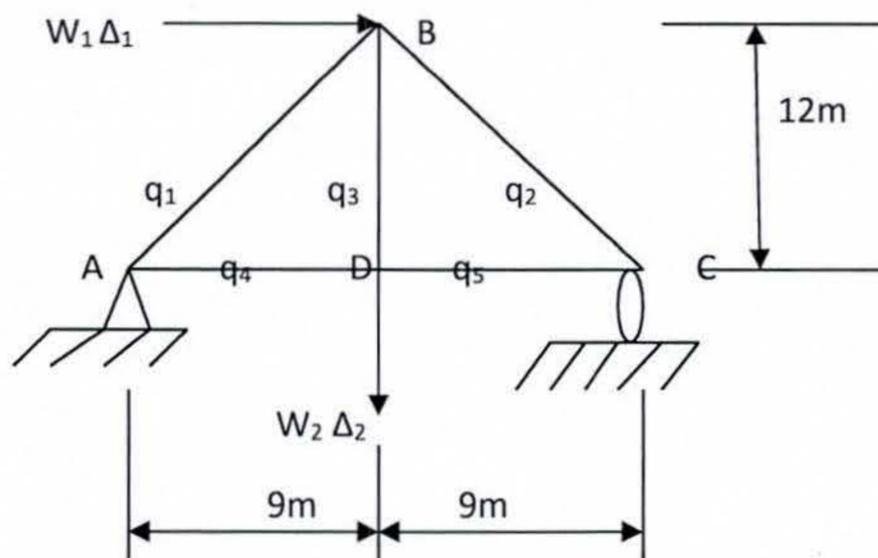
3

QUESTION FIVE

Construct the structure - flexibility matrix and determine the deflections Δ_1 and Δ_2 for the truss in Figure 5.

Modulus of elasticity $E = 100 \times 10^6$ kN/m²

Second moment of area $I = 50 \times 10^6$ mm⁴

Cross –sectional area of each bar $A = 20$ mm²

Loads $W_1 = 10$ kN and $W_2 = 20$ kN respectively.

Figure 5   TOTAL MARKS [25]

END OF PAPER

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