PROGRAM	:	NATIONAL DIPLOMA *CIVIL ENGINEERING*
SUBJECT	:	**STRUCTURAL ANALYSIS II**
CODE	:	**AIS2111**
DATE	:	WINTER EXAMINATION 2019 11 JUNE 2019
DURATION	:	(X-PAPER) 12:30 - 15:30
WEIGHT	:	40 : 60
TOTAL MARKS	:	100

EXAMINER	:	MR F THAIMO
MODERATOR	:	DR J MAHACHI
NUMBER OF PAGES	:	4 PAGES

INSTRUCTIONS	:	HAND HELD CALCULATOR MAY BE USED
REQUIREMENTS	:	2 SHEETS OF A4 GRAPH PAPER PER CANDIDATE.

INSTRUCTIONS TO CANDIDATES:

PLEASE ANSWER ALL THE QUESTIONS.

QUESTION 1

The support conditions of the frame **ABCDEF** shown as Figure 1 below are such that the frame is pinned at A and supported by pin rollers at F. The frame is subjected to loading as shown on the Figure.

1.1 Determine the reactions at the supports A and F and sketch the free body diagram of the frame showing the loading and support reactions.

1.2 Draw the Shear Force, Bending Moment and Axial Force Diagrams for the frame on the graph paper provided. (**Please note that the bending moments are to be drawn on the side of the member where they cause tensile bending stresses**).

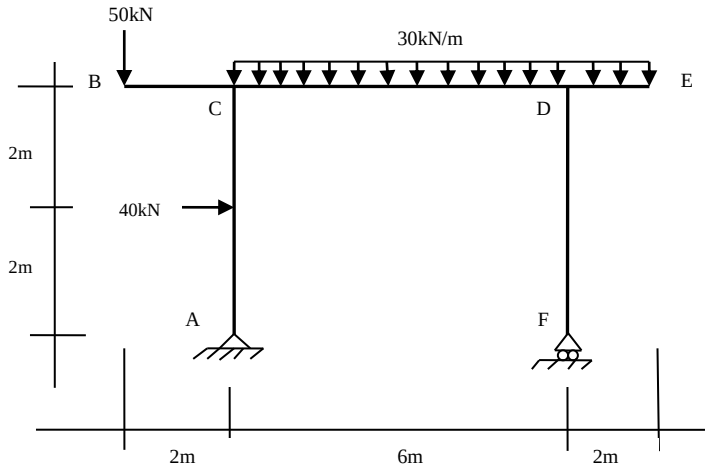

Figure 1

[25]

QUESTION 2

2.1 The symmetrically loaded simply supported beam given as Figure 2 below, is subjected to three (3) point loads of P at the given ratios as shown on the Figure. The flexural rigidity EI value for the beam section is constant and equal to $80x10^3$ kNm^2.

Using **MOMENT-AREA** technique, determine the magnitude of (P) if the deflection at mid-span is 10mm.

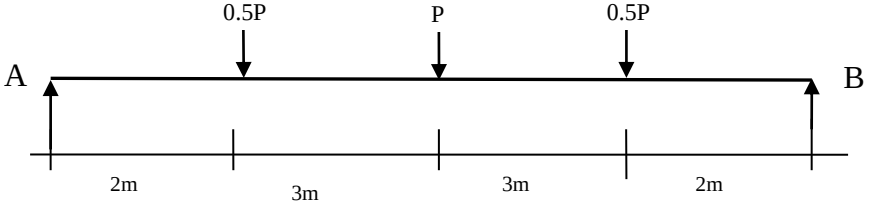

Figure 2

[20]

QUESTION 3

The frame **ABCD** shown as Figure 3 below, is fixed at support D, pinned at support A and supported by pinned roller at C. The frame is subjected to loading as shown on the Figure. Using **SLOPE DEFLECTION** method, draw the Shear Force, Bending Moment and Axial Force diagrams for the frame on the graph paper provided. All the members of the frame have the same flexural rigidity (EI).

Slope deflection equations are as follows:

$$M_{AB} = \frac{2EI}{l}\left[2\theta_A + \theta_B - \frac{3(\Delta_B - \Delta_A)}{l}\right] \qquad M_{BA} = \frac{2EI}{l}\left[\theta_A + 2\theta_B - \frac{3(\Delta_B - \Delta_A)}{l}\right]$$

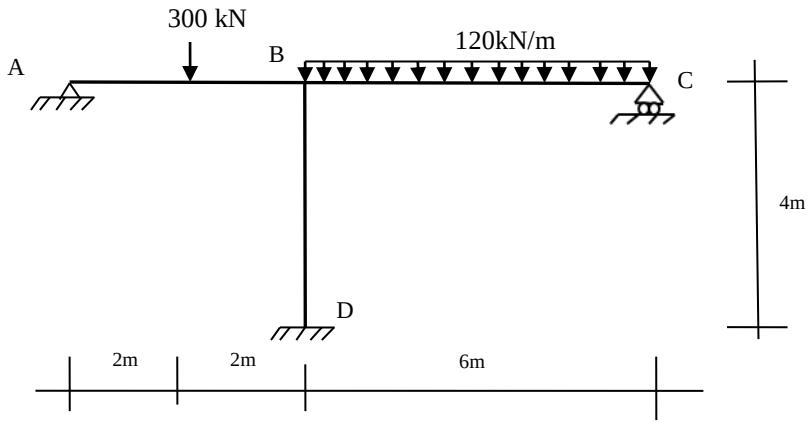

Figure 3

[30]

QUESTION 4

A structural steel member is used as a compression member (strut).
The buckling stress according to Euler equation for the member (σ_e) was calculated and found to be 460 MPa.

a) Calculate the slenderness ratio if the Young's Modulus of the material is 200 GPa.

b) Calculate the radius of gyration (r) if the effective length (l_e) is 4000mm.

c) Calculate the second moment of area (I) of the section of the member if the cross-sectional area is 8.21×10^3 mm^2.

d) If the yield stress of the steel is taken as 300 MPa, what would be the buckling stress and the load to produce the stress if Rankine and Gordon equation is used?

[25]

Total: 100