UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *CIVIL ENGINEERING*
SUBJECT	:	**STRUCTURAL ANALYSIS II**
CODE	:	**AIS2111**
DATE	:	SUPPLEMENTARY EXAMINATION 2016 19 JULY 2019
DURATION	:	(X-PAPER) 08:00 - 11:00
WEIGHT	:	40 : 60
TOTAL MARKS	:	100

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

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

INSTRUCTIONS TO CANDIDATES:

PLEASE ANSWER ALL THE QUESTIONS.

QUESTION 1

The statically determinate frame **ABCD,** Figure1 below, is pinned at both supports A and D, and is connected by a frictionless pin at C. The frame is subjected to loading as shown on the Figure.

1.1 Determine the support reactions at A and D and sketch a free body diagram of the frame showing all the loads and reactions.

1.2 Draw the Shear Force, Bending Moment and Axial Force Diagrams for the frame on the graph paper provided. **Note**: bending moment is to be drawn on the side of the member where it causes tension.

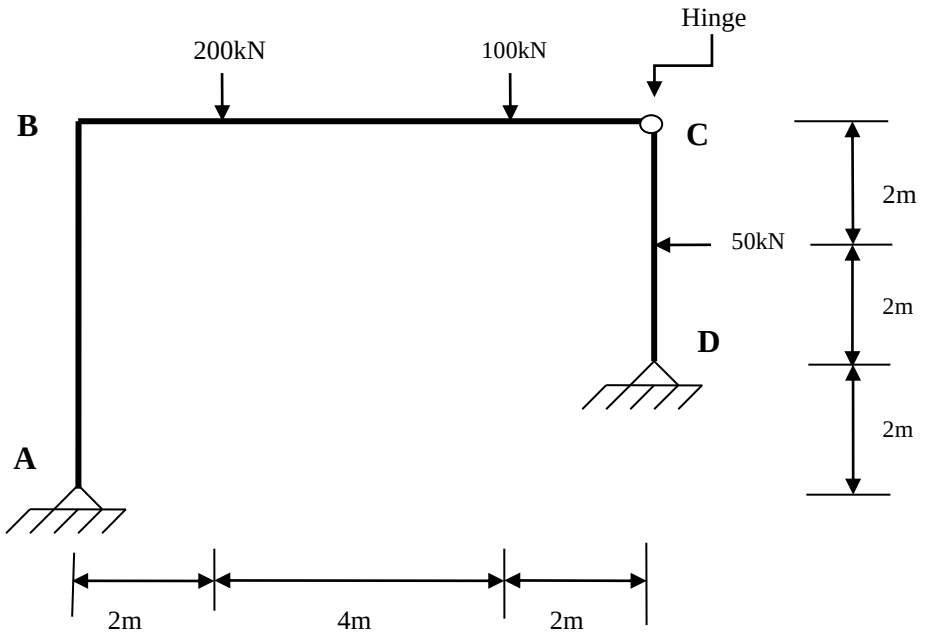

FIGURE 1

[25]

QUESTION 2

A beam with both ends fixed is shown in Figure 2 below. The beam is subjected to a point load at 2m from support A and a UDL as shown on the Figure. The EI value for the beam section is constant.

Using **MOMENT-AREA** theory, determine the reactant bending moments at the supports A and B.

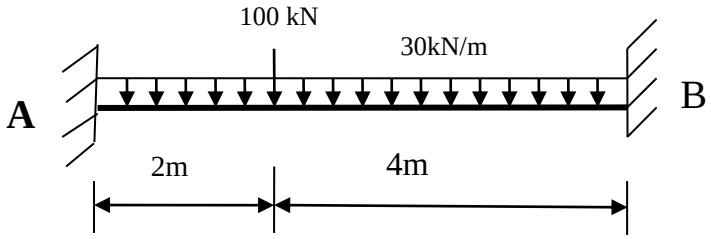

FIGURE 2

[20]

QUESTION 3

Figure 3 below shows a framed ABCDE which is fixed at A, pinned at E and rests on rollers at C. EI is constant. The frame is subjected to different loading as shown in Figure 3.

Using the **SLOPE DEFLECTION** method, analyze the frame and draw the Shear Force, Bending Moment and Axial Force diagrams for the frame on the graph paper provided.

The slope deflection equations are as follows:

$$M_{AB} = \frac{2EI}{l}\left[2\theta A + \theta B - \frac{3(\Delta B - \Delta A)}{l}\right] \qquad M_{BA} = \frac{2EI}{l}\left[\theta A + 2\theta B - \frac{3(\Delta B - \Delta A)}{l}\right]$$

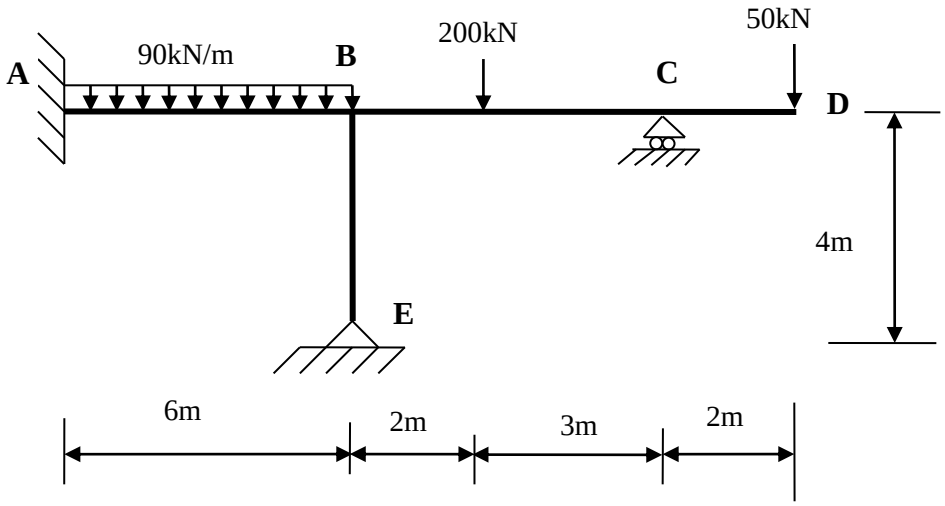

FIGURE 3

[30]

QUESTION 4

A steel section is to be used as a column. The column is to be fixed at one end and pinned at the other for bending about both X-X and Y-Y axis.

The properties of the section are as follows:

A	=	3.490×10^3 mm^2
I_{xx}	=	24.49×10^6 mm^4
I_{yy}	=	3.290×10^6 mm^4
E	=	210 GPa
σ_y	=	250 MPa
L	=	5m

4.1 Calculate the Euler buckling stress and the corresponding load.

4.2 If Perry-Robertson equation is used, what would be the stress at failure and the force to produce this stress?

Perry-Robertson equation is as follows:

$$\sigma_c = \frac{1}{2}\left[\sigma_y + (1+\eta)\sigma_e\right] - \sqrt{\left\{\frac{1}{4}\left[\sigma_y + (1+\eta)\sigma_e\right]^2 - \sigma_y\sigma_e\right\}}$$

[25]

Total: 100