



MACHAKOS UNIVERSITY

University examinations 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR BACHELOR IN CIVIL ENGINEERING

ECV 312: THEORY OF STRCUTURES IV

Date 10/3/2023

Time: 8:30 – 10:00 AM

INSTRUCTIONS

*This paper comprises of FIVE questions. Answer **THREE** questions*

*Question one is **compulsory** and carry 30 marks*

*Answer any other **TWO** questions*

QUESTION ONE (30MKS)

- What are the requirements to be satisfied while analyzing a structure? (3 Marks)
- Define compatibility in force method of analysis. (2Marks)
- Define stiffness coefficient k_{ij} (2Marks)
- Compare flexibility method and stiffness method. (3Marks)
- List the properties of the stiffness matrix (3Marks)
- Consider the following two spring system shown in figure 1 Derive the global matrix for both elements (5Marks)

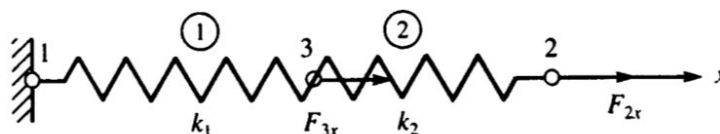


Figure 1

- vii. What are the factors governing the selection of finite elements (3Marks)
- viii. What are the possible locations for nodes in analyzing a two dimensional structure using finite element methods (3Marks)
- ix. Find the degree of statical determinacy of the Portal truss shown in figure 2 (3Marks)

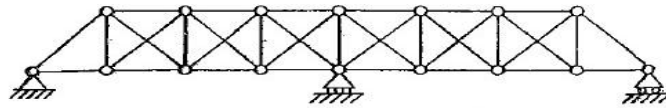


Figure 2

- x. Describe the basic steps in finite element method (3 Marks)

QUESTION TWO (20MKS)

The thin plate of uniform thickness 20mm is as shown in **figure 3** below. In addition to the self weight, the plate is subjected to a point load of 400N at mid-depth. The Young's Modulus $E=2 \times 10^5 \text{ N/mm}^2$ and unit weight, $0.8 \times 10^{-4} \text{ N/mm}^2$. Analyse the plate after modeling it with two elements and find the stresses in each element. Determine the support reaction also. **(20 Marks)**

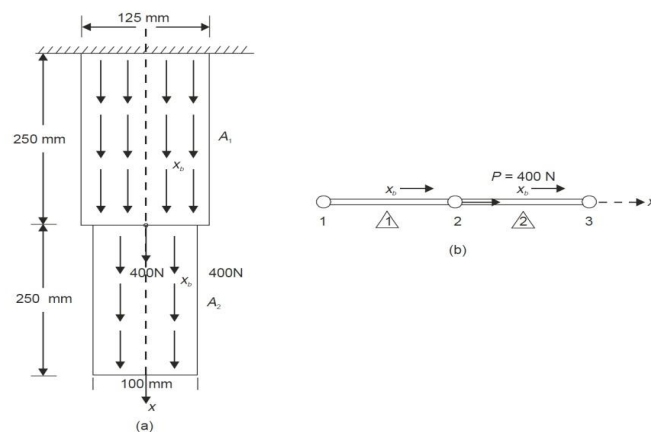


Figure 3

QUESTION THREE (20MKS)

The truss ABCD in figure below is loaded as shown in **figure 4**. Using flexibility method, find the reactions at A and member forces. **(20 Marks)**

All members have constant stiffness

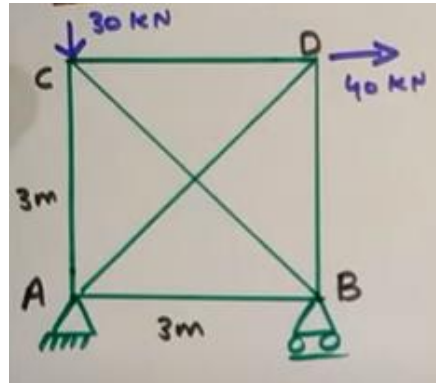


Figure 4

QUESTION FOUR (20MKS)

The beam in **figure 5** is loaded with 10 kN point load and 8kN/m distributed load as shown below. Using direct flexibility method, find the reactions and the bending moments. **(20 Marks)**

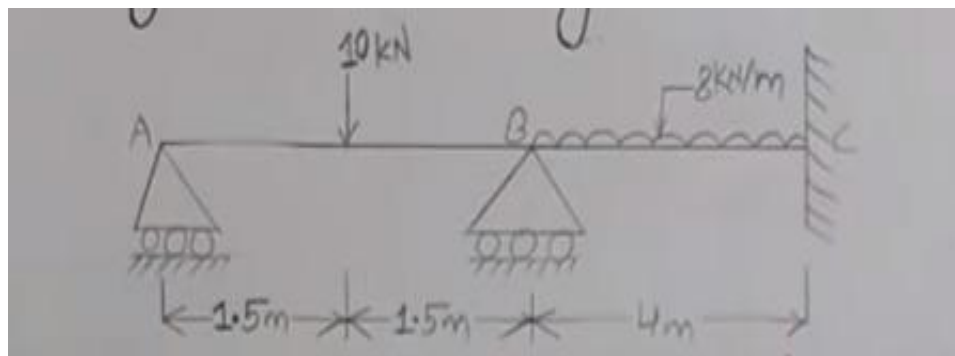


Figure 5

QUESTION FIVE (20MKS)

Using structure approach of stiffness matrix, determine the moments and reactions in the portal frame shown in **figure 6** below. Take EI constant **(20 Marks)**.

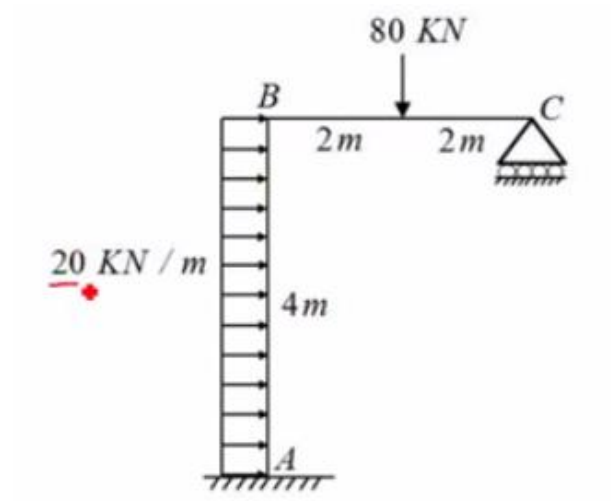


Figure 6