



MACHAKOS UNIVERSITY

University Examinations for 2021/2022

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 312: THEORY OF STRUCTURES IV

DATE

TIME

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 (COMPULSORY) (30 MARKS)

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

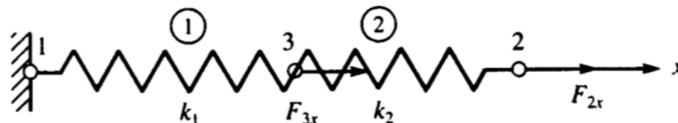


Figure 1

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

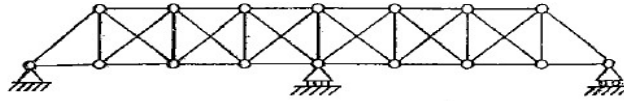


Figure 2

- j) Describe the basic steps in finite element method. (3 marks)

QUESTION TWO (20 MARKS)

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.

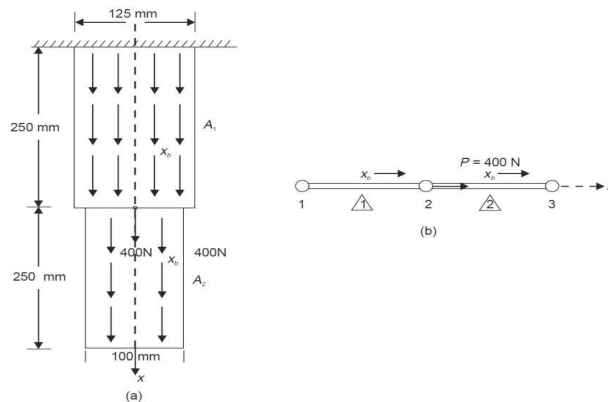


Figure 3

QUESTION THREE (20 MARKS)

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

All members have constant stiffness

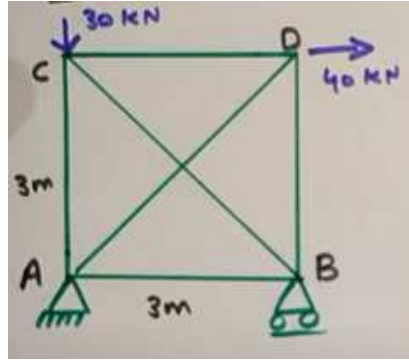


Figure 4

QUESTION FOUR (20 MARKS)

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

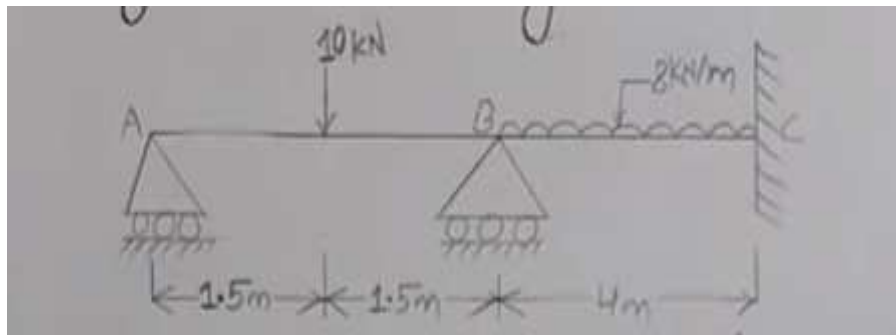


Figure 5

QUESTION FIVE (20 MARKS)

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

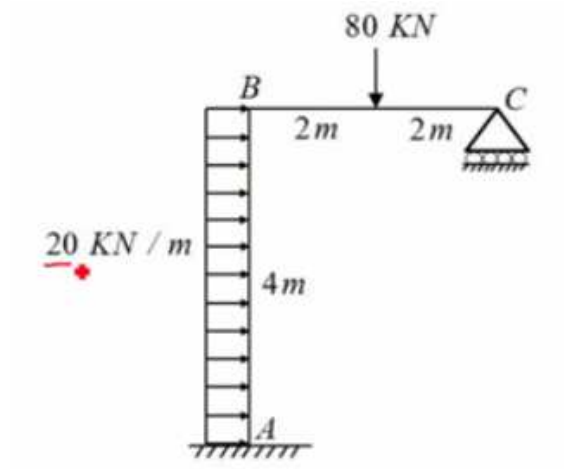


Figure 6