MACHAKOS UNIVERSITY

University Examinations for 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (CIVIL ENGINEERING)

ECV 312 THEORY OF STRUCTURES IV

DATE: **TIME:**

INSTRUCTIONS

Answer Question One and Any Other Two Questions

. You should have the following for this Examination,
Battery-powered calculator

. This paper consist of **Five Questions**
. Attempt Question **One** and **Any other Two.**

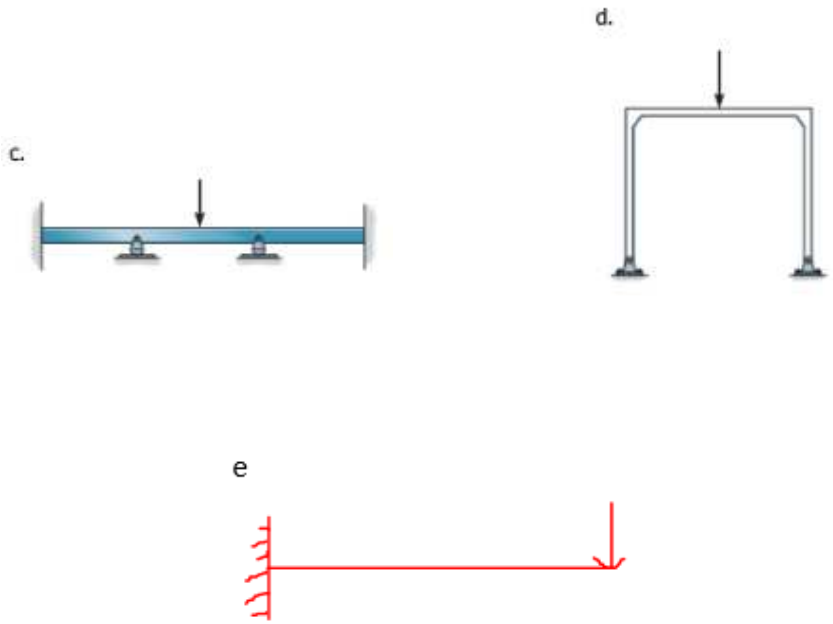
. Question **One** carries **30** Marks and is **COMPULSORY**.
The rest are **20 Marks** Each.

1. (i) Redraw the following structures in your answer booklet and sketch their respective deflected shapes (a-e)

(10 marks)

a.

b.



(ii) Using the flexibility method, find the reactions in Fig. 1. Draw the Shear force and bending moment diagrams.EI is constant. (20 marks)

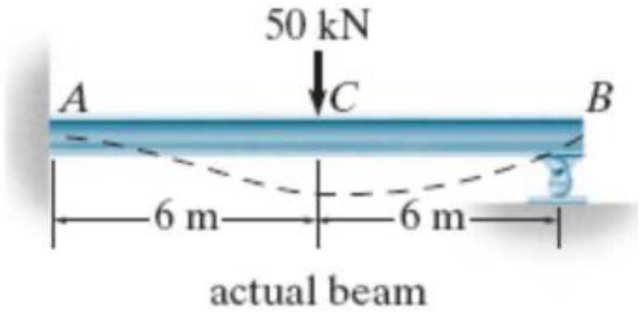


Fig. 1

2. In Fig 2., member AB is loaded with a point load of magnitude P and has stiffness EI_1. Member BC has a uniformly distributed load of magnitude ω and has stiffness EI_2. Transforming the stiffness matrix for member AB, demonstrate from first principles how the global member stiffness matrix can be assembled from local member matrices AB and BC. Derive an expression for the global stiffness matrix for the structure. (20 marks)

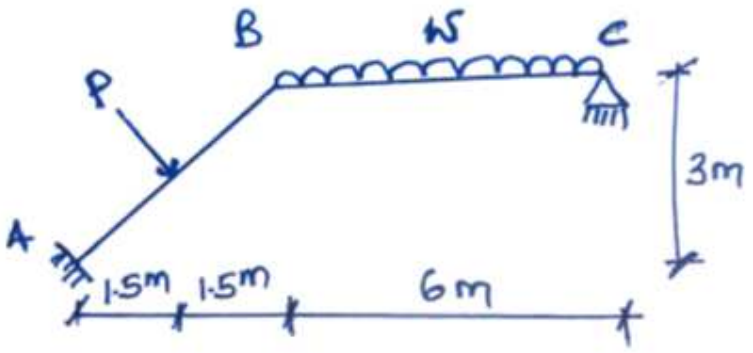


Fig. 2

3. Refer to Fig 2., if P=50 kN, $\omega = 30$ kN/m and E=200kN/mm^2. Member section AB=Member section BC= 40cm by 40 cm.

   (a). Assemble the global stiffness matrix (10 marks)

   (b). Solve the reactions for the structure, draw the shear force diagram and the bending moment diagrams for the structure. Also, sketch the deflected shape. (10 marks)

4. Use the stiffness matrix method to solve the beam reactions in Fig 3. Draw the shear force diagram, the bending moment diagrams and, sketch the deflected shape for the structure.

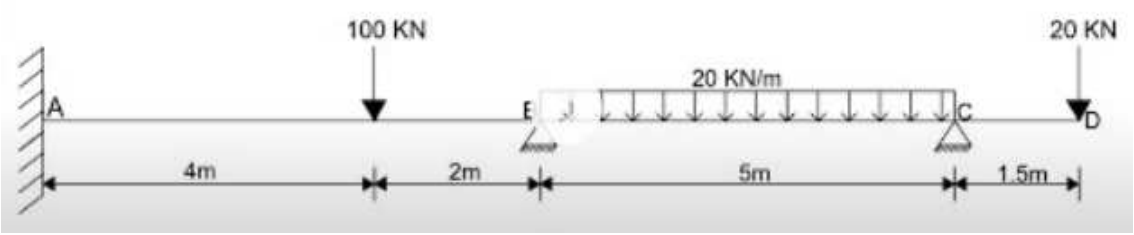


Fig. 3

5. Solve the member forces and the reactions for the truss shown in Fig. 4. Assume EA is constant for all members. The length of each member is 5m.. (20 marks)

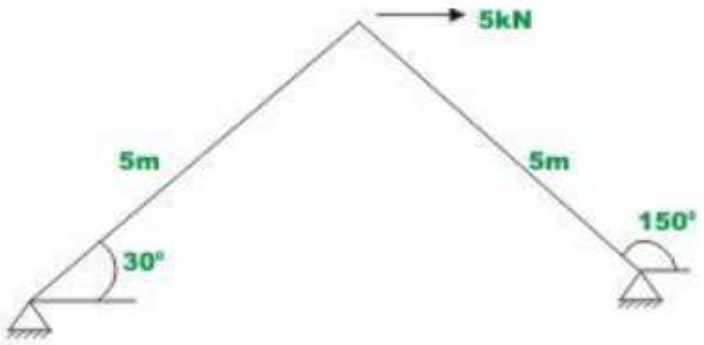
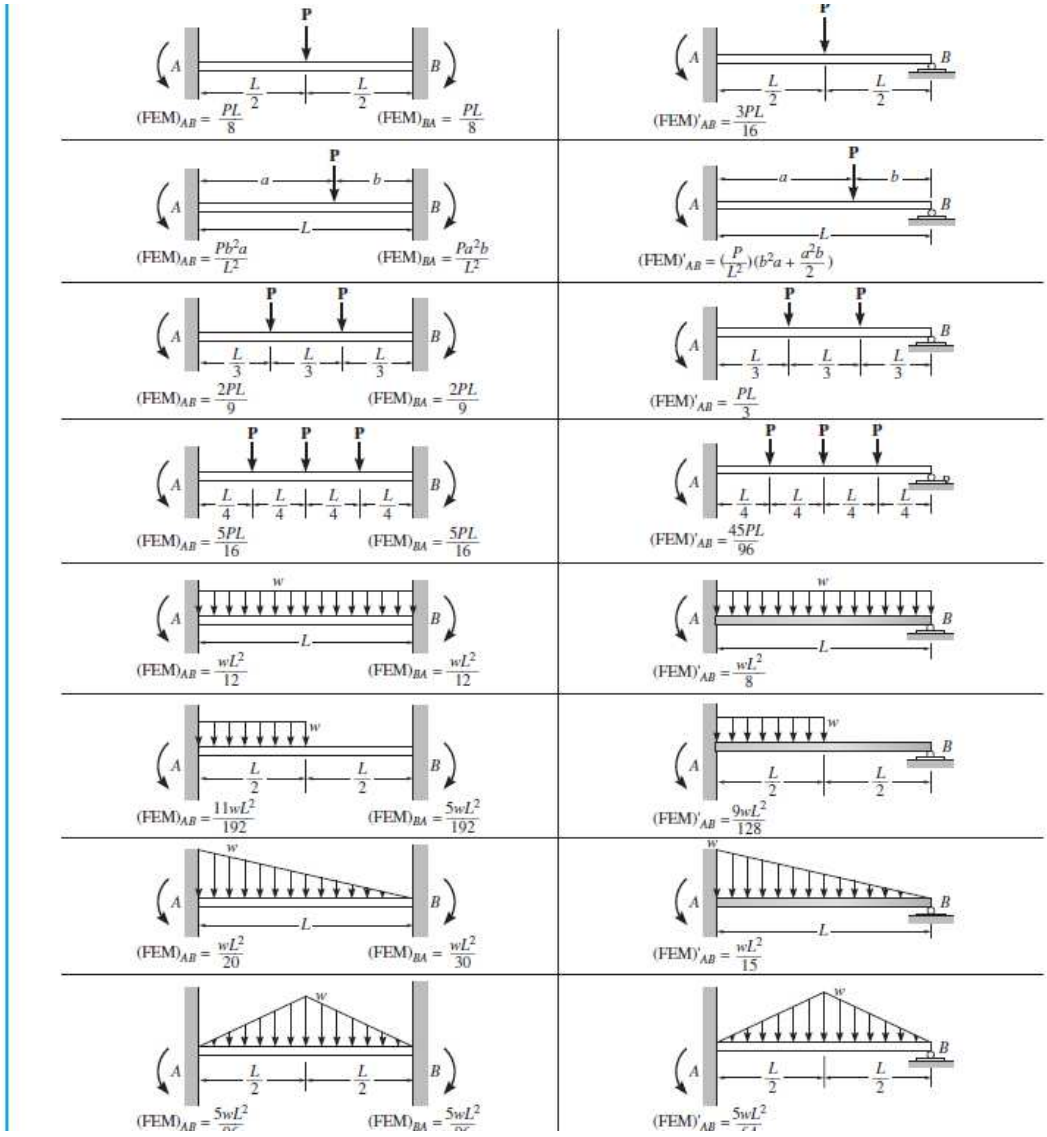

5kN
5m
5m
150°
30°

Fig. 4


P
A
B
L/2
L/2
(FEM)AB = PL/8
(FEM)BA = PL/8
(FEM)'AB = 3PL/16
a
b
L
(FEM)AB = Pb²a/L²
(FEM)BA = Pa²b/L²
(FEM)'AB = (P/L²)(b²a + a²b/2)
L/3
(FEM)AB = 2PL/9
(FEM)BA = 2PL/9
(FEM)'AB = PL/3
L/4
(FEM)AB = 5PL/16
(FEM)BA = 5PL/16
(FEM)'AB = 45PL/96
w
(FEM)AB = wL²/12
(FEM)BA = wL²/12
(FEM)'AB = wL²/8
(FEM)AB = 11wL²/192
(FEM)BA = 5wL²/192
(FEM)'AB = 9wL²/128
(FEM)AB = wL²/20
(FEM)BA = wL²/30
(FEM)'AB = wL²/15
(FEM)AB = 5wL²
(FEM)BA = 5wL²
(FEM)'AB = 5wL²