Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2023/2024

COURSE NAME	:	FINITE ELEMENT ANALYSIS
COURSE CODE	:	BFS 41003
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JANUARY / FEBRUARY 2024
DURATION	:	3 HOURS
INSTRUCTIONS	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ Closed book 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) The nodal coordinates of a Constant Strain Triangular (CST) element are shown in **Figure Q1.1**. Determine the shape functions for each node and verify their correctness.

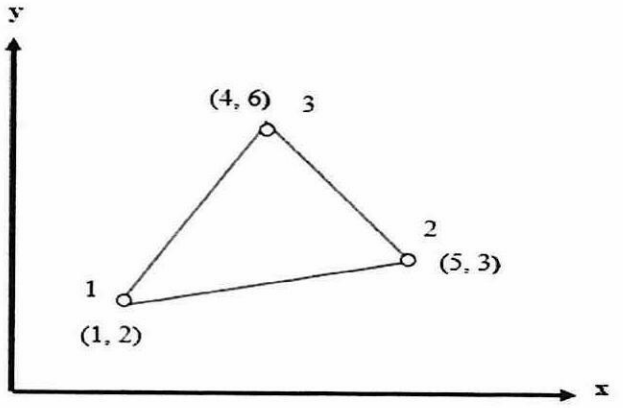

Figure Q1.1

(15 marks)

(b) For the 1-D isoparametric bar element with 5 nodes shown in **Figure Q1.2**, derive the shape functions using the 'zero method'.

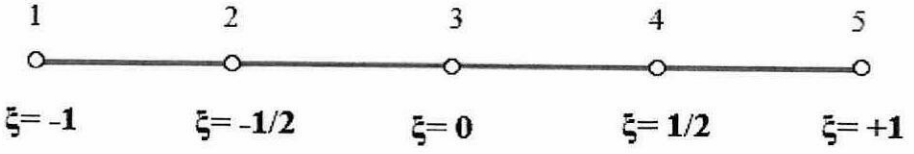

Figure Q1.2

(10 marks)

Q2 A tapered bar structure is shown in **Figure Q2.1**. Discretize it into 2 linear bar elements, follow major steps in finite element method and determine the following.

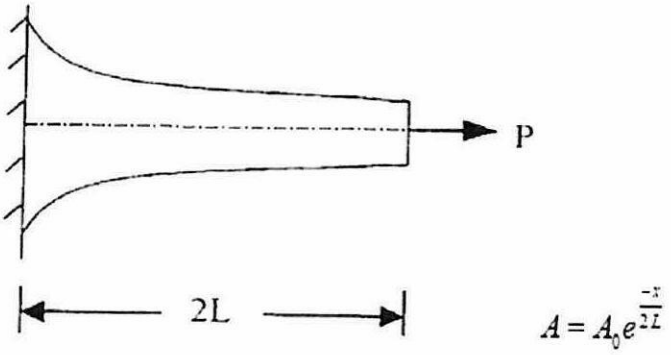

Figure Q2.1

(i) Construct the stiffness matrix.

(11 marks)

(ii) Nodal displacements.

(6 marks)

(iii) Strain and stress in both elements.

(8 marks)

Q3 (a) A triangular distributed load of 'w' is applied to an isoparametric element with 6 nodes, as shown in **Figure Q3.1**. Generate the load vector for the respective nodes.

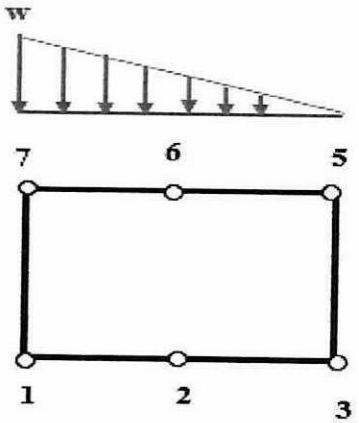

Figure Q3.1

(15 marks)

(b) Apply the Stress-Strain relations for the 3-D case and derive elasticity matrix [D].

(10 marks)

Q4 **Figure Q4.1** displays a truss structure comprising two members and three nodes, supported by two pinned connections. Every node has two degrees of freedom. Node 1 experiences a vertical load of 5 kN applied to it. AE is constant. Determine the following using the direct stiffness matrix method:

(i) Global stiffness matrix

(10 marks)

(ii) Displacements at joint 2 (D1 and D2)

(5 marks)

(iii) Reactions of supports.

(6 marks)

(iv) Internal force in both members.

(4 marks)

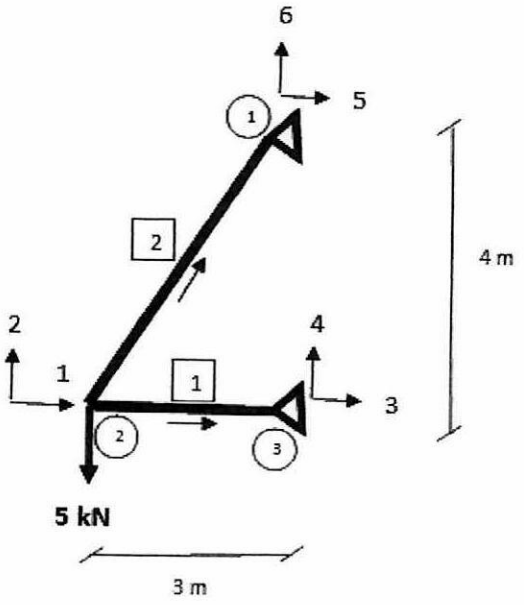

FIGURE Q4.1

- END OF QUESTIONS -