

Indian Maritime University
(A Central University, Govt. of India)
End Semester Examinations – June 2023
Programme Name: M.Tech (NAOE)
Semester: 2
Subject Code: PG11T2203
Subject Name: FINITE ELEMENT METHOD

Date: 02.06.2023

Max Marks: 60

Duration: 03 Hrs

Pass Marks: 30

General Instructions

- (i) All Sections (A, B & C) are to be attempted.
- (ii) Options, if any, are specified in respective sections.

SECTION-A (Answer all)

1. State True or False: Shape function has to be a linear function.

2. If the number of nodes in a system is 3 and each has a DOF of 2, then the size of the stiffness matrix will be.....

3. Which of the following is a weighted residue technique?
 - a) Galerkin technique
 - b) St. Venant's technique
 - c) Rayleigh-Ritz technique
 - d) Potential technique

4. The potential energy of a system consists of:
 - a) Stress Energy and Elastic Potential
 - b) Stress Energy and Work Potential
 - c) Strain Energy and Elastic Potential
 - d) Strain energy and Work Potential

5. Global stiffness K is a _____ matrix.
 - a) Identity matrix
 - b) Upper triangular matrix
 - c) Lower triangular matrix

d) Banded matrix

6. For a given nodal configuration, the half bandwidth number for optimum computation purposes should be.....

- a) Maximum
- b) Zero
- c) Minimum
- d) Does not make any difference

7. Which of the following is a possible load in structural analysis?

- a) Point load
- b) Surface force
- c) Body force
- d) All of the above

8. The determinant of a stiffness matrix is_____

9. In the term CST element, "CST" stands for _____

10. Which of the following is a 3 dimensional element?

- a) Bar
- b) Brick
- c) Beam
- d) Rod

SECTION-B (Answer any FIVE)

11. Discuss two methods to handle displacement boundary conditions. (8 marks)

12. Discuss quadratic shape function for a line element with suitable expressions and figures. (8 marks)

13. Using the stress invariants for a 3-D element, evaluate the principal stresses. (8 marks)

14. For the given triangular element below in Figure 1, assuming an isoparametric representation, find the displacement 'q' at the point P. (8 marks)

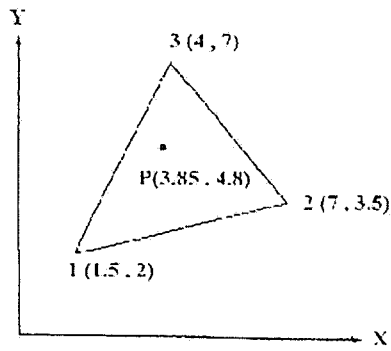


Figure 1.

15. Discuss the basic methodology involved in FEM. State the various properties of the stiffness matrix. (8 marks)
16. What are the non-linearities associated in finite element analysis? How are they handled? (8 marks)
17. For the arrangement given in Figure 2, using the Rayleigh-Ritz method, compute the equilibrium equations in matrix form. (8 marks)

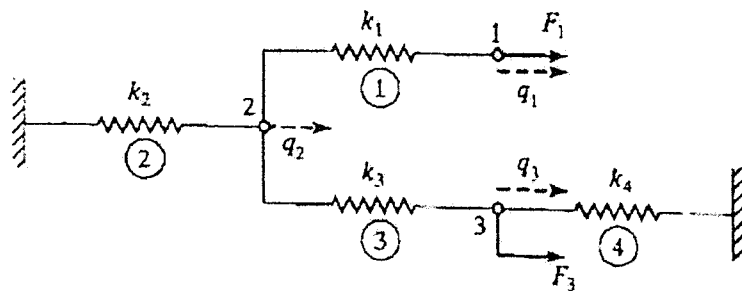


Figure 2

SECTION-C (Answer any ONE)

18. A particular member of a 2-D truss is inclined at an angle of 60° with respect to the positive x-axis. The material of the member is steel with $E=210$ GPa. The length of the member $L=2$ meters & crosssection of the member is circular with radius $R=2$ cm. Evaluate the stiffness matrix for the above member. (10 marks)

19. Using the Galerkin method, solve the following boundary value problem. (10 marks)

$$\frac{\square^2 \square}{\square \square^2} + \square = -1$$

Page 3 of 4

$$\frac{d^2 y}{dx^2} + y = -1$$

Given: $y(0) = 1$ & $y(1) = 1$. Find $y(0.5)$

20. Discuss different procedures for eigenvalue-eigenvector evaluation in context on dynamic analysis in FEM. (10 marks)