



**M.E DEGREE EXAMINATIONS: MAY 2018**

(Regulation 2015)

Second Semester

**STRUCTURAL ENGINEERING**

P15SET201:Finite Element Analysis

**COURSE OUTCOMES**

**CO1: Explain Various aspects of finite element method for Structural Analysis**

**CO2: Formulate shape functions for various elements**

**CO3: Apply finite element method for structural analysis**

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. Assertion (A):Ritz method solving complex structural problems. CO1 [K<sub>2</sub>]  
Reason (R) :Not suitable functions for Ritz method.
  - a) Both A and R are Individually true and R is the correct explanation of A
  - b) Both A and R are Individually true but R is not the correct explanation of A
  - c) A is true but R is false
  - d) A is false but R is true
2. The combining all the element together is called CO1 [K<sub>1</sub>]
  - a) Aspect ratio
  - b) Ritz method
  - c) Assemblage
  - d) Discretization
3. Stiffness matrix equation for an axi-symmetric triangular element CO2 [K<sub>1</sub>]
  - a)  $2\pi A(B)^T D(B)$
  - b)  $2\pi r A(B)^T D(B)$
  - c)  $\pi A(B)^T D(B)$
  - d)  $2\pi A(B)^T D(B)$
4. Matching type item with multiple choice code CO2 [K<sub>2</sub>]

List I	List II
A.CST Nodes	i. Six
B.LST Nodes	ii. Twelve
C.QST Nodes	iii. Three
D. Degree of freedom	iv. Ten

	A	B	C	D
a)	iii	i	iv	ii
b)	iii	iv	ii	i
c)	ii	iv	iii	i
d)	iii	i	ii	iv

5. Assertion (A): It is easy to formulate and computerize the finite element equation. CO2 [K<sub>3</sub>]

Reason (R): polynomials are generally used as shape function.

- |   |   |
|---|---|
| a) Both A and R are Individually true and R is the correct explanation of A | b) Both A and R are Individually true but R is not the correct explanation of A |
| c) A is true but R is false   | d) A is false but R is true   |

6. How many methods are generally associated to FEA. CO3 [K<sub>1</sub>]

- |      |      |
|------|------|
| a) 3 | b) 4 |
| c) 1 | d) 2 |

7. Pick out the true statement. CO3 [K<sub>2</sub>]

1. It is easy to formulate and computerize
2. It no perform the differentiation
3. Integration to the better to element
4. The accuracy of the result can be improved

- |        |        |
|--------|--------|
| a) 1,3 | b) 2,3 |
| c) 1,4 | d) 4,2 |

8. The sum of the element in any column must equal to CO2 [K<sub>1</sub>]

- |      |      |
|------|------|
| a) 1 | b) 2 |
| c) 3 | d) 0 |

9. Ten noded triangular element is CO2 [K<sub>1</sub>]

- |        |        |
|--------|--------|
| a) QST | b) CST |
| c) LST | d) FEA |

10. The step for sequence of the function CO3 [K<sub>2</sub>]

1. The self-weight of the member are neglected.
2. All the member are pin jointed
3. The assumption of truss element
4. The truss is loaded only at the joint

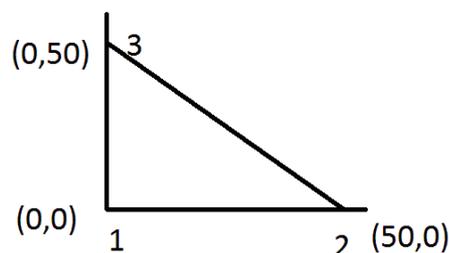
- |            |            |
|------------|------------|
| a) 3-2-4-1 | b) 4-3-2-1 |
| c) 1-2-4-3 | d) 3-2-4-1 |

**PART B (10 x 2 = 20 Marks)**

11. Write the potential energy for beam of span 'L' simply supported at ends subjected to a concentrated 'P' at mid span. Assume EI constant. CO1 [K<sub>2</sub>]
12. List the methods associated with the finite element analysis. CO1 [K<sub>2</sub>]
13. Clarify the purposes of isoperimetric element. CO2 [K<sub>2</sub>]
14. Define the Lagrange interpolation polynomials used for higher order elements. CO2 [K<sub>1</sub>]
15. What is mean by discretization? CO2 [K<sub>1</sub>]
16. What are serendipity elements? CO2 [K<sub>1</sub>]
17. State the assumption made in the case of truss element. CO3 [K<sub>1</sub>]
18. Discuss about HRZ lumping scheme. CO3 [K<sub>2</sub>]
19. Write down the element level heat transistor equation for bar element with heat conduction. CO3 [K<sub>2</sub>]
20. Define dynamic Condensation. CO3 [K<sub>1</sub>]

**PART C (6 x 5 = 30 Marks)**

21. Write short notes on Galerkin's method. CO1 [K<sub>2</sub>]
22. Solve the following differential equation using Ritz method. CO1 [K<sub>3</sub>]  
 $d^2y/dx^2 = -\sin(\pi x)$ , boundary Condition  $u(0)=0$  and  $u(1)=0$
23. Discuss the convergence requirement of interpolation polynomials. CO2 [K<sub>2</sub>]
24. Explain how the consistent mass matrix for a pinpointed bar element is obtained. CO2 [K<sub>2</sub>]
25. Determine the stiffness for the axis symmetric element shown in figure. Take CO3 [K<sub>3</sub>]  
 $E=2.1 \times 10^5 \text{N/mm}^2$ , Poisson's ratio=0.3



26. Explain the isoparametric element and its type. CO3 [K<sub>2</sub>]

**Answer any FOUR Questions**  
**PART D (4 x 10 = 40 Marks)**

27. A simply supported beam is subjected to UDL over entire span .Determine the bending moment and deflection at the mid span using Rayleigh's-Ritz method and compare with exact solution. Use a two term trial function

CO1 [K<sub>3</sub>]

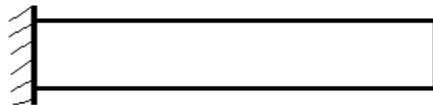
$$Y = a_1 \sin(\pi x/L) + a_2 \sin(3\pi x/L)$$

28. Derive the element strain displacement matrix of a triangle element.

CO2 [K<sub>3</sub>]

29. Consider a uniform cross section bar shown in figure. Length L made up of material whose young's modulus and density is given by E&P. Estimate the natural frequency of axial vibration of the bar using both consistent and lumped mass matrices.

CO2 [K<sub>3</sub>]



30. Determine the buckling load of a square uniform plane dividing it into a mesh 3x3 size. The plane is simply supported and advantage may be taken of symmetry of the mode of buckling.

CO3 [K<sub>3</sub>]

31. Explain plane stress situation, plane strain situation axisymmetric situation.

CO3 [K<sub>2</sub>]

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