

B.E. DEGREE EXAMINATIONS: APRIL/MAY 2012

Sixth Semester

MECHANICAL ENGINEERING

MEC119: Finite Element Analysis

Time: Three Hours

Maximum Marks: 100

Answer All Questions:-

PART A (10 x 1 = 10 Marks)

1. Mention the variational method for the following method.
 - a. Point collocation method
 - b. Sub domain collocation method.
 - c. Rayleigh –Ritz method
 - d. Leas square method
2. How do you calculate the total potentials energy of an elastic body?
 - a. Strain energy- work done due to external forces
 - b. Strain energy- work done due to internal forces
 - c. work done due to internal forces - Strain energy
 - d. work done due to external forces - Strain energy
3. Mention the properties of stiffness for the following properties.
 - a. Diagonal values are positive
 - b. Diagonal values are negative
 - c. Diagonal values are negative and negative
 - d. Sum of column is not zero
4. Mention the heat conduction equation for 1D bar element
 - a. KA/L
 - b. EA/L
 - c. EI/L³
 - d. EA/L³
5. The displacement shapes should not change in local coordinates system. This properties is known as
 - a. Geometric anisotropy
 - b. Geometric isotropy
 - c. Geometric orthotropic
 - d. Geometric variance
6. How many nodes in CST and LST elements.
 - a. 3 & 8
 - b. 4 & 6
 - c. 3 & 6
 - d. 3 & 3
7. How do you calculate the stiffness matrix for axisymmetric triangular element?
 - a. $\int_v [B]^T [D][B]$
 - b. $\int_v 2\pi r [B]^T [D][B]$
 - c. $2\pi r A [B]^T [D][B]$
 - d. $t A [B]^T [D][B]$
8. Identify the circumferential strain for the following.
 - a. u/r
 - b. u/z
 - c. w/z
 - d. r/u

9. In shape function the field variables and geometers transformation are in equal
- Subparametric elements
 - Superparametric elements
 - Isoparametric elements
 - Parametric elements
10. A transformation is used to converts Cartesian coordinates into local coordinates
- [D] matrix
 - [B] matrix
 - [J] matrix
 - [K] matrix

PART B (10 x 2 = 20 Marks)

- What is the limitation of Ritz method?
- Why the variational formulation is also referred as “Weak Formulation”?
- What are the properties of the stiffness Matrix?
- What is the stationary property of potential energy?
- Write the displacement functions for bar and beam elements.
- A burner is heating a spot on two dimensional body. How do you attempt to model this..
- Define axisymmetric element.
- Write the analogies between structural, heat transfer and fluid mechanics.
- Differentiate between sub parametric, isoperimetric and super parametric elements.
- What is a Jacobian Matrix of transformation in two-dimensional iso-parametric element formulation?

PART C (5 x14 =70 Marks)

21. a) A beam of ABC of length 100 mm is fixed at its ends A and C and is subjected to load of 50 kN at the midpoint. The span AB has $I=25 \times 10^6 \text{ mm}^4$ and the span BC has $2I$. Given $E=200 \text{ GPa}$, compute the displacement and slope at the point of application of load, Span $AB=BC=5000 \text{ mm}$.

(OR)

- b) (i) Distinguish and differentiate between variational method and weighted residuals.(10)
(ii) Explain the basic concept of FEM. (4)
22. a) A bar of length 100 mm with rectangular section of width 30 mm and depth 20mm is experiencing a temperature of 90° at its left end. Assuming convection over the length of the bar, obtain the temperature distribution along the length. Use two 1-D elements with nodes at its ends and the following data: $K=0.5 \text{ W/mm}^\circ\text{C}$, $h=20 \text{ W/mm}^2\text{-}^\circ\text{C}$, $T_\infty=25^\circ\text{C}$

(OR)

- b) Derive the quadratic shape functions for a one dimensional quadratic element. Also discuss their characteristics.

23. a) Derive the finite element equation for two dimensional heat transfer element

(OR)

- b) Use Galerkins method of weighted residuals to obtain an approximate solution of the differential equation $(d^2y/dx^2)-10x^2=5$, $0 \leq x \leq 1$. With boundary conditions $y(0) = y(1)=0$.

24. a) Evaluate the [B] for a axisymmetric rectangular element, expressing the shape functions relative to the origin of the global coordinate system.

(OR)

- b) Compute the finite element stiffness matrixes for axisymmetric triangular element of coordinates are (0,0), (50,0) and (50,50). Take 200 GN/m² and $\mu=0.3$ at unit thickness.

25. a) Derive the shape functions of a second order eight noded quadrilateral element.

(OR)

- b) (i) Numerically integrate the functions $f(x) = x^4 + x^3$ between the limits -1 and +1. (7)
- (ii) What are serendipity elements? For a four nodes serendipity element evaluate the shape functions (7)
