Reg. No. : | | | | | | | | | | |

Question Paper Code: 47702

B.E. / B.Tech. DEGREE EXAMINATION, APRIL 2019

Seventh Semester

Mechanical Engineering

14UME702 - FINITE ELEMENT ANALYSIS

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. Primary variable in FEM structural analysis is

   (a) Displacement (b) Force (c) Stress (d) Strain

2. The accuracy of FEM results can be improved by_____ the order of the polynomial

   (a) Decreasing (b) Increasing (c) keeping constant (d) None

3. When the aspect ratio increases, the accuracy of the solution

   (a) Increases (b) Decreases

   (c) Neither increases nor decreases (d) None

4. The derivative of sum of the shape functions within the element is equal to __

   (a) 0 (b) -1 (c) 1 (d) more than one

5. When there are less geometric nodes than shape function nodes then the element is called

   (a) Sub parametric (b) Super parametric (c) Iso parametric (d) None

6. When thin plate is subjected to loading in its own plane only, the condition is called

(a) Plane stress (b) Plane strain (c) Axi-symmetric (d) General

7. All the calculations are made at limited number of points known as

(a) Elements (b) Nodes (c) Discretization (d) Mesh

8. Sum of shape functions is

(a) +1 (b) -1 (c) 0 (d) Infinity

9. The boundary condition which in terms of the field variables is known as

(a) Primary (b) Secondary (c) Natural (d) Essential

10. Thermal conductivity Kx=Ky=Kz in case of

(a) Isotropic material (b) Orthotropic material

(c) Anisotropic material (d) Homogenous material

PART - B (5 x 2 = 10 Marks)

11. State the properties of stiffness matrix.

12. Mention the basic steps of Rayleigh Ritz method.

13. List four applications where axisymmetric elements can be used.

14. Explain the term Eigen value Problem

15. List the applications of FEM in thermal and fluid region

PART - C (5 x 16 = 80 Marks)

16. (a) Solve the governing equation $\frac{d^2u}{dx^2} + 1 = 0 \; 0 \le x \le 1$. By using the Galerkin method with the trail function $u(x) = \sum^{2} J = 1 N^{j}(x) \dot{u} J$, where $N^j = x^J$. The boundary conditions are given u(0) = 0 and du/dx(1) = 20. (16)

Or

(b) A bar of length L and uniform cross section of A is clamped at one end and left the other end and it is subjected to a uniform axial load of P at the free end. Calculate the displacement and stress in the bar using two terms of polynominal. (16)

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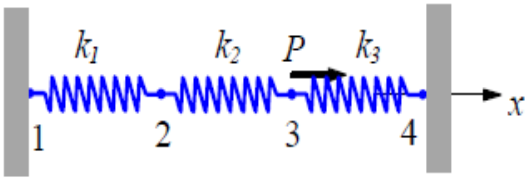
17. (a) For the spring system shown above, k_1 = 100 N/mm, k_2 =200N/mm, k_3 = 100 N/mm P = 500 N, u_1=u_4=0. Find (a) the global stiffness matrix, (b) displacement of nodes 2 and 3, (c) the reaction forces at nodes 1 and 4 and d) the force in the spring 2.



(16)

Or

(b) A concentrated load P=50KN is applied at the center of a fixed beam of length 3m,depth 200mm and width 120mm. Calculate the deflection and slope at the midpoint. Assume E=200GPa. (16)

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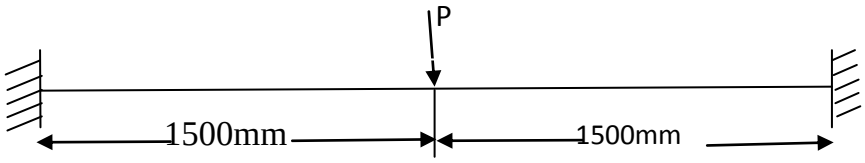

18. (a) A four noded rectangular element of length 2mm and height 1mm determine
(i) Jacobian matrix
(ii) Strain-displacement matrix
(iii) Element stresses. Taking E=200GPa, Poisson's ratio=0.25, Nodal displacements as (0, 0, 0.003, 0.004, 0.006, 0.004, 0, 0) with local coordinates of (0, 0). (16)

Or

(b) (i) Explain the step by step procedure involved in the FEM of structural analysis (8)

(ii) Evaluate the integral e^{-x} dx by applying 3 point Gaussian approach with limit of -1 to +1. (8)

19. (a) Using Newton's law of motion, derive the natural frequency equation for the single DOF system. (16)

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Or

(b) A simply supported beam of both end hinged supported has length of 1m and cross sectional area of $30cm^2$.Determine the natural frequency by taking two elements with lumped mass condition. Take $E=2X10^{11}N/mm^2$ and density as $7800kg/m^3$ (16)

20. (a) A steel rod of diameter 2cm, length of 5cm and thermal conductivity of 50W/m°C is exposed at one end to a constant temperature of 320°C.The other end is in ambient air of temperature 20°C with a convective coefficient of $100W/m^2°C$.Determine the temperature at the midpoint of the rod. (16)

Or

(b) The motion of fluid particles in aduct are given by

$$^{t}x1 = -5 + \sqrt{(25 + 10^{0}x_{1} + (0x_{1})^{2} + 4t)}$$

Calculate the velocities and accelerations of the particles. Express your results in the Legrangians form $^{t}\dot{u}_1 = f_1\ (^{0}x_1, t), ^{t}\ddot{u}_1 = f_2(^{0}x^1, t)$. (16)