Code: 15A03604

R15

B.Tech III Year II Semester (R15) Regular Examinations May/June 2018

FINITE ELEMENT METHOD

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) What is the difference between the residual method and weighted residual method?
(b) State the principle of minimum potential energy.
(c) Give the properties of stiffness matrix in FEM.
(d) Suggest one example involving multipoint constraints.
(e) Define cubic element in FEM.
(f) Sketch tetrahedral element.
(g) When do you adopt 2D formulation in FEM?
(h) Compare the axi-symmetric triangular element with 2D triangular element.
(i) Specify various boundary conditions imposed on one dimensional fin element.
(j) List the approaches followed to derive finite element formulation of two dimensional fluid flow.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 An axial bar of length L and uniform cross section A is fixed at one end and free at the other end. It is subjected to a uniformly distributed load of intensity q over the entire length. Making use of Galerkin's method, solve for axial displacement and stress developed. Take young's modulus as E.

OR

3 With the help of principle of minimum potential energy, derive stiffness matrix and load vector for a tapered axial bar element subjected to a uniform distributed axial load. Use appropriate symbols.

UNIT – II

4 Compute the transformation matrix and stiffness matrix for truss element whose cross section is 1 cm^2 young's modulus 210 GPa and coordinates are (1, 2) and (4, 4) cm. If the axial nodal loads are 1 kN and 1.5 kN, find the load vector and nodal displacement vector.

OR

5 Determine the displacement at the midpoint of a fixed beam of length 1 m with uniformly distributed load of 6 kN/m through the span. Use two beam elements. Take E = 200 GPa and EI = 2 X 10^4 $N.m^2$.

UNIT – III

6 Consider a nine node quadrilateral element in natural square coordinate system. Develop expressions for shape functions and transformation relation between CCS and NCS.

OR

7 Sketch an iso-parametric hexahedral element and derive its shape functions in natural coordinate system.

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UNIT – IV

8 The coordinates of triangular element are 1(4.3), 2(8, 6) and 3(6, 9) cm. Its load vector is $[-2, 3, 1, -4, 5, 3]^T$ kN , modulus of elasticity is 200 GPa and Poisson's ratio is 0.25. Compute nodal displacement vector and stress vector.

OR

9 Develop strain displacement relations in case of axi-symmetrical elastic body in $r - \theta$ coordinate system.

UNIT – V

10 Compute the nodal temperatures across the thickness of a slab of thickness 15 cm and thermal conductivity 1.5 Watt/cm-℃. The temperature on left surface is 150°C and right surface is exposed to air flow with h = 10 W/m^2-℃ and temperature 45°C. Assume the slab has square cross section area as $10^4 cm^2$. Discretize the slab in to two linear elements.

OR

11 Write down the governing partial differential equation for a two dimensional potential flow and evaluate element matrices with the help of triangular element. Use usual notations.

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