Code: 15A03604 **R15**

B.Tech III Year II Semester (R15) Supplementary Examinations December/January 2018/19

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 plane stress and plane strain models?
(b) State the stress equilibrium equations in elastic body subjected to body forces only.
(c) Give the importance of penalty approach for incorporation of boundary conditions in FEM.
(d) Suggest the type of interpolation function for the formulation of stiffness matrix of a beam element.
(e) Define convergence in FEM.
(f) Where do you use higher order isoparametric elements?
(g) Why lumped load vector gives less accurate solution than the consistent load vector?
(h) Sketch the Axi-symmetric triangular element.
(i) Specify maximum number of degrees of freedom two dimensional fin element.
(j) Name the approaches followed to derive finite element formulation of two dimensional fluid flows.

PART – B

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

UNIT – I

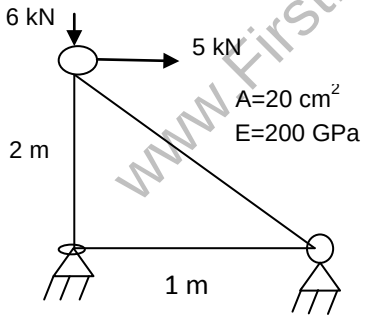
2 An axial bar of length L and uniform cross section A is fixed at one end and free at the other end. It is subjected to a uniformly distributed load of intensity q over the entire length. Making use of Rayleigh Ritz method, solve for axial displacement and stress developed. Take young's modulus as E.

OR

3 The displacement field in a 2D elastic plate is given by $u=x^2+xy+y^3$ and $v=2x^2y+xy$. Take Young's modulus is 210 GPa and Poisson ratio is 0.25. Find stress field at a point (1,1)

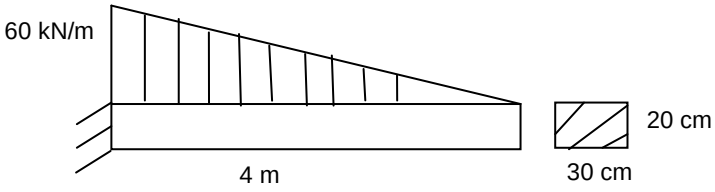
UNIT – II

4 Compute the stresses developed in the members of the truss shown below.



OR

5 Determine the displacement at the free end of cantilever beam shown below: Use single beam element. A linearly varying vertical down load is acting on the beam. E = 200 GPa.



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UNIT – III

6 Consider a quadrilateral element in the XY coordinate system with four nodes located at the corners and sketch it in natural square coordinate system. Develop transformation relation between these coordinate systems.

OR

7 A tetrahedron element has coordinated 1(4, 8, 5), 2(2, 4, 5), 3(5, 4, 8) and 4(8, 4, 5). Compute strain displacement matrix [B].

UNIT – IV

8 The coordinates of triangular element are 1(4, 3), 2(8, 6) and 3(6, 9) cm. Its nodal displacement vector: $[-0.002, 0.003, 0.001, -0.004, 0.005, 0.003]^T$. Modulus of elasticity is 200 GPa and Poisson ratio is 0.25. Compute normal and shear stresses developed.

OR

9 Evaluate the following integral with Gauss quadrature with n = 2.

$$\int_2^3 \frac{1}{x} \log x \, dx$$

UNIT – V

10 Compute the temperature distribution across the thickness of a slab of thickness 15cm and thermal conductivity 1.5 Watt/cm-℃. The temperature on left and right surfaces are 150℃. Assume the slab has cross section area as 10^4 cm^2. The internal heat generation inside the slab is 1.5 Watt/cm^3. Discretize the slab into three linear elements.

OR

11 Evaluate convective matrix and thermal load vector for triangular thin plate element when it is exposed to a fluid of temperature T_0 = 20°C. Take convective heat transfer coefficient: h = 10 Watt/cm^2-°C. The coordinates of the triangle is (0, 0), (2, 0) and (0, 3).

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