CBCS SCHEME

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15AE651

Sixth Semester B.E. Degree Examination, July/August 2021
Finite Element Method

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions.***

1 a. Derive equilibrium equations for the 3D state of stress in rectangular coordinate system. **(10 Marks)**

b. Explain plane stress and plane strain with stress-strain relationship and give examples for each. **(06 Marks)**

2 a. Sketch the different types of elements used in finite element analysis. **(06 Marks)**

b. Using the Galerikin's method, determine the expression for the displacement of a cantilever beam shown in Fig Q2(b).

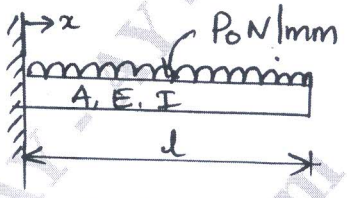

Fig Q2(b) **(10 Marks)**

3 a. Derive shape functions for 1D bar element is NCS. **(08 Marks)**

b. Consider the three bar truss shown in Fig Q3(b). Determine the nodal displacement and stresses is each member. Find the support reactions also. Take $A_1 = 1500mm^2$; $A_2 = A_3 = 2000mm^2$ and E = 200GPa.

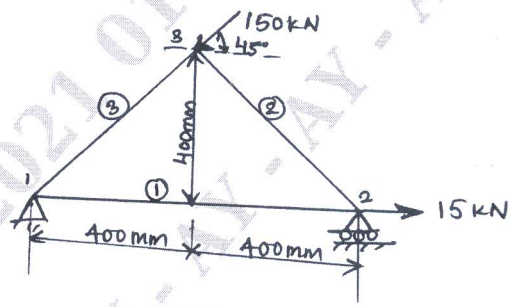

Fig Q3(b) **(08 Marks)**

4 Fig Q4 show a simply supported beam subjected to a uniformly distributed load. Obtain the maximum deflection. Take E = 200GPa and moment of Inertia $I = 2 \times 10^6 mm^4$.

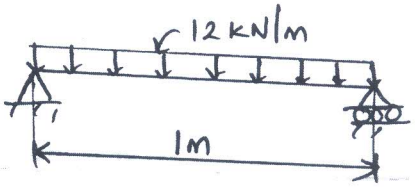

Fig Q4 **(16 Marks)**

5 a. Derive shape function for nine node rectangular element in Natural coordinate system. **(10 Marks)**

b. Determine the Cartesian coordinate of the point p($\xi = 0.8, \eta = 0.9$) as shown in Fig Q5(b).

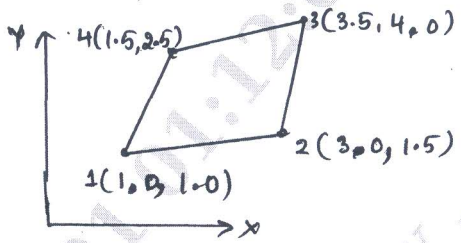

Fig Q5(b) **(06 Marks)**

6 a. Derive shape functions for a tetrahedral element in Natural coordinate system. **(08 Marks)**

b. Derive shape functions for a hexahedral element in natural coordinate system. **(08 Marks)**

7 Briefly explain the following :

i) I_{so}, sub and super parametric elements

ii) Structure of computer program for FEM analysis

iii) Finite element softwares. **(16 Marks)**

8 a. What is axisymmetric element? Where do you use? **(04 Marks)**

b. Formulate strain displacement matrix for an axisymmetric linear triangular element. **(12 Marks)**

9 a. Derive the shape functions for 1D heat conduction element is global coordinate system. **(08 Marks)**

b. Determine the temperature distribution in one dimensional fin shown in Fig Q9(b).

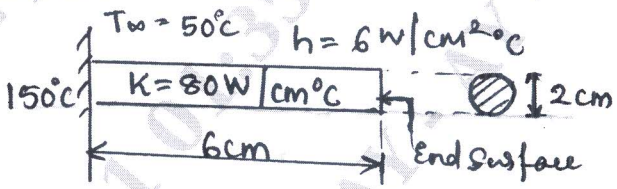

Fig Q9(b) **(08 Marks)**

10 a. Derive element conductivity matrix for 1D heat conduction. **(05 Marks)**

b. Briefly explain Hamilton's principle. **(03 Marks)**

c. Determine the temperature distribution and heat transfer through an iron fin of thickness 5mm, length 50mm and width 1000mm. The heat transfer coefficient around the fin is $10 W/m^2K$ and ambient temperature is 28°C. The base of the fin is at 108°C. Take K = 50W/mK. Use two elements. **(08 Marks)**

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