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10ME64

Sixth Semester B.E. Degree Examination, July/August 2022
Finite Element Methods

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART – A

1 a. Define finite element method. Enlist any five merits and three limitation of FEM. **(10 Marks)**

b. Explain plane stress and plane strain problem. **(06 Marks)**

c. What is the effect of size and number of elements on the solution by FEM? **(04 Marks)**

2 a. State : i) Principle of virtual works ii) Principle of minimum potential energy. **(06 Marks)**

b. For a bar shown in Fig Q2(b) determine the displacement variation and the stress variation. Also find the displacement at the loading point using Raleigh – Ritz method.

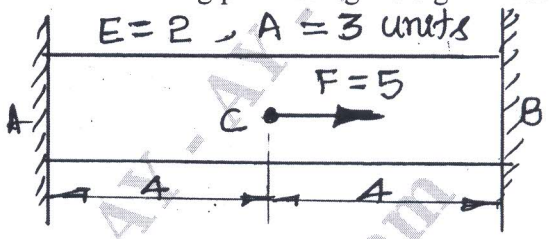

Fig Q2(b) **(14 Marks)**

3 a. Derive the shape function for two noded bar element using natural co-ordinate system. **(06 Marks)**

b. Sketch and explain simplex, complex and multiplex elements used in FEA. **(05 Marks)**

c. Derive Jacobian matrix for CST element and hence determine Jacobian of CST element shown in Fig Q3(c).

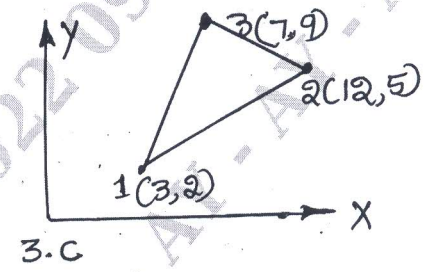

Fig Q3(c) **(09 Marks)**

4 A steel rod subjected to compression is modded by two bar elements as shown in Fig Q4. Determine the displacement field, stresses and support reactions in the bar using both elimination and penalty approach boundary conditions.

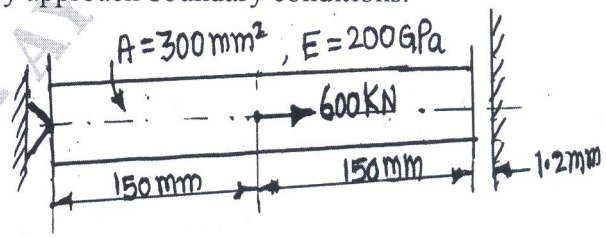

Fig Q4 **(20 Marks)**

PART – B

5 a. Derive the shape function of 2-D quadrilateral element and plot the same. **(10 Marks)**

b. Discuss isoparametric, subparametric and super parametric elements with neat sketches. **(06 Marks)**

c. Evaluate the following integral using two point Gaussian quadratic formula.

$\int_{-1}^{+1}\int_{-1}^{+1} r^2 s^2 dr.ds$. **(04 Marks)**

6 a. Derive stiffness matrix of a truss element. **(08 Marks)**

b. For the two bar truss shown in Fig Q6(b), determine nodal displacement and stress in element 1. Take E = 200Gpa, A= 200mm^2.

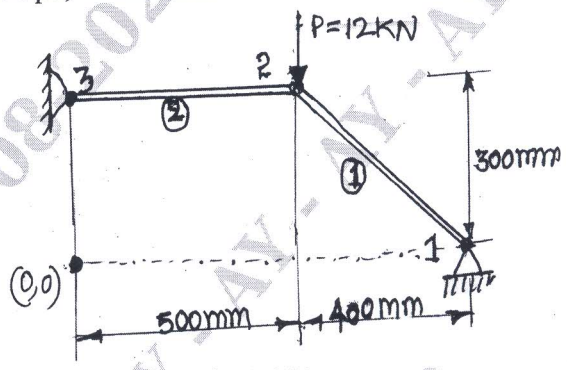

Fig Q6(b) **(12 Marks)**

7 a. Derive Hermite shape functions for the beam element. **(10 Marks)**

b. Determine the maximum deflection in the uniform cross section of cantilever beam as shown in Fig Q7(b). Take = 200Gpa and I = 10^9mm^4.

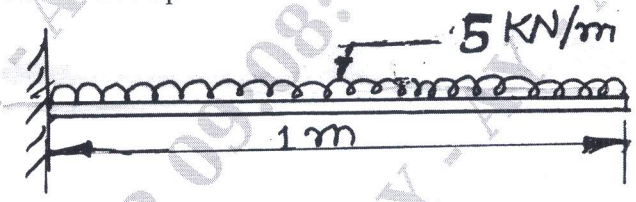

Fig Q7(b)

Assuming the beam as a single element. **(10 Marks)**

8 a. Consider a brickwall of thickness L = 30cm, K = 0.7W/m°C. The inner surface is at 28°C and the outer surface is exposed to cold air at -15°C. The heat transfer coefficient associated with outer side surface is h = 40W/m^2°C. Determine the steady state temperature distribution within the wall and also the heat flux through wall. Use two element models.

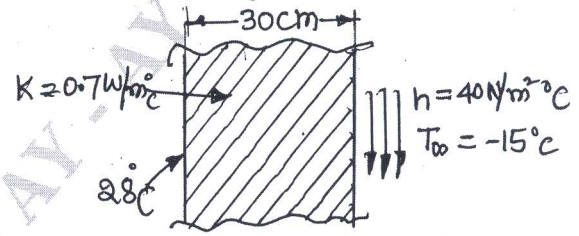

Fig Q8(a) **(14 Marks)**

b. Discuss the types of boundary conditions in heat transfer problems through thin fins. **(06 Marks)**

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