USN

06ME63

Sixth Semester B.E. Degree Examination, December 2010
Modeling and Finite Element Analysis

Time: 3 hrs. Max. Marks:100

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Explain, with a sketch, plain stress and plain strain for two dimensions. **(06 Marks)**

b. State the principles of minimum potential energy. Explain the potential energy, with usual notations. **(06 Marks)**

c. What are the steps involved in Rayleigh-Ritz method? Determine the displacement at mid point and stress in linear one-dimensional rod as shown in Fig.1(c). Use second degree polynomial approximation, for the displacement. **(08 Marks)**

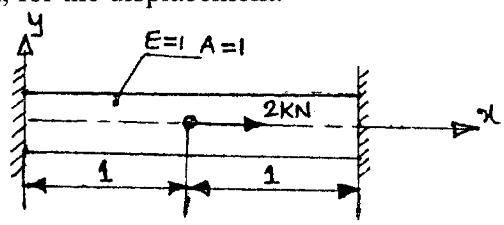


Fig.1(c).

2 a. Bring out the four differences in continuum method with finite element method. **(04 Marks)**

b. What do you understand FEM? Briefly explain the steps involved in FEM, with example. **(10 Marks)**

c. Write properties of stiffness matrix K. Show the general node numbering and its effect on the half bandwidth. **(06 Marks)**

3 a. What is an interpolation function? **(02 Marks)**

b. What are convergence requirements? Discuss three conditions of convergence requirements. **(08 Marks)**

c. Write a shot notes on :

i) Geometrical isotropy for 2D Pascal triangle

ii) Shape function for constant strain triangular (CST) element, with a sketch. **(10 Marks)**

4 a. Derive the shape functions for the one-dimensional bar element, in natural co-ordinates. **(08 Marks)**

b. Derive the shape functions for a four-node quadrilateral element, in natural co-ordinates. **(08 Marks)**

c. Write four properties of shape functions. **(04 Marks)**

PART – B

5 a. Derive the following :

i) Element stiffness matrix (K^e).

ii) Element load vector (f^e)

by direct method for one-dimensional bar element. **(12 Marks)**

b. Derive inverse of the Jocabian transformation matrix (J^{-1}) for constant strain triangle (CST). **(08 Marks)**

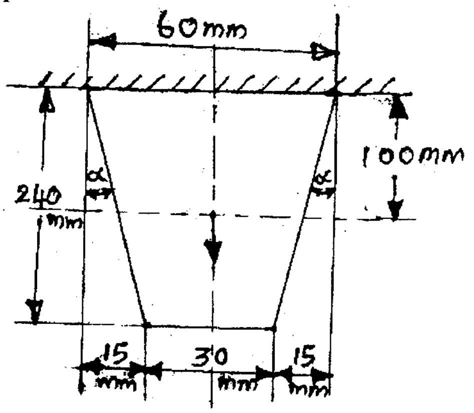
6 a. Explain with a sketch, one-dimensional heat conduction. **(06 Marks)**

b. Derive the element matrices, using Galerkin approach, for heat conduction in one dimensional element. **(10 Marks)**

c. Explain heat flux boundary condition in one dimension. **(04 Marks)**

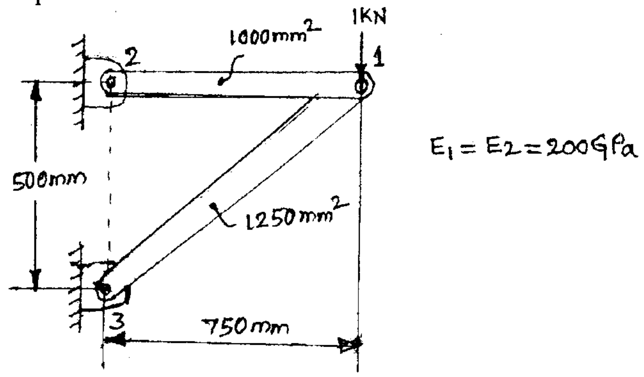
7 a. Solve for nodal displacements and elemental stresses for the following. Fig.Q.7(a), shows a thin plate of uniform 1mm thickness, Young's modulus E = 200 GPa, weight density of the plate = 76.6×10^{-6} N/mm^2. In addition to its weight, it is subjected to a point load of 1 kN at its mid point and model the plate with 2 bar elements. **(10 Marks)**

Fig.Q.7(a).



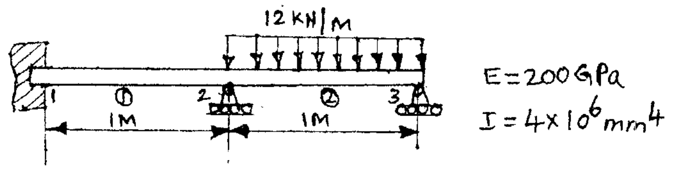
b. For the pin-jointed configuration shown in Fig.Q.7(b), formulate the stiffness matrix. Also determine the nodal displacements. **(10 Marks)**

Fig.Q.7(b).



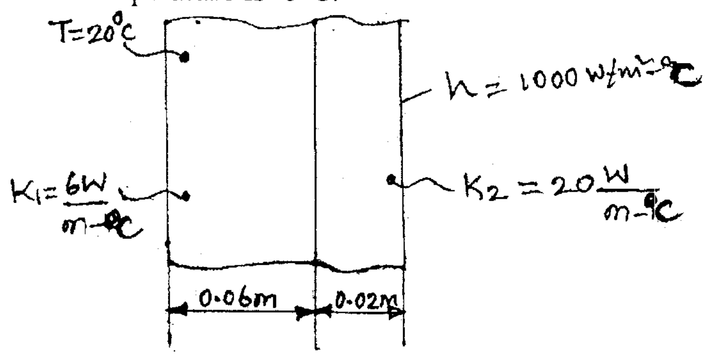
8 a. Solve for vertical deflection and slopes, at points 2 and 3, using beam elements, for the structure shown in Fig.Q.8(a). Also determine the deflection at the centre of the portion of the beam carrying UDL. **(10 Marks)**

Fig.Q.8(a).



b. Determine the temperature distribution through the composite wall, subjected to convection heat transfer on the right side surface, with convective heat transfer co-efficient shown in Fig.Q.8(b). The ambient temperature is -5°C. **(10 Marks)**

Fig.Q.8(b).



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