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10AE64

Sixth Semester B.E. Degree Examination, June/July 2019
Finite Element Analysis

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Explain with a sketch, plane stress and plane strain for two dimensions with notations. **(08 Marks)**

b. Using Rayleigh Ritz method, derive an expression for the displacement of a Cantilever beam subjected to uniformly distributed load P_0 over entire length as shown in Fig. Q1 (b). **(12 Marks)**

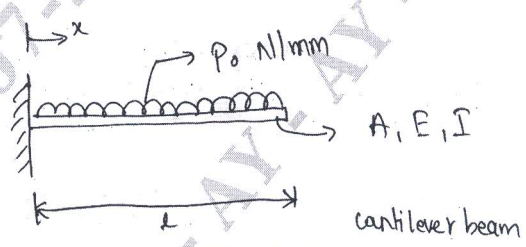


Fig. Q1 (b)

where E – Young's modulus, I – moment of inertia and A is area of cross section.

2 a. Differentiate between global local and natural co-ordinate system. **(06 Marks)**

b. Explain the convergence criteria with suitable examples. **(04 Marks)**

c. Derive the shape function for a two noded beam element. **(10 Marks)**

3 a. What do you mean by boundary conditions in FEM? Explain in brief. **(04 Marks)**

b. Consider the four-bar truss as shown in Fig. Q3 (b). It is given that $E = 2\times10^5$ N/mm^2 and $A_e = 100$ mm^2 for all elements:

(i) Determine the element stiffness matrix for each element.
(ii) Assemble the elemental stiffness matrix K for entire element.
(iii) Using elimination approach for the nodal displacement.
(iv) Calculate stresses in each element.
(v) Calculate the reaction forces. **(16 Marks)**

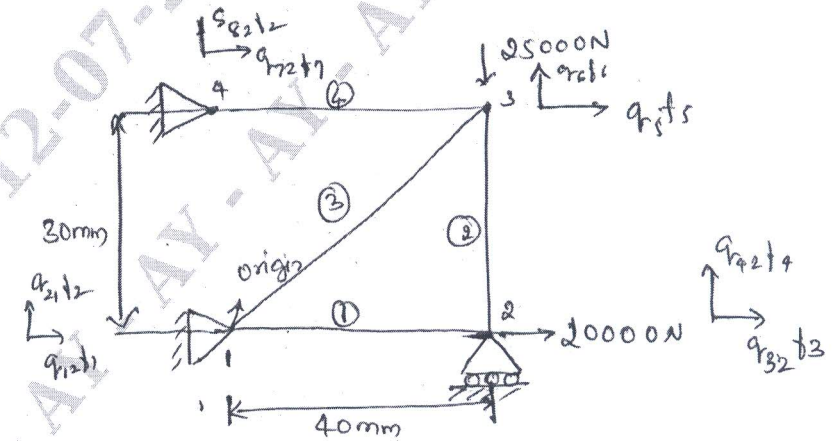


Fig. Q3 (b)

4 a. Derive the shape functions for a rectangular element with usefull notations. Use natural co-ordinate system. **(10 Marks)**

b. Derive the shape function for a Linear Strain Triangular (LST) element. Use natural co-ordinate system. **(10 Marks)**

PART – B

5 a. Explain the method of finding the shape functions for hexahedral element. **(10 Marks)**

b. Discuss about serendipity family and Langrange family. **(08 Marks)**

c. Define a shape function. **(02 Marks)**

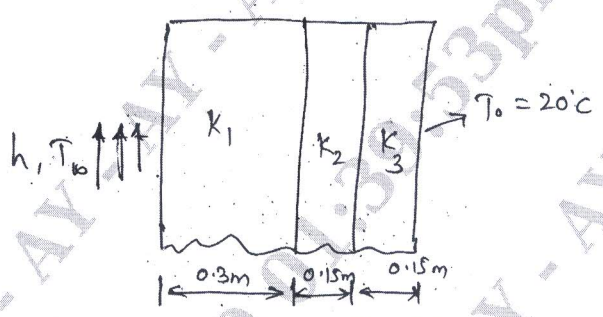
6 a. Explain the concept of isoparametric, subparametric and super parametric elements and their uses. **(10 Marks)**

b. Explain pre and post processing in FEA and List out various applications of FEA in engineering. **(10 Marks)**

7 a. Explain the concept of axysymetric element . **(04 Marks)**

b. Using the shape functions discuss the finite element modeling of triangular element of axisymmetric element. **(16 Marks)**

8 a. A composite wall consists of three materials as shown in Fig. Q8 (a). The outer temperature is $T_0 = 20^\circ C$. Convection heat transfer takes place on the inner surface of the wall with $T_\infty = 800^\circ C$ and $h = 25\ W/m^2{}^\circ C$. Determine the temperature distribution in the wall. **(16 Marks)**



$K_1 = 20\ W/m^\circ C$
$K_2 = 30\ W/m^\circ C$
$K_3 = 50\ W/m^\circ C$
$h = 25\ W/m^{2^\circ} C$
$T_\infty = 800^\circ C$

Fig. Q8 (a)

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

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