CBCS SCHEME

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15AU73

Seventh Semester B.E. Degree Examination, Jan./Feb. 2021
Finite Element Modeling and Analysis

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Explain with neat sketch, plane stress and plane strain. **(08 Marks)**

b. Solve the following system of simultaneous equation by Gaussian Elimination method.

$$x_1 - 2x_2 + 6x_3 = 0$$
$$2x_1 + 2x_2 + 3x_3 = 3$$
$$-x_1 + 3x_2 = 0$$

(08 Marks)

OR

2 a. Explain simplex, complex and multiplex elements with examples. **(06 Marks)**

b. For the spring shown in Fig Q2(b), determine the nodal displacement using principle of minimum potential energy.

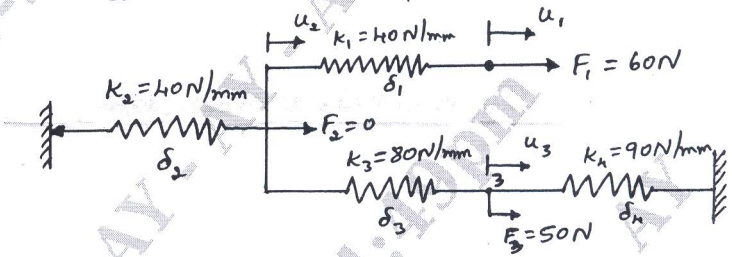


Fig Q2(b) **(10 Marks)**

Module-2

3 a. Derive the shape function of a bar element in Global co-ordinates system. **(08 Marks)**

b. Explain the convergence requirements. **(04 Marks)**

c. List the Application and Limitation of FEM. **(04 Marks)**

OR

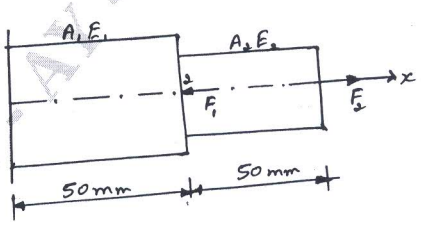
4 a. Derive the stiffness matrix for the Bar Element. **(08 Marks)**

b. List the discritization process and explain. **(04 Marks)**

c. Explain Pascal triangle with neat sketch. **(04 Marks)**

Module-3

5 a. Using the direct stiffness method, determine the nodal displacement of stepped bar shown in Fig Q5(a)

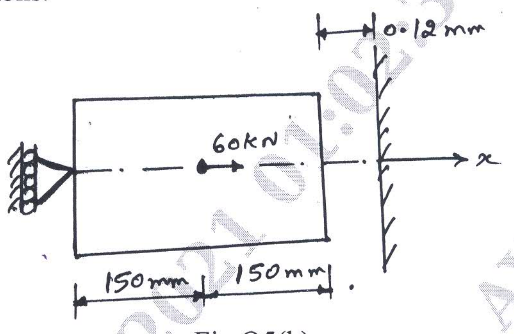


$E_1 = 200GPa$
$E_2 = 70GPa$
$A_1 = 150mm^2$
$A_2 = 100mm^2$
$F_1 = 10kN$
$F_2 = 5kN$

Fig Q5(a)

(08 Marks)

b. Consider the bar shown in Fig Q5(b), an axial load $P = 60 \times 10^3$N is applied at its midpoint. Using penalty method of handling boundary condition, determine the nodal displacement and support reactions.



$A = 250mm^2$
$E = 200$ GPa

Fig Q5(b)

(08 Marks)

OR

6 a. Derive the element stiffness matrix for truss elements. **(08 Marks)**

b. A plane truss shown in Fig Q6(b), determine nodal displacement, and stresses in each element.
$E = 200GPa$, $A_1 = 1200mm^2$, $A_2 = 1000mm^2$, $P = 50kN$.

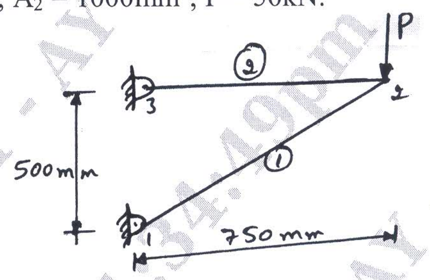


Fig Q6(b) **(08 Marks)**

Module-4

7 a. Derive the shape functions for a 4 noded 2D elements Quadrilateral/Rectangular element. **(12 Marks)**

b. Define shape function. List the properties. **(04 Marks)**

OR

8 Derive the Hermite shape function for beam element. Sketch the variation. **(16 Marks)**

Module-5

9 For the beam shown in Fig Q9, determine the load vector due to load acting on the beam.

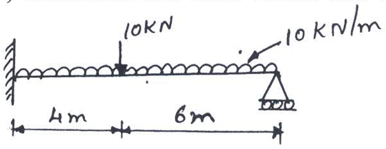


Fig Q9 **(16 Marks)**

OR

10 a. Obtain the differential equation for an 1-D Heat conduction. **(06 Marks)**

b. Determine the temperature distribution through the composite wall subjected to convection heat loss on the right side surface with convective heat transfer coefficient as shown in Fig Q10(b). The ambient temperature is -5°C.

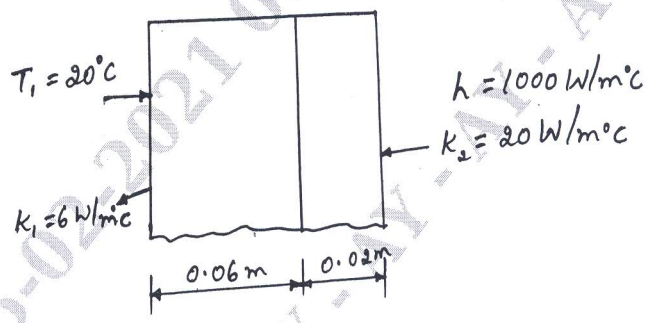


Fig Q10(b) **(10 Marks)**

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