CBCS SCHEME

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18AU71

Seventh Semester B.E. Degree Examination, June/July 2025
Finite Element Modeling and Analysis

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. What do you understand FEM? Briefly explain the steps involved in FEM. **(10 Marks)**

b. Explain plane stress and plane strain problems with suitable examples. **(10 Marks)**

OR

2 a. Explain the discretization process. Sketch the different types of elements 1D, 2D, 3D elements used in the finite element analytics. **(10 Marks)**

b. By Raleigh-Ritz method for a bar of cross sectional area A elastic modulus E, subjected to uniaxial loading P, show that at a distance x from fixed end is $u = \left(\frac{P}{AE}\right)x$ and hence determine the end deflection and the stress to which the bar is subjected to shown in Fig Q2(b).

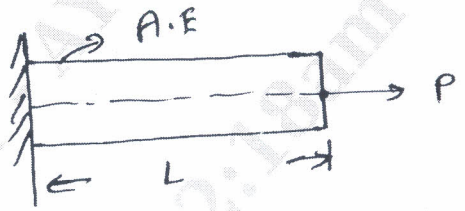


Fig Q2(b) **(10 Marks)**

Module-2

3 a. Explain simplex, complex and multiplexer elements. **(10 Marks)**

b. What are interpolation functions? Explain 2-D Pascal triangle. **(10 Marks)**

OR

4 a. State the principles of minimum potential energy. Explain the potential energy with usual notations. **(10 Marks)**

b. Use Galerkin method, to find the displacement of the system shows in Fig Q4(b).

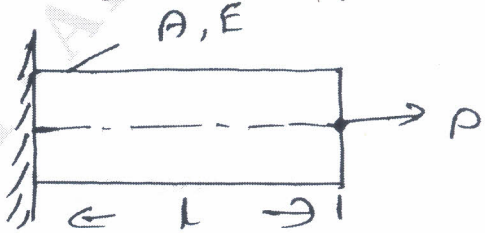


Fig Q4(b) **(10 Marks)**

Module-3

5 a. Solve the following system of simultaneous equations by Gauss elimination method.

$x+y+z=9$

$x-2y+3z=8$

$2x+y-z=3$ **(10 Marks)**

b. Fig Q5(b) shows a one dimensional bar subjected to an axial loading. Taking it as single bar element. Determine :

i) Nodal displacement
ii) Stress in each element
iii) Reaction at the support.

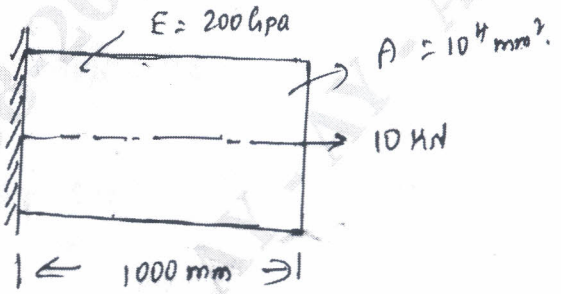


Fig Q5(b) **(10 Marks)**

OR

6 For the two bar truss shown in Fig Q6, it is given that $E = 2 \times 10^5$ N/mm^2 and A = 200 mm^2 for all elements.

a) Determine the elements stillness matrix for each element.
b) Assembly the elements stiffness matrix 'K' for the entire truss
c) Using the elimination approach Solve for the Nodal displacement
d) Calculate stress in each element
e) Calculate the reaction forces

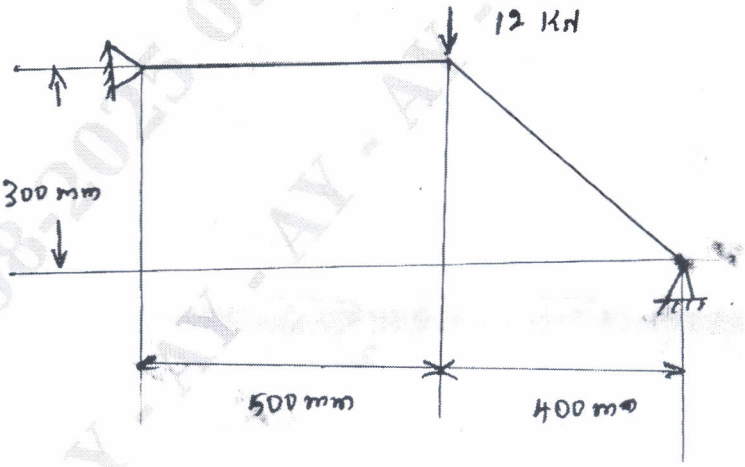


Fig Q6 **(20 Marks)**

Module-4

7 a. Briefly explain ISO, sub and super parametric elements. **(10 Marks)**

b. Define the shape functions and write the properties of shape functions. **(10 Marks)**

OR

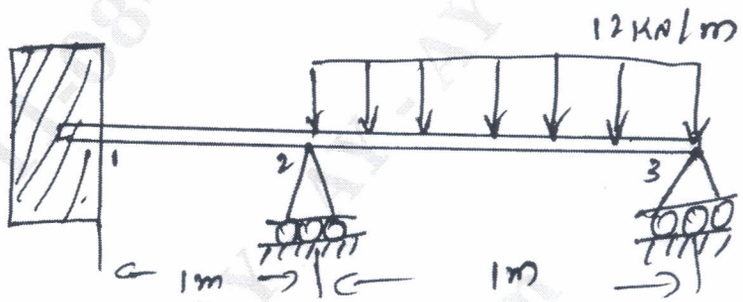
8 a. Derive the shape functions for the one – dimensional bar elements in natural coordinates. **(10 Marks)**

b. Derive the strain displacement matrix for 1-D linear elements and also show that $\sigma = EBq$ **(10 Marks)**

Module-5

9 a. Derive the Hermite function of a beam element. **(08 Marks)**

b. Solve for vertical deflection and slopes at point 2 and 3, using beam elements for the structure shown in Fig Q9(b). Also determine the deflection at the centre of the portion of the beam carrying uniformly distributed load.



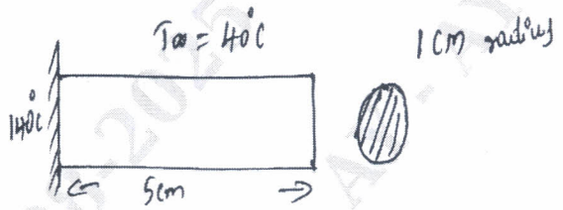
$E = 200$ GPa, $I = 4 \times 10^6 mm^4$

Fig Q9(b) **(12 Marks)**

OR

10 a. Derive the element matrices of stiffness matrix for the heat conduction. **(10 Marks)**

b. Find the distribution in the 1D dia shown in Fig Q10(b). Take two elements for EE idealization.



$h = 5 W/cm^2 - K$

$k = 70 W/cm - K$

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

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