CBCS SCHEME

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18AU71

Seventh Semester B.E. Degree Examination, July/August 2022
Finite Element Modelling 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. Write the basic steps in finite elements method. **(10 Marks)**

b. Derive the differential equation of equilibrium for a 2D body. **(10 Marks)**

OR

2 a. Write the advantages, disadvantages and applications of finite element method. **(10 Marks)**

b. A bar of length L, cross sectional are a 'A' and modulus of elasticity E, is subjected to distributed axial load q = cx, where 'C' is a constant as shown in Fig.Q2(b). Determine the displacement of the bar at the end using Rayleigh – Ritz method.

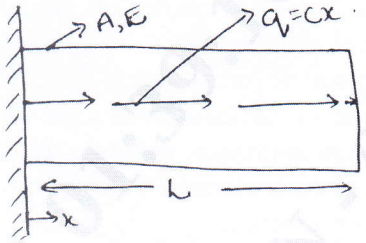


Fig.Q2(b) **(10 Marks)**

Module-2

3 a. Define shape functions. And derive the shape function in Global co-ordinate (or) Cartesian co-ordinates. **(10 Marks)**

b. Explain Pascal triangle by geometric invariance. **(06 Marks)**

c. Write the convergence requirements. **(04 Marks)**

OR

4 a. Derive the shape function in natural co-ordinates. **(10 Marks)**

b. Use the Galerkin's method, to obtain the approximate solution of the differential equation

$$\frac{d^2y}{dx^2} - 10x^2 = 5, \qquad 0 \le x \le 1$$

with boundary condition $y(0) = y(1) = 0$ Take the trial functions as $N_1(x) = x(x-1)$ and $N_2(x) = x^2(x-1)$. **(10 Marks)**

Module-3

5 a. Using Penalty method of handling boundary condition determine the nodal displacement, stress in each element and support reaction in the bar shown in Fig.Q5(a) due to applied force P = 100kN take E_{steel} = 200GPa E_{cu} = 100GPa.

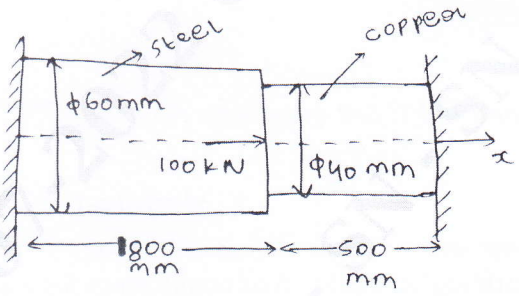


Fig.Q5(a) (10 Marks)

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

$x_1 = 2x_2 + 6x_3 = 0$

$2x_1 + 2x_2 + 3x_3 = 3$

$-x_1 + 3x_2 = 2.$ (10 Marks)

OR

6 Consider the Four-bar truss shown in Fig.Q6 it is given that E = 2×10^5 N/mm^2 and A_S = 100mm^2 for all elements.

a. Determine the element stiffness matrix for each element

b. Assemble the elemental stiffness matrix 'k' for the entire truss

c. Using the elimination approach, solve for the nodal displacement

d. Calculate stresses in each element

e. Calculate the reaction forces.

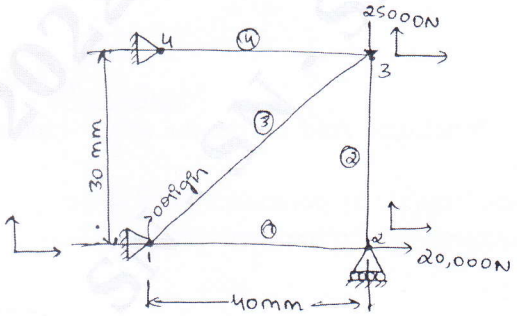


Fig.Q6 (20 Marks)

Module-4

7 a. Derive the shape function for a 4-noded quadratic bar element using lagrargian method. (10 Marks)

b. Briefly explain sub parametric elements and super parametric elements. (06 Marks)

c. Write the properties of shape functions. (04 Marks)

OR

8 a. Using Gaussian quadratic formula, evaluate :

$$I = \int_{-1}^{+1} (1 + r + 2r^2 + 3r^3)dr$$ **(08 Marks)**

b. Evaluate the value of the integral $I = \int_{2}^{4} X \, dx$. **(08 Marks)**

c. What are higher order and isoparameteric elements? **(04 Marks)**

Module-5

9 a. Using Hermite shape function, derive the element stiffness matrix. **(10 Marks)**

b. Determine the deflection at the centre of the position of the beam carrying UDL.
E = 200GPa ;
$I = 4 \times 106mm^4$.

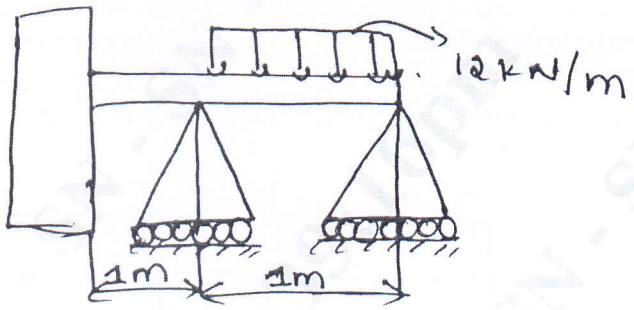
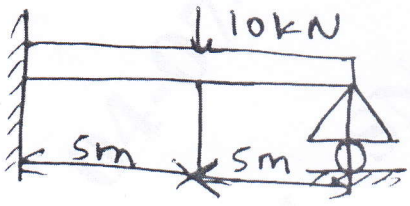


Fig.Q9(b) **(10 Marks)**

OR

10 a. Derive the equation for shape function of 1-D heat conduction. **(10 Marks)**

b. For the beam element shown in Fig.Q10(b), determine deflection under the given load.



$E = 2 \times 10^8 \ kN/m^2$

$I = 4 \times 10^{-6} \ m^4$.

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

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