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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Sixth Semester, B.E. - Mechanical Engineering

Semester End Examination; June - 2016

Finite Element Method

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each **unit**.*
ii) Missing data may suitably assume.

UNIT - I

1 a. Mention the difference between continuum method and FEM. 5

b. Explain the basic steps involved in FEM. 7

c. Using two point Gaussian quadrature formula evaluate $I = \int_{-1}^{+1} \left(1 + r + 2r^2 + 3r^3\right] dr$ 8

2 a. Explain principle of minimum potential energy. 4

b. Write a short note on : 8

i) Size of element ii) Plane strain problem.

c. Solve the following simultaneous equation by Gauss elimination method. 8

$x + y + z = 9$

$x - 2y + 3z = 8$

$2x + y - z = 3$

UNIT - II

3 a. What is shape function? Derive the shape function of 1-D bar element using natural Co-ordinates. 7

b. With necessary sketches, Explain concept of Iso, Sub and super parametric element. 8

c. For the triangular plate shown in Fig. 3C, compute Jacobin matrix and area of element. 5

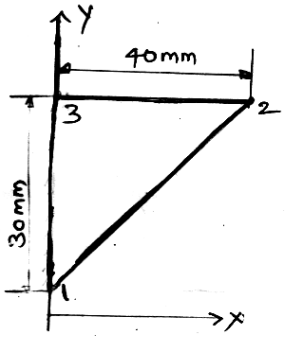


Fig 3.c

4 a. Drive shape function for 4 nodes bar element using Lagrangian method. 8

b. Drive shape function for rectangular element in Cartesian Co-ordinate. 8

c. Explain concept of Jacobin matrix. 4

Contd…2

UNIT - III

5 a. For a quadratic bar element, drive the expression for the stiffness matrix. 7

b. List the properties of stiffness matrix. 3

c. Using penalty method of handling boundary condition determine the nodal displacement, stress in each element and support reaction in the bar shown in Fig. 5.C due to applied force P = 100 kN. Take; E_{steel} = 200 GPa, E_{cu} = 100 GPa. 10

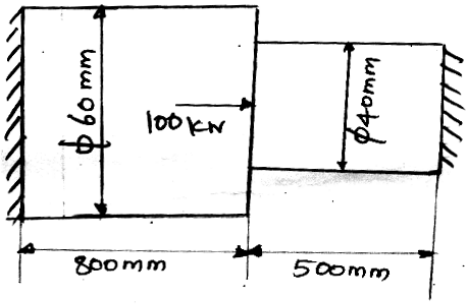


Fig 5.C

6 a. Explain elimination and penalty method of Handling Boundary condition. 7

b. Determine the nodal displacement, stress in each element and reaction at fixed support for thin plate uniform thickness of 1 mm as shown in Fig. 6.b take E = 200 GPa. Weight density of the plate $\rho = 76.6 \times 10^{-6}$ N/mm^2. In addition to its weight it is subjected to point load of 100 N at its mid point. Model the plate with two bar element. 13

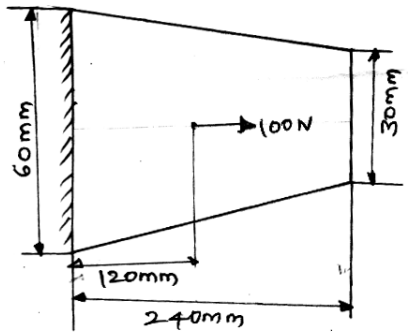


Fig 6.b

UNIT - IV

7 a. For the plane trusses shown in Fig. 7a. Determine the displacements at the nodes and stress in each element. For all elements have E = 201 GPa and Area 4×10^{-4} m^2. 16

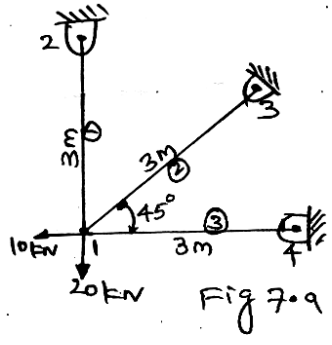


Fig 7.a

Contd….3

b. Define Trusses and list the assumptions made in to analysis of trusses. 4

8 a. Derive the load vector for the beam element subjected to uniformly distributed load. 6

b. Solve for vertical deflection and slopes at point 2 and 3 using beam elements for structure shown in Fig. 8.b. Also determine the deflection at the center of the portion of the beam carrying UDL. 14

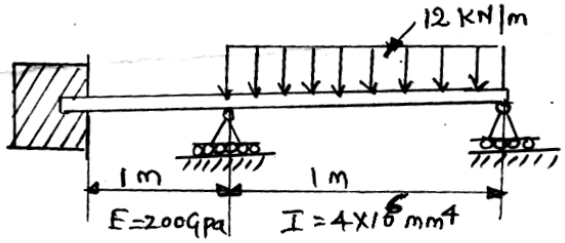
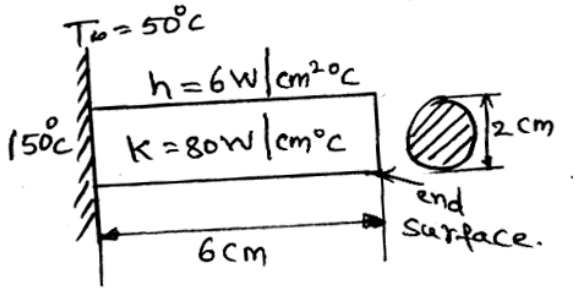


Fig 8.b

UNIT - V

9 a. Derive element conductivity matrix for a 1-D heat condition problem using Galerkin approach. 8

b. Find the temperature distribution in the one dimensional fin shown in Fig. 9.b.
Given; h = 6 W/cm^2 ^{o}C, K = 80 W/cm ^{o}C. 12



10 a. Explain types of boundary conditions in heat transfer problem. 6

b. For the brick wall shown Fig. 10.b. The inner surface temperature is 28^o C and outer surface is exposed to cold air at -15^o C. Determine the temperature distribution in steady state within the wall by considering 2 one dimensional heat flow elements. Given K = 0.7 W/m^{2}C and h = 40 W/m^2 ^{o}C. 14

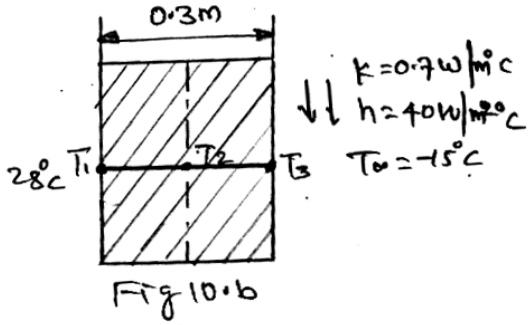


Fig 10.b

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