7E7011

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B.Tech. VII Semester (Main) Examination , Nov./Dec.- 2015

Mechanical Engineering

7ME1A Finite Element Methods

(Common With PI)

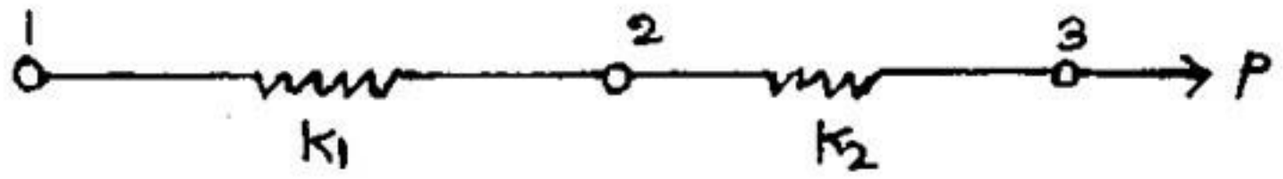
Time : 3 Hours **Maximum Marks : 80**
Min. Passing Marks : 24

Instructions to Candidates:

*Attempt any **five** questions, selecting one question from **each unit**. All questions carry equal marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly).*

Unit - I

1. a) Find deflection of nodes 2 and 3 for the system shown in figure. Develop global stiffness matrix. **(10)**



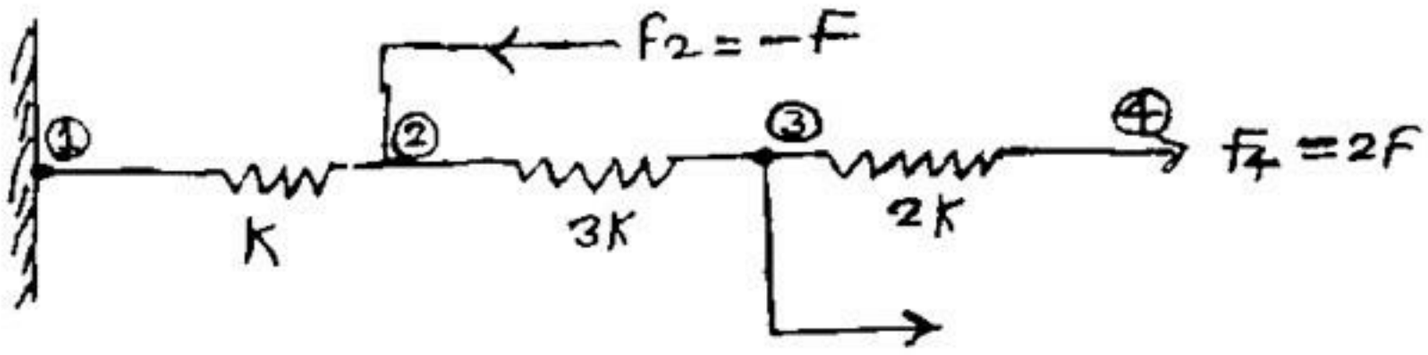
b) Discuss banded symmetric matrix and band width with suitable example. **(6)**

OR

1. a) Solve following system of simultaneous equations by Gauss - elimination method. **(6)**

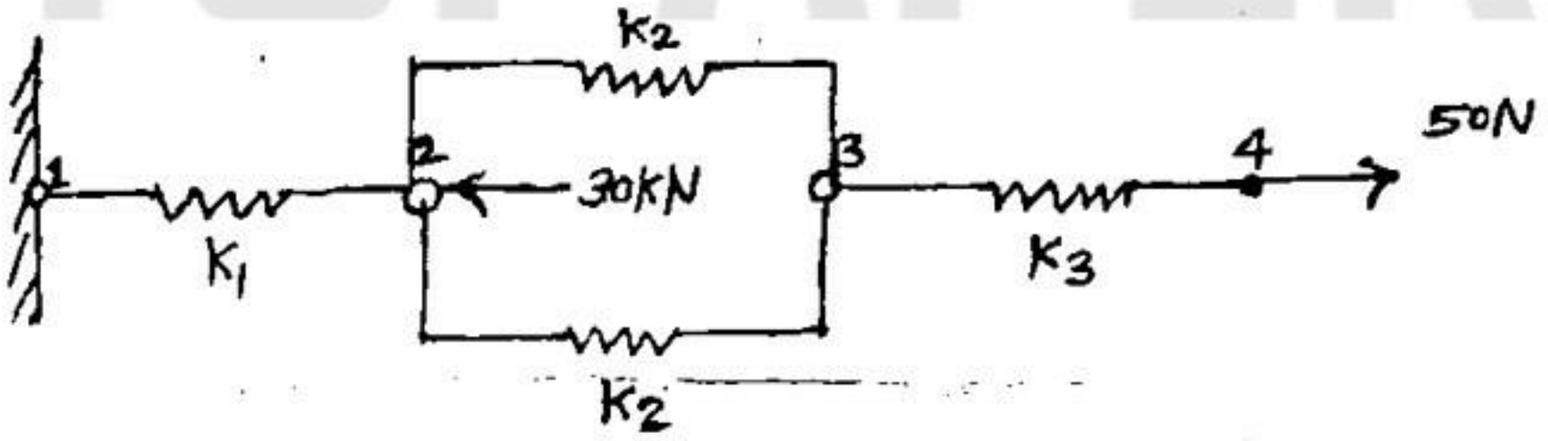
$$x + y + z = 9$$
$$x - 2y + 3z = 8$$
$$2x + y - z = 3$$

b) Determine the displacement of each node and force required at node 3 for specific conditions as follows:- **(10)**



Unit - II

2. a) Using minimum potential energy approach solve for displacement at 2,3 and 4 and reaction force at node 1 for following node 3 is rigid. **(10)**



$K_1 = 40$ N/mm, $K_2 = 60$ N/mm, $K_3 = 30$ N/mm

b) Explain the terms node and mesh. Also explain Node numbering and its significance. **(6)**

OR

2. Shape functions satisfy property of consistency i.e. they are able to model rigid body motion and condition of constant strain. Write shape functions for linear and quadratic interpolation for 1D element. Also show that these shape functions are consistent. **(16)**

Unit - III

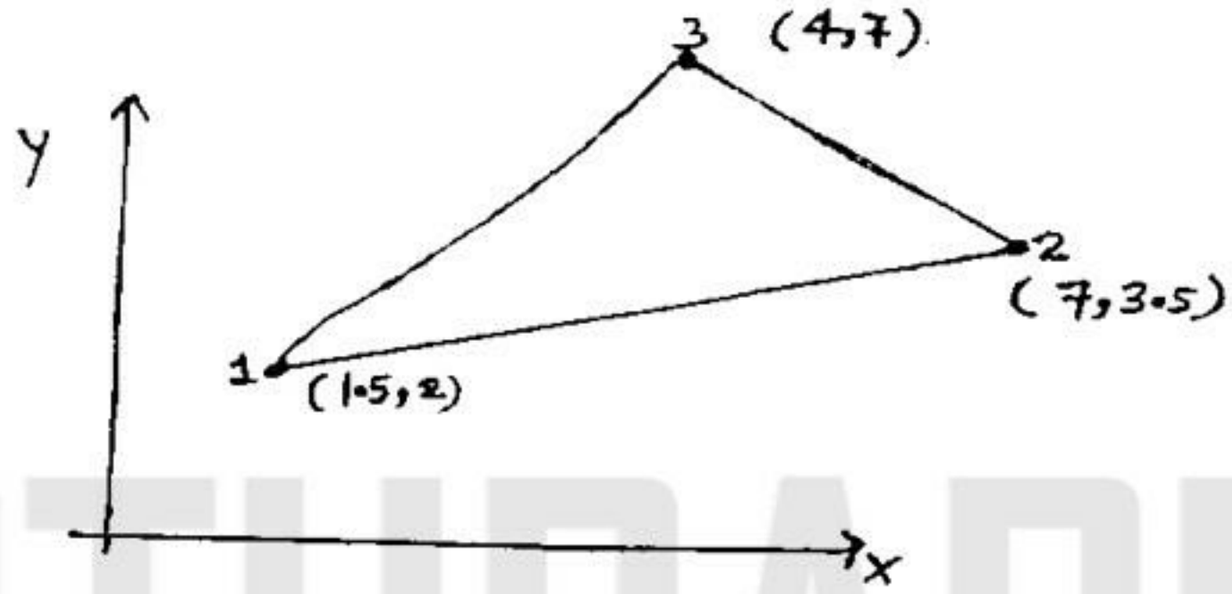
3. a) Evaluate by Gaussian quadrature method. **(8)**

$I = \int_1^3 \frac{dx}{x}$ by 3 point formula.

b) Derive shape functions for CST triangular element in local coordinates. **(8)**

OR

3. Evaluate the shape functions N_1, N_2 and N_3 at the interior point P for the triangular element as shown in figure.



Also determine Jacobian matrix of the above triangular element. **(16)**

Unit - IV

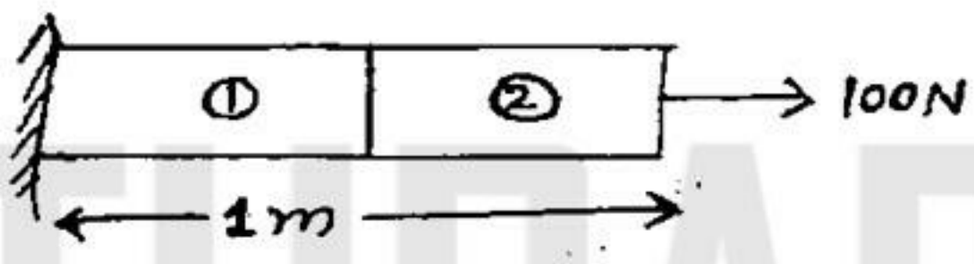
4. Using Galerkin's approach. Find element stiffness matrix and force vector for 1 D equilibrium equation.

$$\frac{d}{dx}\left(EA\frac{du}{dx}\right)+eAg=0$$

Use quadratic interpolation for displacement variable u . Explain the essential and natural boundary conditions involved in this problem. **(16)**

OR

4. a) Solve the displacement for two element mesh using variational technique for following problem **(8)**



Cross - section area = 30 mm²

$$E=2\times10^{n}\,N/m^2$$

b) Derive 1 D heat transfer equation by using any variational method. **(8)**

Unit - V

5. Write **(8+8=16)**

i) p and h refinement methods.

ii) Concept of element mass matrix in dynamics analysis.

OR

5. a) Discuss the difference between finite element methods, Finite difference methods and finite volume methods. **(10)**

b) Discuss steps involved in finite element modeling. **(6)**