

B.E.(Civil Engineering)

FINITE ELEMENT METHOD IN CIVIL ENGINEERING
(2012 Course) (Elective-III)(5)(Semester-II)(End Sem.)(401009E)

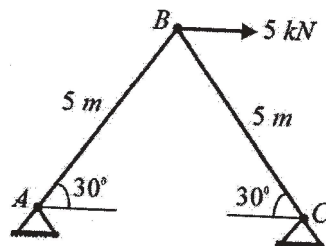
Time : 2½Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right indicates full marks.
- 4) Use of electronic pocket calculator is allowed.
- 5) Assume suitable data if necessary.

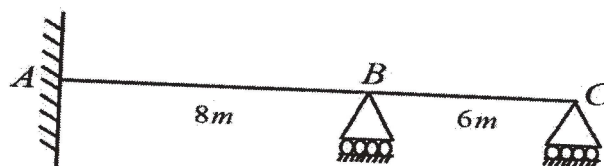
- Q1)** a) Write short note on: [6]
- i) Discretization of structure
 - ii) Aspect ratio of element
- b) Determine displacements at loaded joint of truss shown in figure using finite element method. Take $A=1000 \text{ mm}^2$ and $E=200 \text{ GPa}$ [8]



- c) Derive the transformation matrix for two noded frame element having six degrees of freedom. [6]

OR

- Q2)** a) State the convergence criteria for the choice of the displacement function in FEM. [6]
- b) Determine rotations at supports B and C of continuous beam ABC if support B sinks by 10mm. Take $EI=6000 \text{ kN.m}^2$. Use finite element method. [8]



- c) Derive the stiffness matrix for the grid element considering six degrees of freedom. [6]

P.T.O.

Q3) Write short note on: [16]

- a) Principle of minimum potential energy.
- b) Principle of virtual work.
- c) CST and LST elements
- d) 3D Tetrahedron and Hexahedron elements.

OR

Q4) Derive connectivity matrix[A], elasticity matrix[D], strain-displacement matrix[B] and stiffness matrix[K] for the four noded rectangular element in Cartesian coordinate system using finite element formulation. [16]

Q5) Derive shape functions for the following elements using Lagrange's interpolation function.

- a) Two noded bar element [4]
- b) Four noded rectangular element [6]
- c) Nine noded rectangular element [8]

OR

Q6) a) Derive the area coordinates for the three noded CST element having Cartesian coordinates node 1 (1,2), node 2 (3,3) and node 3 (2,4). [10]

- b) Drive shape functions for the eight noded serendipity element in natural coordinate (ξ, η) system. [8]

Q7) Write short note on:

- a) Isoparametric, sub-parametric and super-parametric elements. [5]
- b) Theorems of isoparametric formulations. [5]
- c) Jacobian matrix [6]

OR

Q8) Derive the Jacobian matrix for the four noded quadrilateral isoparametric element having Cartesian coordinates at node 1(1, 1), node 2 (4, 1), node 3 (1, 2) and node 4 (4,2). [16]

