

**UNIVERSITY OF KERALA- MODEL QUESTION PAPER**  
**SECOND SEMESTER M.TECH DEGREE EXAMINATION-2014**  
**(Civil-Structural Engineering)**

**CSE 2004 Finite Element Method**

**Time: 3 hours**

**Maximum marks: 60**

Answer any **two** full questions from **each** module. All questions carry equal marks

MODULE I

1. State and prove principle of virtual displacement (10 marks)
2. Compute the approximate value of the central deflection for a simply supported beam shown in Fig.1 by (i) Collocation method (ii) Galerkin's method and (iii) least square method

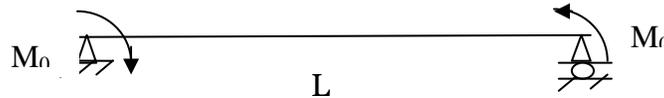


Fig.1

(10 marks)

3. (a) Find the expression for the stress for one dimensional element of length 'L' subjected to an axial force **q/unit length** shown in Fig. 2. AE is same throughout. Use Rayleigh-Ritz method.

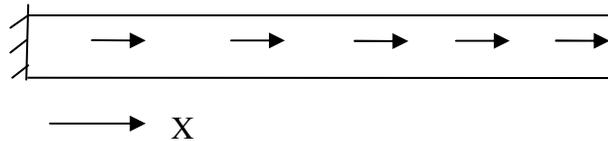


Fig.2

(5 marks)

- (b) Explain the different steps involved in the finite element procedure (5 marks)

MODULE II

4. (a) Derive the expression for the stiffness matrix and consistent load vector for an element from fundamentals (5 marks)  
(b) Derive and plot the shape function for a three noded bar element (5 marks)
5. (a) Explain the convergence requirements to be satisfied by the displacement model? (5 marks)  
(b) Explain the plane stress and plane strain cases of 2D analysis indicating the constitutive relations. (5 marks)

6. (a) Evaluate the shape function  $N_1, N_2$  and  $N_3$  at the interior point  $P$  for the triangular element shown in the Fig.3. (5 marks)

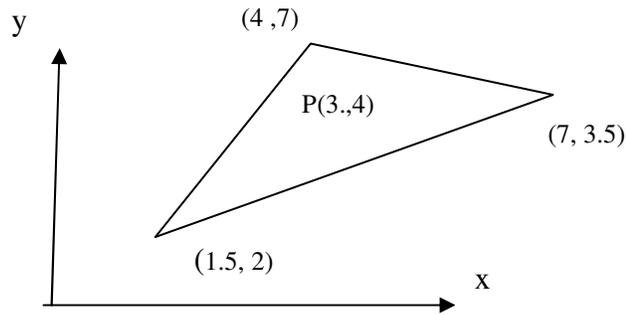


Fig.3

- (b) Using Gauss quadrature, evaluate the integral using 3 sampling points

$$\int_{-1}^1 \int_{-1}^1 (\xi^3 + \eta^2) d\xi d\eta \quad (5 \text{ marks})$$

### MODULE III

7. Obtain an explicit expression for an isoparametric mapping for the element shown in the Fig.4. (10 marks)

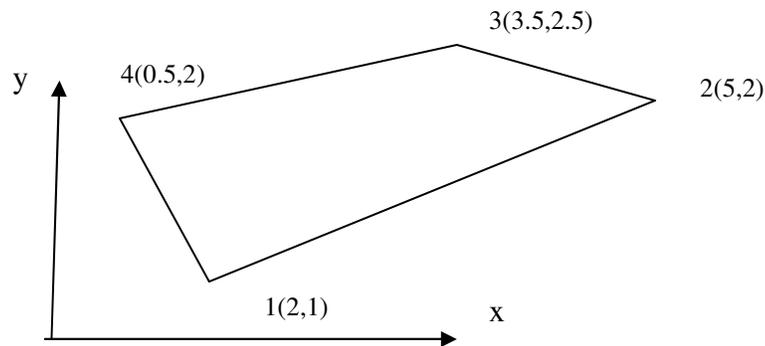


Fig.4

8. Derive the shape function for 8 noded rectangular element in natural coordinates (10 marks)
9. Write short note on the following
- (a) Isoparametric element
  - (b) Subparametric element
  - (c) Superparametric elements
  - (d) Static condensation

(2.5x4=10 marks)