Code No. M0122 /R07 **R07** **Set No.1**

IV B.Tech I Semester Supplementary Examinations, February/March, 2011

FINITE ELEMENT METHODS IN CIVIL ENGINEERING

(Civil Engineering)

Time: 3 hours **Max. Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

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1. What are the various steps in Finite Element Method and explain them.

2. a) Derive the equilibrium equations at any point in a 2 Dimensional elastic systems under the action of external forces; in terms of stresses.
   b) If stresses at any point in an elastic body are
   $\sigma_{xx} = \alpha x + \beta y,\ \sigma_{yy} = 2\alpha x + 3\beta y,\ \ and\ \tau_{xy} = 3\alpha x + 2\beta y,$ then determine α *and* β.

3. a) What do you mean by shape functions and derive shape functions for a simple bar element.
   b) Derive stiffness matrix of a simple bar element using interpolation functions.

4. What are convergence requirements in the context of displacement model, and explain their significance.

5. Explain how stiffness matrix of a three nodded triangular element is determined.

6. a) What do you mean by iso-parametric element and explain it.
   b) Derive shape functions of a simple rectangular element in terms of iso-parametric element.

7. a) What do you mean by axi-symmetric problem and explain it.
   b) Derive stress-strain relationship for axi-symmetric problem.

8. Write short answers on the following.
   i) Numerical integration
   ii) Static condensation
   iii) Geo-metric invariance
   iv) Boundary conditions

Code No. M0122 /R07 **R07** **Set No.2**

IV B.Tech I Semester Supplementary Examinations, February/March, 2011

FINITE ELEMENT METHODS IN CIVIL ENGINEERING

(Civil Engineering)

Time: 3 hours **Max. Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

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1. a) Explain the concept of Finite Element Method.
   b) Enlist the merits and demerits o Finite Element Method.

2. a) If u and v are displacement components along x- and y-axes respectively at any point in a 2D elastic body; derive strain-displacement relations,
   $$\varepsilon_{xx} = \left(\frac{\partial u}{\partial x}\right), \quad \varepsilon_{yy} = \left(\frac{\partial v}{\partial y}\right), \quad and \quad \gamma_{xy} = \left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}\right)$$
   b) If the displacements at any point in an elastic body are,
   $u = 10^{-3}\left(2x^2 + 3y\right), v = 10^{-3}\left(4x^3 + 3y^2 + 5\right)$, *and find strains at the point*.

3. a) If shape functions of a 2 nodded bar element of length, L are,
   $N_1 = \left(\alpha_1 x + \beta_1\right)$ *and* $N_2 = \left(\alpha_2 x + \beta_2\right)$, determine the constants.
   b) Derive stiffness of using the shape functions given in the above problem.

4. Explain how equivalent nodal loads due to traction on the 2D element are computed.

5. Explain how stiffness matrix of a four nodded rectangular element is determined.

6. Derive the shape functions of a simple rectangular Lagrangian element in terms of isoparametric element form.

7. Derive stiffness matrix of an axi-symmetric triangular element.

8. Write short answers on the following.
   a) Gaussian points in the context of numerical integration.
   b) Assembling of elements' stiffness matrices
   c) Principle of minimum potential energy.
   d) Displacement boundary conditions

Code No. M0122 /R07

R07

Set No.3

IV B.Tech I Semester Supplementary Examinations, February/March, 2011

FINITE ELEMENT METHODS IN CIVIL ENGINEERING

(Civil Engineering)

Time: 3 hours **Max. Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

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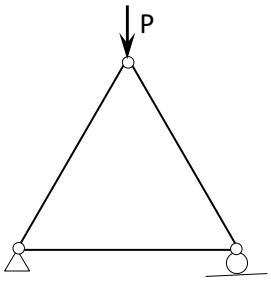
1. Explain the basic principle of the Rayleigh-Ritz method, in the context Finite Element method.

2. a)What do you mean by plane stress and explain it.
   b) Derive the constitute relationships for plane stress case.

3. A 1Dimensional structure, of length L fixed at one end; is subjected to an axially distributed load, $/mq$ all throughout. Assume axial stiffness, AE is constant. Analyze the structure using finite element method and find maximum stress and maximum displacement.

4. Analyse the equilateral triangular truss structure shown in Fig.1 using finite element method and find the member forces. Take AE is constant.

Fig. 1



5. Explain how nodal load matrix of a three nodded triangular element is determined.

6. Derive the shape functions of a simple rectangular Serendipity element in terms of isoparametric element form.

7. Differentiate how axi-symmetric element is different from 2D element and explain it.

8. Write short answers on the following.

   a) Derive the one-point numerical integrations, $\int_0^l f(x)dx = \omega_1 f(x_1) = f(x_1)$

   b) Find the $\int_0^3 (2x^2 + 3x + 4)dx$ using one-point formula.

   c) Find the $\int_0^3 (2x^2 + 3x + 4)dx$ using two-point formula.

   d) Static condensation

Code No. M0122 /R07 **R07** **Set No.4**

IV B.Tech I Semester Supplementary Examinations, February/March, 2011

FINITE ELEMENT METHODS IN CIVIL ENGINEERING

(Civil Engineering)

Time: 3 hours **Max. Marks: 80**

Answer any FIVE Questions

All Questions carry equal marks

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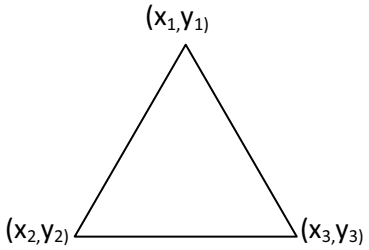
1. A cantilever beam is subjected to uniformly Distributed load, w/m throughout the span. Analyze the beam using Rayleigh-Ritz method and determine the following,
   i) Displacement function,
   ii) Max. Bending Moment,
   iii) Max. Shear Force,
   iv) Max. Deflection and comment on the results.

2. a) What do you mean by plane strain and explain it.
   b) Derive the constitute relationships for plane strain case.

3. A fixed beam is subjected to uniformly distributed load, w/m all throughout. Analyze the beam using finite element method and determine the maximum deflection and maximum bending moment in the beam.

4. a) What do you mean by constant strain triangular element and explain it.
   b) Derive the shape functions of a triangular element with coordinates as shown in Fig. 1.

Fig.1



5. Explain how nodal load matrix of a four nodded rectangular element is determined.

6. Derive the shape functions of a 8 nodded isoparametric element.

Code No. M0122 /R07 **R07** **Set No.4**

7. Derive material stiffness matrix of an axi-symmetric element.

8. Write short answers on the following.
   a) Jacobin matrix
   b) Strain-displacement matrix
   c) Assembling of elements' nodal force vector into global matrix.
   d) Beam element