Printed Pages:03 NME-012

Paper Id: | 1 | 4 | 0 | 6 | 0 | 9 | Roll No. | 1 | 5 | 9 | 3 | 2 | 4 | 0 | 1 | 1 | 1 |

B TECH
(SEM-VI) THEORY EXAMINATION 2017-18
FINITE ELEMENT METHODS

Time: 3 Hours *Total Marks: 100*

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.
2. Any special paper specific instruction.

SECTION A

1. **Attempt *all* questions in brief.** 2 x 10 = 20

a. Write down the shape functions for four noded rectangular elements.

b. What are the steps involved in finite element modeling?

c. Specify stress and strain tensors for plane stress case.

d. Write down the stiffness matrix for 2D beam element.

e. What do you mean by convergence in finite element analysis?

f. Explain the principle of minimum potential energy.

g. What is Galerkin approach and how to use in FEM analysis?

h. What are the merits and the demerits of Finite Element Methods?

i. What is meant by displacement function?

j. Explain the features of Hermition interpolation function with an example.

SECTION B

2. **Attempt any *three* of the following:** 10 x 3 = 30

(a)Derive the shape functions for a four node (corner) rectangular element using Lagrange method.

(b)Using the Rayleigh-Ritz method or using the weighted residual method, find out the expression for deflection of a cantilever beam of length 'L' subjected to uniformly distributed load over its entire length. Consider E=Modulus of elasticity, I=Area moment of inertia.

(c)Determine the Galerkin approximation solution of the differential equation

$$A\frac{d^2u}{dx^2}+B\frac{du}{dx}+C=0$$

Given, u (0) = u (L) = 0

(d)Derive the constant strain triangle (CST) infinite element modeling isoperimetric representation.

(e)Explain and differentiate between the local coordinates, global coordinates and natural coordinates in FEM.

SECTION C

3. **Attempt any *one* part of the following:** **10 x 1 = 10**

(a) A vertically hanging bar having length L, uniform cross-sectional area A, density and young's modulus E, find the element level stress strain for Two-element solution.

(b)(i) Derive the stress-strain relationship and strain displacement elevation.
(ii) With the help of a neat diagram, describe the various components of stress and strains.

4. **Attempt any *one* part of the following:** **10 x 1 = 10**

(a) A certain problem of one-dimensional steady heat transfer with a distributed heat source is governed by the equation

$$\frac{d^2\phi}{dx^2} + \phi + 1 = 0$$

$$\phi = 0 \text{ at } x = 0$$

$$\frac{d\phi}{dx} = -\phi \text{ at } x = 1$$

Find the Galerkin approximation solution of the above differential equation.

(b) Explain the term weak form of weighted residual statement by considering a suitable example.

5. **Attempt any *one* part of the following:** **10 x 1 = 10**

(a) Write all the shape functions for the elements shown in **fig.1**.

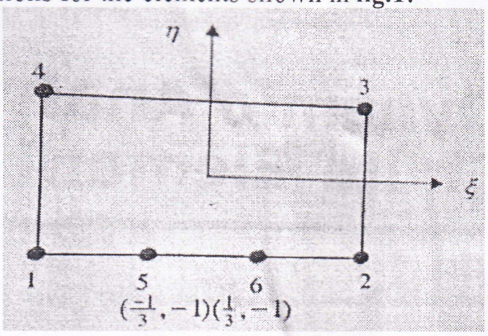

fig.1

(b) **(i)** What are the convergence and compatibility requirements? Discuss in detail.
(ii) Differentiate conforming and non-conforming elements.

6. **Attempt any *one* part of the following:** **10 x 1 = 10**

(a) For the triangular element shown in **fig.2**, the nodal values of displacements are:

$u_1 = 2, \quad u_2 = 3, u_3 = 5$

$v_1 = 1, \quad v_2 = 2, v_3 = 3$

Obtain the displacements (i.e. u, v) of the point P (2, 2) within the element.

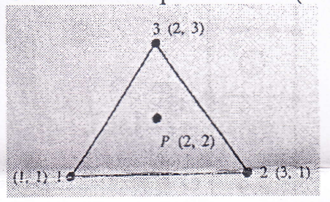

fig.2

(b) What is a frame element? How do you obtain the stiffness matrix and load vector for a frame element subjected to uniformly distributed axial and bending load.

7. **Attempt any *one* part of the following:** **10 x 1 = 10**

(a)Determine the displacement of nodes of the spring system shown in **fig.3** by the principle of minimum potential energy.

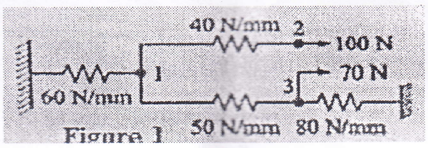

Figure 1

fig.3

(b) What is the procedure for finite element analysis starting from a given differential equation?