CBCS SCHEME

USN | | | | | | | | | | |

17AU73

Seventh Semester B.E. Degree Examination, Feb./Mar. 2022
Finite Element Modeling and Analysis

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Derive the differential equation of equilibrium for a body subjected to a three dimensional stress system and body force. **(10 Marks)**

b. Write down the equilibrium equation of a 3-D elastic body subjected to body forces, surface forces and point loads in Cartesian co-ordinates. **(10 Marks)**

OR

2 a. Derive the Euler – language equation for an integral function using variational principle. **(10 Marks)**

b. Determine the displacements of nodes 1 and 2 in the spring system shown in Fig Q2(b), use minimum of potential energy principle to assemble equations of equilibrium.

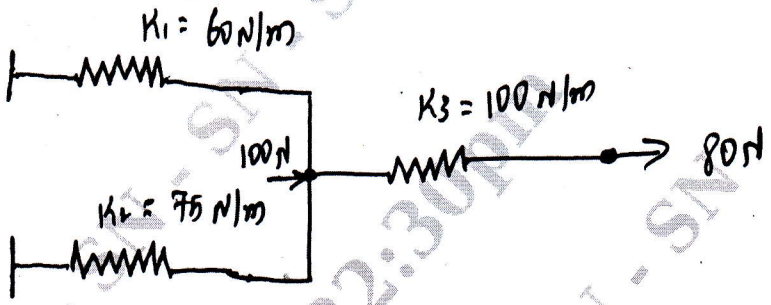


Fig Q2(b) **(10 Marks)**

Module-2

3 a. Write properties of stiffness matrix K, Show node numbering and its effect on the half bandwidth. **(10 Marks)**

b. Determine the displacement in the system shown in Fig Q3(b) and hence determine the displacement at the point of application of load by Galerkin method.

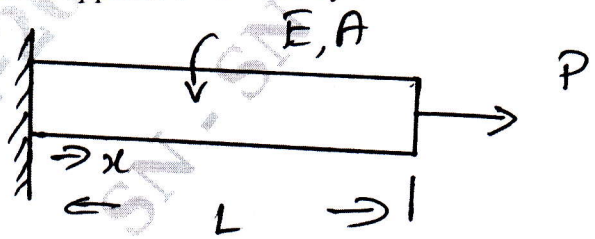


Fig Q3(b) **(10 Marks)**

OR

4 a. Explain the steps involved in FEM. **(08 Marks)**

b. What are the factors considered for discritization process? Explain any one factor. **(08 Marks)**

c. What are the properties of shape functions? **(04 Marks)**

Module-3

5 a. Fig Q5(a), show a one dimensional bar subjected to an axial loading. Taking it as a two bar element, determine i) Nodal displacement ii) Stress in each element iii) Reaction at the support.

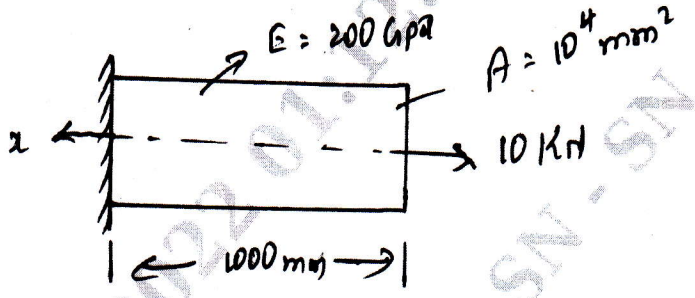
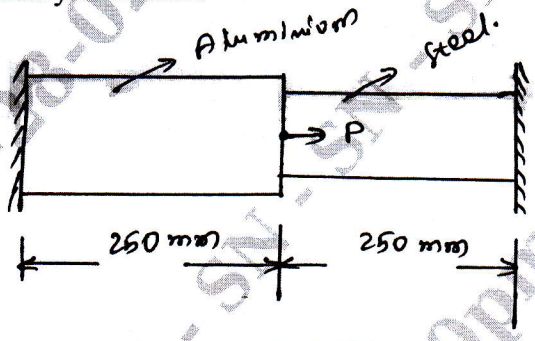


Fig Q5(a) **(10 Marks)**

b. Solve for stresses in members of structure given below in Fig Q5(b) using penalty approach of handling boundary condition.



$P = 4000N$
$A_1 = 1600mm^2$
$A_2 = 800mm^2$
$E_{Al} = 80GPa$
$E_{Steel} = 210GPa$

Fig Q5(b) **(10 Marks)**

OR

6 a. Derive the element stiffness matrix for the truss element. **(08 Marks)**

b. For the two bar truss shown in Fig Q6(b). Determine the Nodal displacement and the stress in each member. Also find the support reaction. Take E = 200GPa.

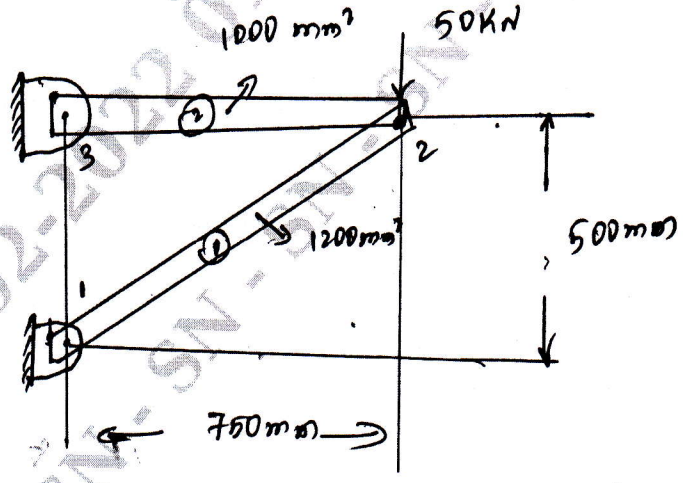


Fig Q6(b) **(12 Marks)**

Module-4

7 a. Briefly explain iso-parametric sub and super-parametric elements. **(06 Marks)**

b. Derive the shape function for the Nine Noded quadrilateral element. **(08 Marks)**

c. Explain Lagrange interpolation function. **(06 Marks)**

OR

8 a. Derive the shape function 3-Node bar element. **(10 Marks)**

b. Derive the shape function for Four-Node bar element. **(10 Marks)**

Module-5

9 a. Derive hermite shape function ROF beam element. **(10 Marks)**

b. Fig Q9(b) shows a simply supported beam subjected to a uniformly distributed load. Obtain the maximum, deflection. Take Young's modulus E = 200GPa and moment of inertia $I = 2 \times 10^6 mm^4$.

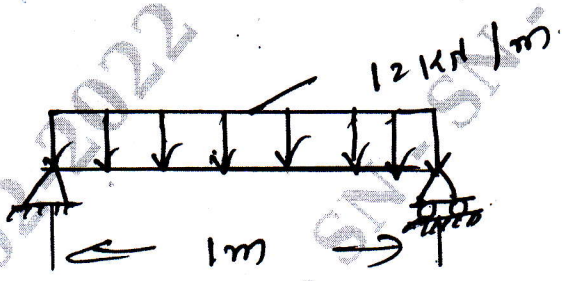
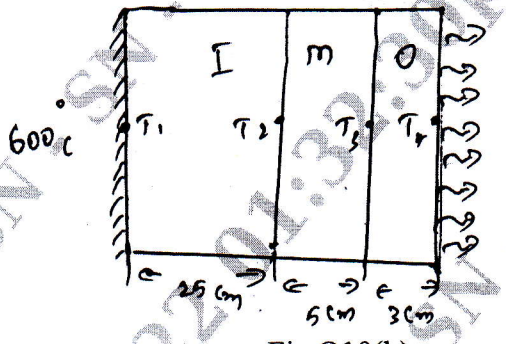


Fig Q9(b) **(10 Marks)**

OR

10 a. Derive the expression for differential equation for an 1-D Heat conduction. **(08 Marks)**

b. An induction durance wall is made up of three layers, inside, middle and outer layer with thermal conductivity K_1, K_2 and K_3 respectively of shown in Fig Q10(b). Determine the Nodal temperature.



$K_1 = 8.5 W/mK$
$K_2 = 0.25 W/mK$
$K_3 = 0.08 W/mK$
$h = 45 W/m^2/K$
$T_\infty = 30°C$

Fig Q10(b) **(12 Marks)**

* * * * *