Register Number.........................

M.E. DEGREE EXAMINATIONS: DECEMBER 2009

First Semester

CAD / CAM

CCM502: Advanced Finite Element Analysis

Time: Three Hours

Maximum Marks: 100

Answer All the Questions:-

PART A (10 x 2 = 20 Marks)

1. What is aspect ratio?
2. State the properties of stiffness matrix.
3. Differentiate between LST and CST element.
4. What is meant by plane stress and plane strain analysis?
5. What are the conditions for a problem to be axisymmetric?
6. What is meant by geometric nonlinearity?
7. Define superparametric and subparametric elements.
8. What is natural coordinates?
9. Write the expression for consistent - mass matrix for a truss element subjected to time dependent loads.
10. What are the different methods to determine solution of Eigen value problem?

PART B (5 x 16 = 80 Marks)

11. (a) For the beam loaded as shown in the Fig 11. (a) Determine slope at B and C. Take E = 210 GPa and I = 6 X 10^{-6} m^4.

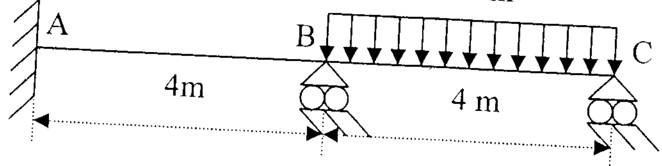

Fig 11. (a)

(OR)

(b) (i) Consider a uniform rod subjected to a uniform load. It can be shown th[...] deformation of the bar is governed by differential equation $AE(d^2u/dx^2) + q$[...] with boundary condition $u(0) = 0$, $(du/dx)(L) = 0$. Find an approximate soluti[...] weighted residual method.

(ii) Derive a stiffness matrix for 1 D, 2 noded bar element.

12. (a) Determine the stiffness matrix for the constant strain triangular element whose [...] coordinates are given as $(x_1,y_1) = (10,7.5)$; $(x_2,y_2) = (15,5)$ and $(x_3,y_3) = (15,10)$[...] coordinates are in mm. Assume plane stress condition. Take E = 210 GPa, $\mu = 0.2$[...] t = 10 mm.

(OR)

(b) A wall of industrial oven is made of three layers, the first layer is composed of 5 c[...] insulating cement with clay binder that has a thermal conductivity of 0.08 W/m.K 15[...] second layer is made from 15 cm of 6-ply asbestos board with a thermal conductivi[...] 0.074 W/m.K and the third layer consist of 10 cm common brick with a the[...] conductivity of 0.072 W/m.K. The inside wall temperature of the oven is 200 ^{0} C,[...] the outside air is 30^0 C with a convection coefficient of 40 W/m^2.K. Determine[...] temperature distribution along the composite wall.

13. (a) Derive an expression for strain displacement matrix, stress strain relationship matrix[...] element stiffness matrix for an axisymmetric element.

(OR)

(b) The nodal coordinates for an axisymmetric element are given as (r_1=0 , z_1=0) ; (r_2=[...] mm, z_2=0) and (r_3=0, z_3=50 mm). Evaluate Strain displacement matrix and stress str[...] relationship matrix for that element. Take E = 200 GPa, μ = 0.25.

14. (a) (i) Integrate the function $f(x) = x^2 + \cos(x/2)$ between the limits -1 and +1 by using 3 point Gaussian quadrature. (8)

(ii) Derive the shape function for a quadratic isoparametic element. (8)

(OR)

(i) Evaluate the Cartesian coordinate of the point P which has local coordinates $\varepsilon = 0.6$ and $\eta = 0.8$ as shown in the Fig 14. (b) (8)

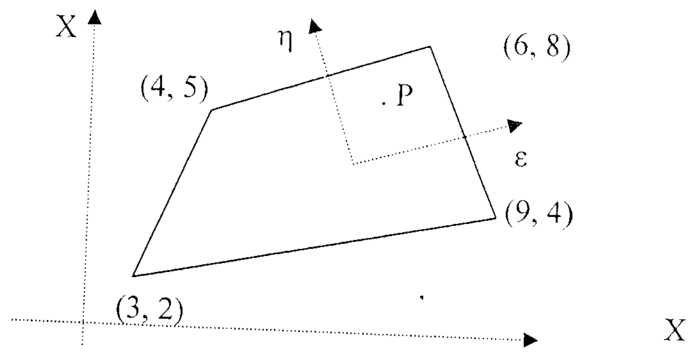

Fig 14. (b)

(ii) Derive shape function for a linear hexahedral element. (8)

15. (a) Consider a uniform cross section bar of length L made up of materials whose mass density $= \rho$, modulus of elasticity = E and cross sectional area = A, estimate the natural frequencies of axial vibration of the bar using lumped mass matrix and consistent mass matrix.

   (i) Consider one element of length L.

   (ii) Discretise the bar into two elements of length L/2.

(OR)

(b) Explain the procedure to determine the nodal displacement at different time increments for a given dynamic system by explicit direct integration method.

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