AE 2351/FINITE ELEMENT METHOD

1) Explain the general steps in FEA with the help of a flowchart?

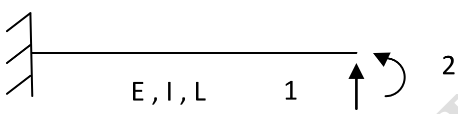
2) A beam AB of span 'L' simply supported at ends and carrying a concentrated load 'W' at the center 'C'. Determine the deflection at midspan by using the Rayleigh- Ritz method.

3) Solve the equations using Gauss- Elimination method
2x + 4y +2z = 15
2x + y + 2 z = -5
4x + y – 2z = 0

4) Describe the four types of weighted residual method.

5) Derive the governing equation for the finite element procedure and list down the convergence criteria for the finite element method. (NOV 2008)

6) Using the basic definition of stiffness coefficient derive the stiffness matrix for the beam shown in fig.



7) Explain the principle of minimum potential energy. Derive the governing equations for the finite element method using the above principle. List down the steps involved in the finite element method. (NOV 2001) Derive the stiffness matrix [K] for the truss element

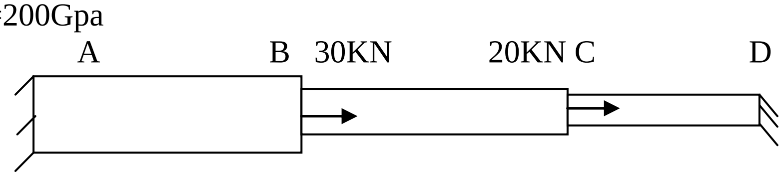
8) Derive the stiffness matrix [K] for the truss element

9) Derive the shape function for one-dimensional bar element.

10) Using finite element, find the stress distribution in a uniformly tapering bar of circular cross sectional area 3cm2 and 2 cm2 at their ends, length 100mm, subjected to an axial tensile load of 50 N at smaller end and fixed at larger end. Take the value of Youngs modulus as 2 x 105N/mm^2.

11) (i) Explain the Galerkin's method.
(ii) Explain the Gaussian elimination.

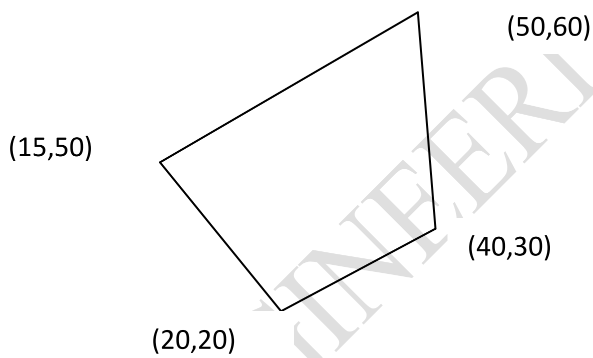
12)Compute the nodal displacements for the bar shown in fig.The segment AB is made of aluminium with length = 80mm, area 800mm2, E=70Gpa, The segment BC is made of brass with area 400mm2, E=105Gpa and the segment CD is made steel with length 60mm area 200mm2 and E=200Gpa



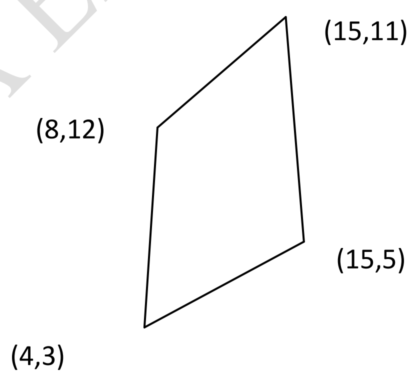
13) Derive the constitutive matrix for 2D element.

14) Derive the stiffness matrix for a constant triangular element. (NOV 2008)
15) Derive the shape function expressions for a linear strain triangular element in terms area coordinates. (NOV 2008)
16) Derive the strain displacement matrix for the linear strain triangular matrix. (NOV 2006)
17) Derive the shape function for a six noded triangular element with two degrees of freedom per node. (NOV 2006)

18) Derive the expression for the stiffness matrix for an axisymmetric shell element.
19) In detail explain the steps involved in the derivation of element stiffness matrix for a four noded quadrilateral isoparametric element. (NOV 2006)
20) Compute the stain displacement matrix for the quadrilateral element shown in fig at Gauss point r =0.57735 and s= -0.57735 (NOV-2006)



21) Compute the stain displacement matrix for the quadrilateral element shown in fig at Gauss point r =0.57735 and s= -0.57735 (NOV-2008)



22) Explain the terms plane stress and plane strain conditions. Give the constitutive laws for these cases.

23) Derive the element stiffness matrix for a linear isoparametric quadrilateral element.

24) Evaluate the integral by using Gaussian quadrature _ x2dx.

25) Compute the element matrices for the case shown in Fig 7. Heat conductivity is 2W/m K. Convection coefficient is 0.2 W/m2 K and the surrounding temperature is 40°C. The triangular co ordinates are (2,6) , (5,1) and (-2,2)

26) Solve the following equations using any one of the factorization methods.

$X_1-X_2 = 1$
$-X_1+2X_2-X_3 = 1$
$-X_2+2X_3-X_4 = 1$
$-X_3+2X_4-X_5 = 1$
$-X_4+2X_5 = 1$

27. Derive the Governing equation for the finite element procedure and list down the convergence criteria for the Finite element Method.

28.Using the basic definition of stiffness Coefficient derive the stiffness matrix for the beam shown in fig.1

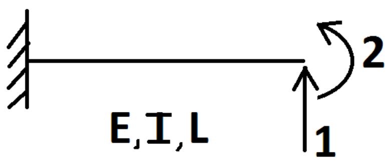


Fig. 1.

29(a) (i) Derive the stiffness matrix for a bar element with two nodes.

(ii) Compute the nodal displacements of the bar shown in fig. 2. The segment AB is made of aluminium with length = 80mm. Area =800 mm^2, E=70Gpa, the segment BC is made of brass with length = 1m, Area =400 mm^2 E = 105Gpa, and the segments CD is made of steel with Length =60mm, Area = 200 mm^2 E = 200Gpa.

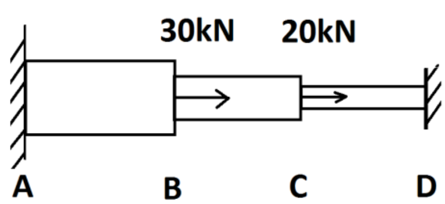
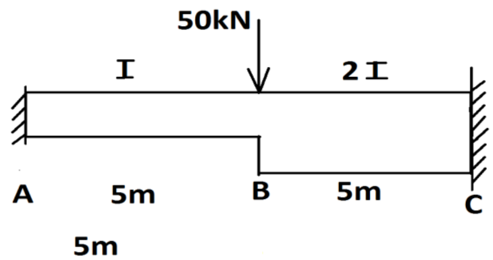


Fig. 2.

30.Compute the nodal displacements for the beam shown in fig. 3. E = 200Gpa and I = 8000 Cm^4. Use two element idealization.



31.Derive the stiffness matrix for a constant Triangular element.

32 (i) Derive the shape function expressions for a linear strain triangular element in terms area co-ordinates.
(ii) Derive the strain – displacement matrix for the linear strain triangular matrix.

33.Compute the strain displacement matrix for the isoparametric element shown In fig. 4 at the natural co-ordinate values r = + 0.57735 and s = - 0.57735

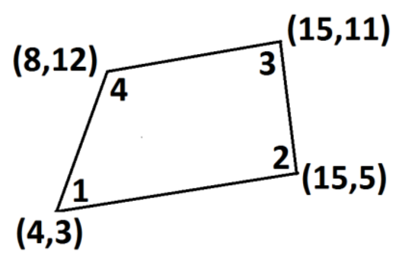


Fig.4.

34.Derive the consistent nodal load vector for the element shown in fig. 5.

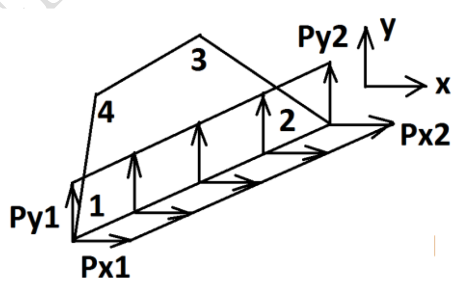


Fig. 5.

35.Compute nodal temperature values for the bar shown in fig.6. thermal conductivity (k) is 3 W/cm°C, convention coefficient (h) is 0.1 W/cm^{2}°C and surrounding temperature is 20°C. use two element idealization.

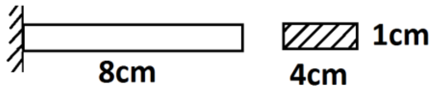


Fig.6.

36. Compute the element matrices for the case shown in fig. 7. Heat conductivity (k) is 2 W/cm°C, Convection is 0.2 W/cm°C and surrounding temperature is 40°C.

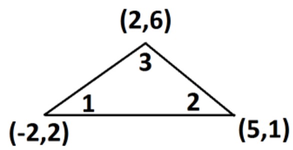
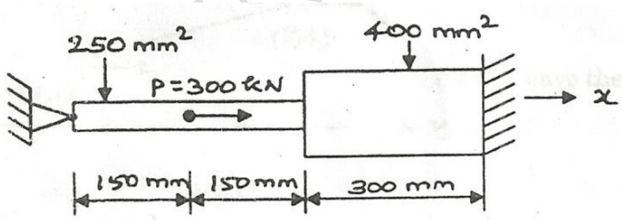


Fig. 7.

37(. (i) Show that the stiffness matrix for a finite element may be obtained in the form of [K] = $\int [B]\,[C]\,[B]\,dV$.

(ii) Explain how the bandwidth of global stiffness matrix can be minimized.

38 . Consider the stepped bar shown in Fig.1. Determine the nodal displacements and element stresses.



$E = 200\times10^{9} N/m^2$

FIG.1 STEPPED BAR

39.Consider a three-member truss shown in fig.2 all members of the truss have identical area of cross section A and modulus E. the hinged supports at joints A,B and C allow free motion of the members about the Z-axis. Determine the horizontal and vertical displacements at the joints C and forces in each member of the structure.

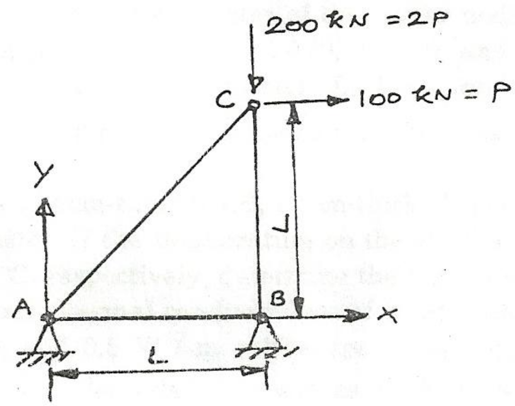
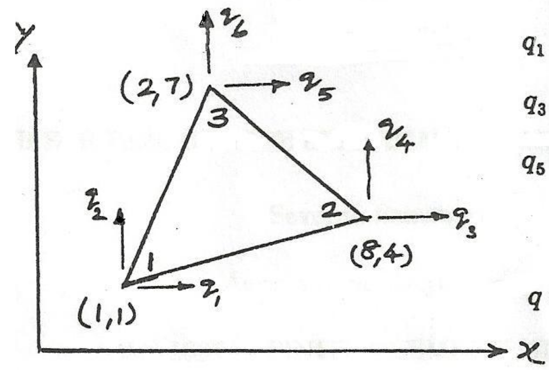


FIG.2

40.For the triangular element shown in fig.3, obtain the strain-displacement relation matrix B and determine the strains ϵ_x,ϵ_y and γ_{xy}.



$q_1 = 0.001$ $q_2 = -0.004$

$q_3 = 0.003$ $q_4 = 0.002$

$q_5 = -0.002$ $q_6 = 0.005$

q and x have the same units

FIG.3