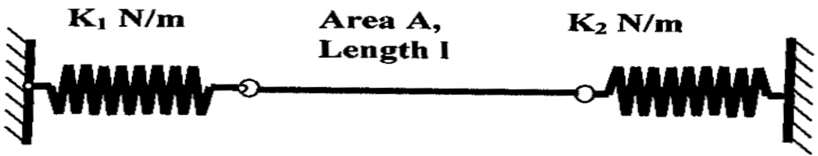
SATHYABAMA UNIVERSITY
(Established under section 3 of UGC Act, 1956)

Course & Branch: B.E - Aeronautical
Title of the paper: Finite Element Method
Semester: VI Max. Marks: 80
Sub.Code: 526E01 Time: 3 Hours
Date: 01-05-2008 Session: FN

PART – A (10 x 2 = 20)
Answer All the Questions

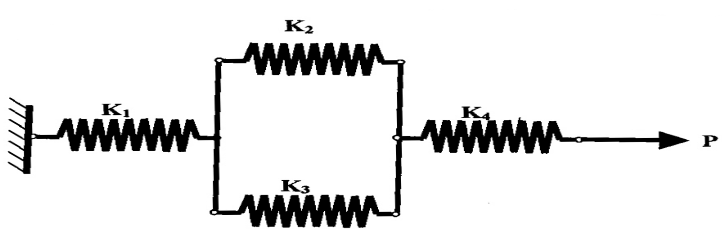
1. What is meant by discretization of domain?
2. State the principle of minimum potential energy.
3. What is meant by aspect ratio of an element?
4. Two springs and a bar are connected as shown. Give the stiffness matrix for the assembly if spring 1 is stretched along the axis.



5. State the purpose of interpolation models.
6. Sketch a cubic three –dimensional element.
7. What are Isoparametric Elements?
8. What is the necessity for Natural coordinate system?
9. Name any four commercial Finite element packages.
10. Mention the advantages of Finite Element Method.

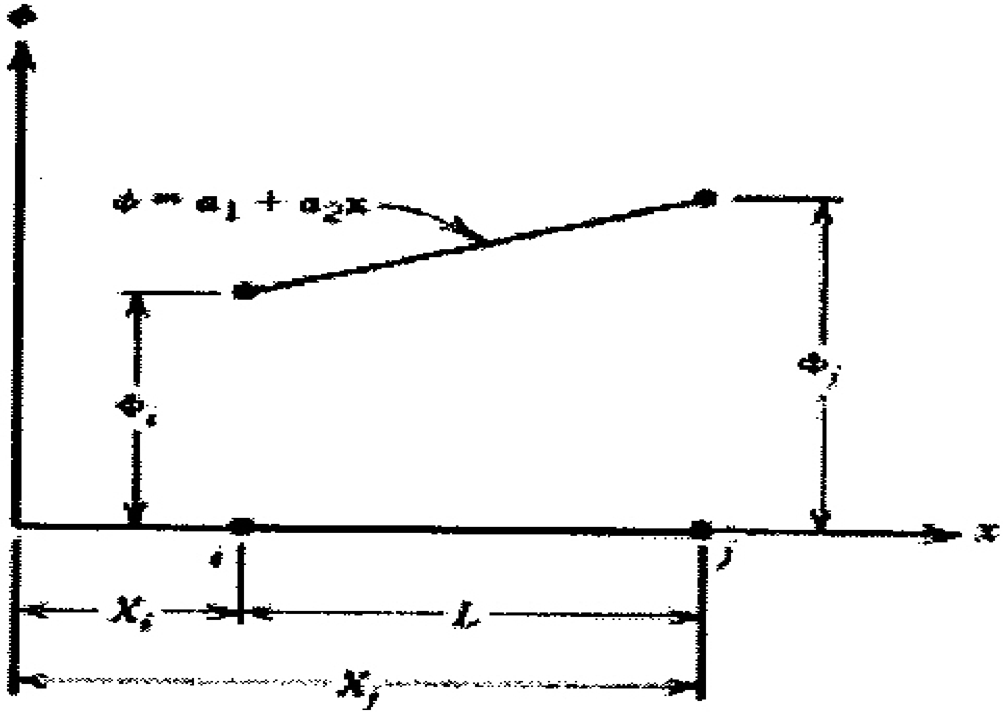
PART – B (5 x 12 = 60)
Answer All the Questions

11. For the spring system shown below, if the stiffness of all springs is equal to 170kN/m and P=250kN, determine 1. Global stiffness matrix 2. Nodal displacements 3. Reactions and 4. Force in each spring.

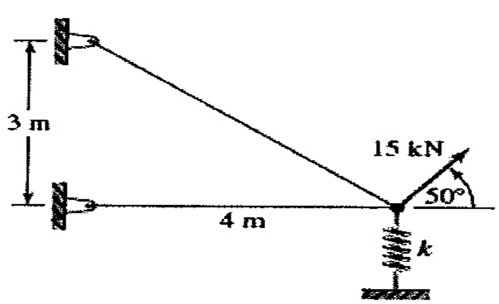


(or)

12. A one-dimensional linear element used to approximate the temperature distribution, $\phi(x)$ in a fin is shown below. A) Develop shape function $N_i(x)$ and $N_j(x)$ starting with $\phi(x) = a_1 + a_2 (x)$ and solving for a_1 and a_2. b) Given $X_i = 3$ and $X_j = 4.5$, $\phi_i = 27°C$ and $\phi_j = 33°C$. Find ϕ (3.6).



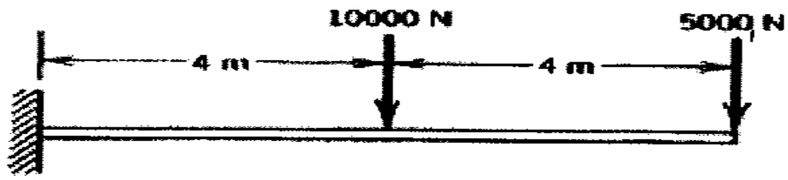
13. A two-member plane truss supported by a linearly elastic spring is shown below. The truss members are of solid circular section having d = 20mm and E = 80 GPa. The spring has a stiffness of 50 N/mm. (a) Assemble the system global stiffness matrix (b) Calculate the global displacements of the unconstrained node. (c) Compute the reaction forces.



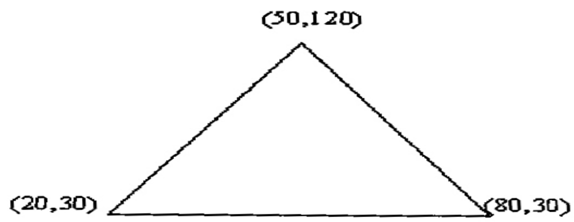
(or)

14. Consider the beam shown below. Given $E = 20 \times 10^6$ N/cm^2 and $I = 8000$ cm^2, determine 1. The global stiffness matrix for the

structure. 2. Nodal displacements 3. Rotations at nodes. And 4. Forces in each element.

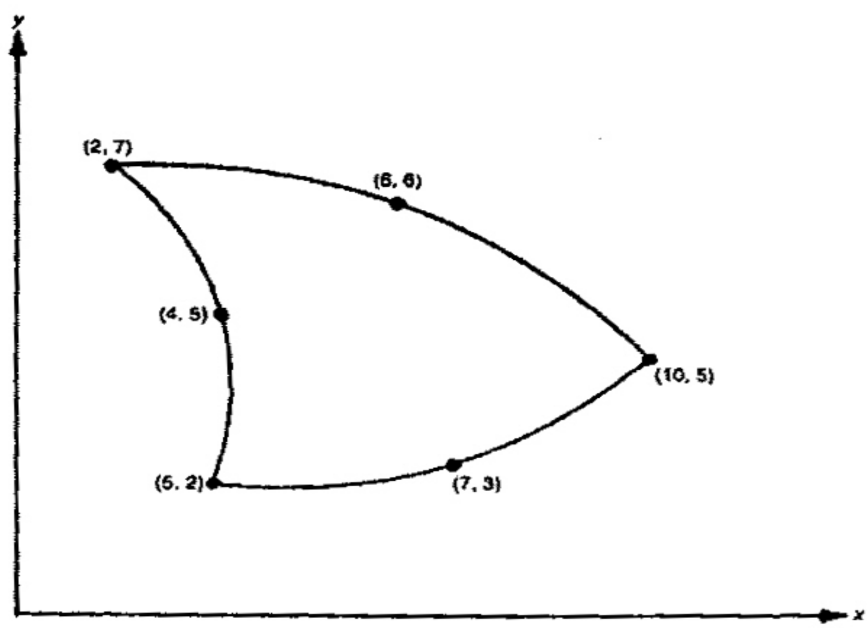


15. Evaluate the stiffness matrix for the element shown below. The coordinates are given in units of millimeters. Assume plane stress condition. Let E = 210 GPa, v = 0.3 and t = 10mm.

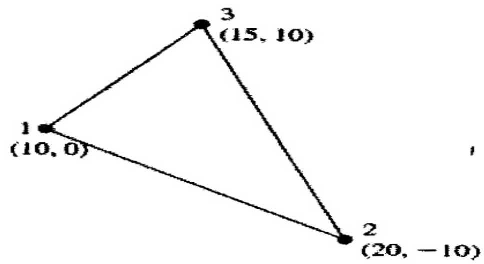


(or)

16. Determine the jacobian matrix for the quadratic isoparametric triangular element shown below.



17. A three-node triangular element having nodal coordinates as shown below is to be used as an axisymmetric element. The material properties are E = 82GPa and v= 0.3. The dimensions are in millimeters. Calculate the element stiffness matrix.



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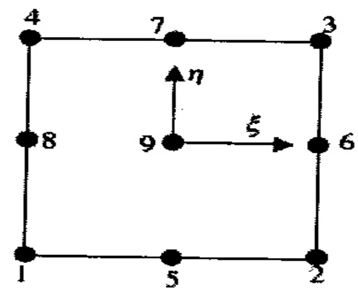
18. (a) Use lagrangian interpolation formula to derive the shape function. For a nine-node element using ξ, η coordinates and the node numbering sequence shown. (7)



(b) Using Gauss integration evaluate $\int_{-1}^{1}\int_{-1}^{1}(r^2 s^3 + rs^4)\,dr\,ds$ (5)

19. Explain the following:
 a) Finite element and node. (3)
 b) Bandwidth and Node numbering scheme (5)
 c) Convergence of Finite element Solution. (4)

(or)

20. Find the temperature distribution in the circular fin shown below. Include the convection loss from the end of the fin.