

IV B.Tech II Semester Regular Examinations, Apr/May 2008

FINITE ELEMENT METHODS

(Common to Mechanical Engineering and Production Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. Determine the circumference of a circle of radius 'r' using the basic principles of finite element method. [16]
2. With a suitable example, explain the physical interpretation of finite element method for one dimensional analysis. [16]
3. Derive the element stiffness matrix for the 2-noded beam element using direct approach. [16]
4. A triangular plate is subjected to a transverse load of 1kN as shown in figure 4. Find the transverse displacement and the stresses induced in the plate using one element idealization. Assume $E = 205 \text{ Gpa}$. Poisson's ratio $\mu = 0.33$ and thickness $t = 10 \text{ mm}$. [16]

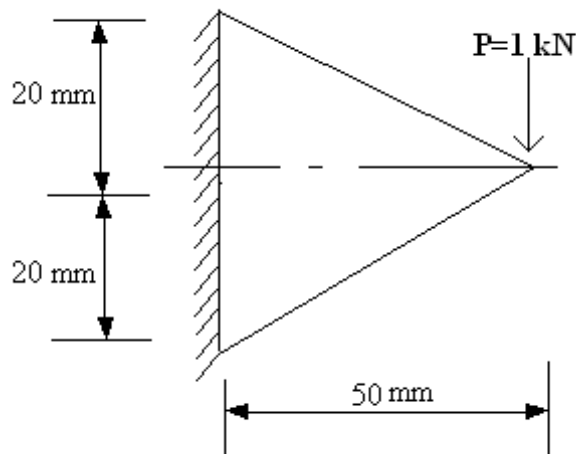


Figure 4

5. Derive the element conductivity matrix and load vector for solving 1- D heat conduction problems, if one of the surfaces is exposed to a heat transfer coefficient of h and ambient temperature of T_∞ ? [16]
6. Find the natural frequencies and the corresponding mode shapes for the longitudinal vibrations for the stepped bar.
Assume $A_1 = 2A$ and $A_2 = A$; $I_1 = I_2 = I$; $E_1 = E_2 = E$. [16]
7. Write a procedure for model creation and mesh generation for aerofoil shape turbine blades. [16]

Code No: RR420302

Set No. 1

8. With an example, explain the procedure involved in solving an engineering problem in computational finite element analysis using computer software. [16]

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1. If a displacement field is described as follows,
 $u = (-x^2 + 2y^2 + 6xy)10^{-4}$ and $v = (3x + 6y - y^2)10^{-4}$
 Determine the strain components ϵ_{xx} , ϵ_{yy} , and ϵ_{xy} at the point $x = 1; y = 0$. [16]
2. With a suitable example, explain the physical interpretation of finite element method for one dimensional analysis. [16]
3. Derive the methodology to develop a stiffness matrix and load vector for a 2-noded beam element with 2 degree of freedom? [16]
4. (a) Explain about Local Co-ordinate system.
 (b) The nodal coordinates and its functional value of a triangular linear element is given below. Calculate the value at (20, 6). [6+10]

	Co-ordinates	Value
Node 1	(13,1)	190
Node 2	(25, 6)	160
Node 3	(13,3)	185

5. A fin of size $2.5 \text{ cm} \times 25 \text{ cm} \times 250 \text{ cm}$ extends from a wall. If the wall temperature is maintained at 900°C and the ambient temperature is 30°C , determine the temperature distribution in the fin 1-D elements along x-direction. Take $k = 35 \text{ W/mK}$ and $h = 120 \text{ W/m}^2\text{K}$. [16]
6. Derive the elemental mass matrix for 1-D bar element and 1-D plane truss element? [16]
7. (a) Explain the automatic mesh generation technique.
 (b) Explain coupled field analysis and give some examples. [8+8]
8. Give the necessity of rotating and offsetting the work plane in ANSYS environment. What are the useful features of CAEFEM package in analysis? [16]

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1. What are the basic steps involved in finite element analysis and explain them briefly. [16]
2. Derive the shape functions for a one dimensional linear line element in global Co-ordinate system. [16]
3. A cantilever beam of 1 m length carries a single point load at the end of the beam of 10 kN. Calculate the deflection at the end of the beam using FEM, if $E = 70$ Gpa, $A = 500 \text{ mm}^2$ and $I = 2500 \text{ mm}^4$. [16]
4. Calculate the nodal forces of the four node axisymmetric finite element shown in figure4 when the element is subjected to centrifugal loading. [16]

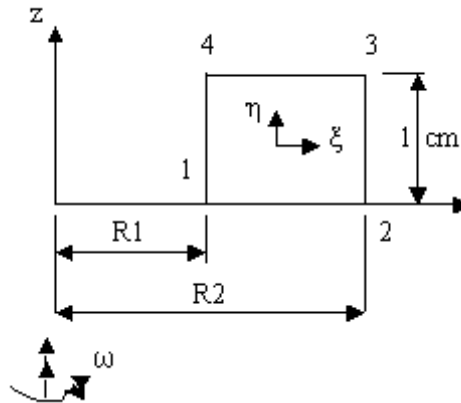


Figure 4

5. Determine the temperature distribution in a circular tapered fin varies the diameter from 4 cm to 1 cm over a length of 1 m. The convection takes place on lateral surface as well as tip. The conductivity of the fin material is 200 W/m K , heat transfer coefficient over the surface is $980 \text{ W/m}^2\text{K}$ and $T_\infty = 22^\circ\text{C}$. Assume base temperature is 100°C . [16]
6. Explain the following with examples.
 - (a) Lumped parameter model.
 - (b) Continuous system model. [8+8]
7. Derive strain displacement matrix (B) for four node tetrahedral element. [16]

Code No: RR420302

Set No. 3

8. Give the necessity of rotating and offsetting the work plane in ANSYS environment.
What are the useful features of CAEFEM package in analysis? [16]

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1. Explain briefly about the following:
 - (a) Variational method.
 - (b) Importance of Boundary conditions. [8+8]
2. With a suitable example, explain the physical interpretation of finite element method for one dimensional analysis. [16]
3. Define and derive the Hermite shape functions for a two noded beam element? [16]
4. (a) What is a constant strain triangular element? State its properties and applications.
- (b) The nodal coordinates of the triangular element are shown in figure4b . At the interior Point P

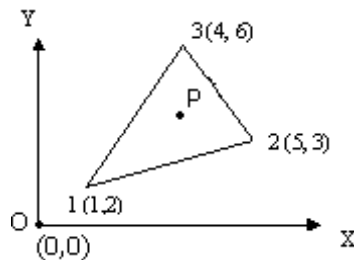


Figure 4b

- the x coordinate is 3.3 and the shape function at node 1 is N_1 is 0.3. Determine the shape functions at nodes 2 and 3 and also the y coordinate of the point P. [5+11]
5. Discuss the method to solve 1-D steady state heat transfer problem using variational principle and compare with the Galerkin's method of solution. [16]
 6. Derive the elemental mass matrix for 1-D bar element and 1-D plane truss element? [16]
 7. The coordinates of the nodes of a 3-D simplex elements are given below.

Node number	Coordinate of the node		
	X	Y	Z
i	0	10	0
j	10	0	0
k	0	15	0
l	0	0	20

Determine the shape function of the element. [16]

8. (a) What is the necessity of determining Von misses stresses in finite element static analysis?

(b) Briefly explain about ANSYS software package. [8+8]
