

KATHMANDU UNIVERSITY
End Semester Examination [C]
May/June, 2019

Marks Scored:

Level: B. E.
Year : IV

Course : MEPP 430
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date **31 MAY 2019**

SECTION "A"

[5 Q. × 1 = 5 marks]

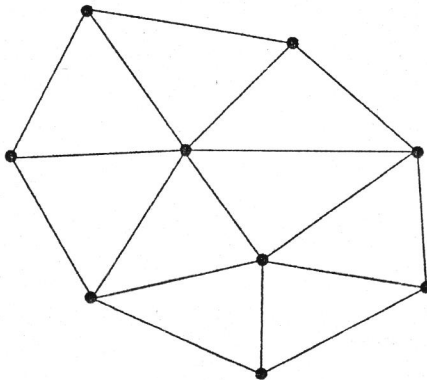
Choose and encircle the most appropriate answer.

- The number of nodes on an element that has polynomial basis functions of order k is solution by FEM is
 - k
 - $k-1$
 - $k+1$
 - $2k$
- Determinant of assembled stiffness matrix before applying boundary condition is
 - Less than zero
 - Equal to zero
 - Greater than zero
 - Depends on the problem
- If a one-dimensional simplex element has its ends located at $x_1 = 50$ and $x_2 = 100$, its pyramid function will be
 - $N_i(e) = \frac{100-x}{50}$ and $N_j(e) = \frac{x-50}{50}$
 - $N_i(e) = \frac{x-50}{50}$ and $N_j(e) = \frac{100-x}{50}$
 - $N_i(e) = \frac{x-100}{100}$ and $N_j(e) = \frac{x-50}{100}$
 - $N_i(e) = -\frac{x-60}{80}$ and $N_j(e) = \frac{x-20}{80}$
- The transmission lines (wires) carrying electricity are supported by electric transmission towers and are subjected to axial tension and gravity, wind and snow loads. The most suitable types of finite elements/models that can be used for the stress analysis of transmission lines is
 - Bar element
 - Beam element
 - Fluid element
 - Electrical resistor element
- Boundary conditions associated with primary variable are called
 - primary boundary conditions
 - secondary boundary conditions
 - natural boundary conditions
 - essential boundary conditions

SECTION "B"
[5 Q. × 1 = 5 marks]

Fill in the blanks with appropriate word or sign(s).

6. Any point in a structure can have maximum _____ Degree of freedom.
7. FEM divides the structure into elements and nodes is called _____
8. The process of computing desired quantities in numerical form or graphical form, from the known finite element solution is called _____
9. Write down the interpolation function for three node triangular element.
 $N_i(x, y) =$ _____
 $N_j(x, y) =$ _____
 $N_k(x, y) =$ _____
10. Label the elements and nodes for each of the systems shown in figure to produce a minimum bandwidth. In addition, find the resulting bandwidth in each case.



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SECTION "C"

Attempt *ALL* questions. Assume suitably if any data missing. Do not change the node and element number if specified.

1. Consider the flow of an incompressible fluid through the networks of three pipes as shown in figure. The viscosity of the fluid is $\mu = 1.6 \times 10^{-6}$ lbf-sec/in and the density is $\rho = 1.9$ slugs /ft³. Determine the following. [5]
 - i. Fluid pressure at node 2
 - ii. Volume flow rate in each of the pipe

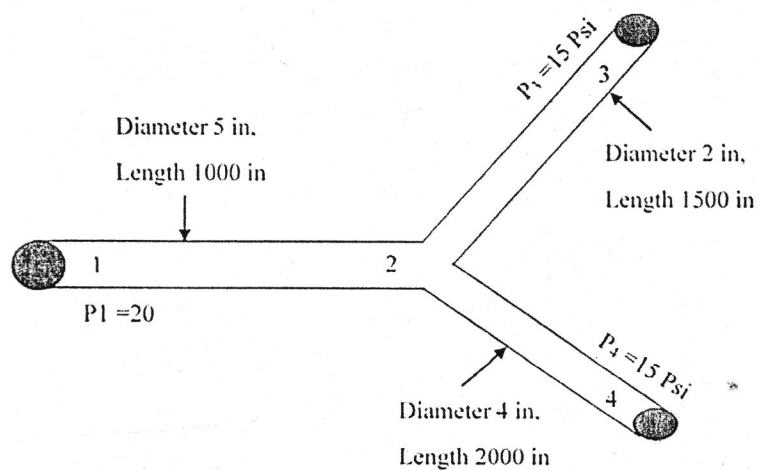


Figure 1

2. For the spring assemblages shown in figure, determine the nodal displacements, the forces and the reactions by using **variation method**. [5]

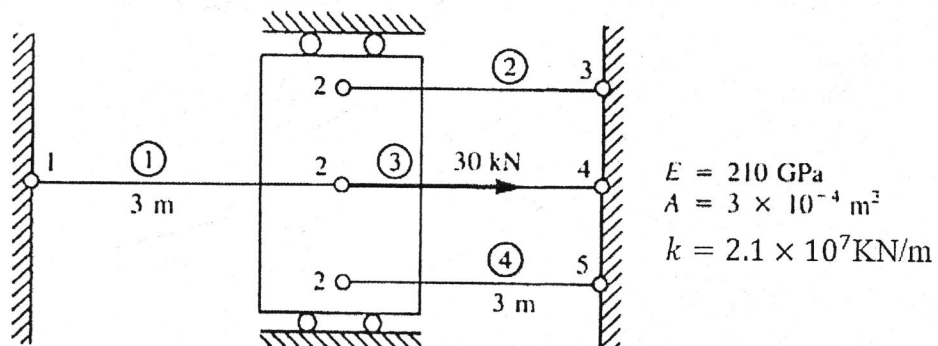


Figure 2

3. Determine the axial force P in each portion, AB and BC, of the uniaxial bar shown in figure. What are the support reactions? Young's modulus is $E = 100\text{GPa}$; area of cross sections of the two portions AB and BC are $1 \times 10^{-4} \text{ m}^2$ and $2 \times 10^{-4} \text{ m}^2$ respectively, and $F=10000 \text{ N}$. The force is applied at the cross section at B. [4]

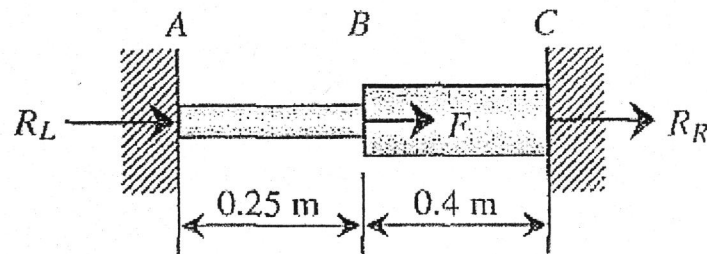


Figure 3

4. For the beam shown in figure, determine the nodal displacements and, slope at the nodes in each element. [5]

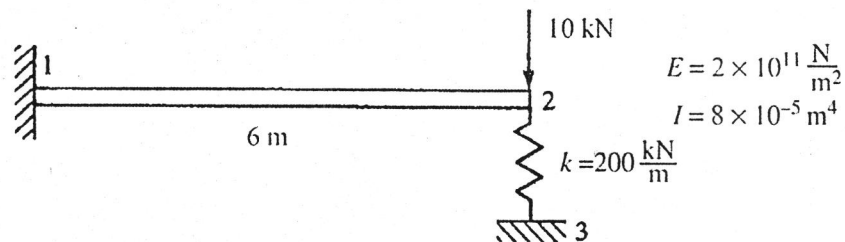
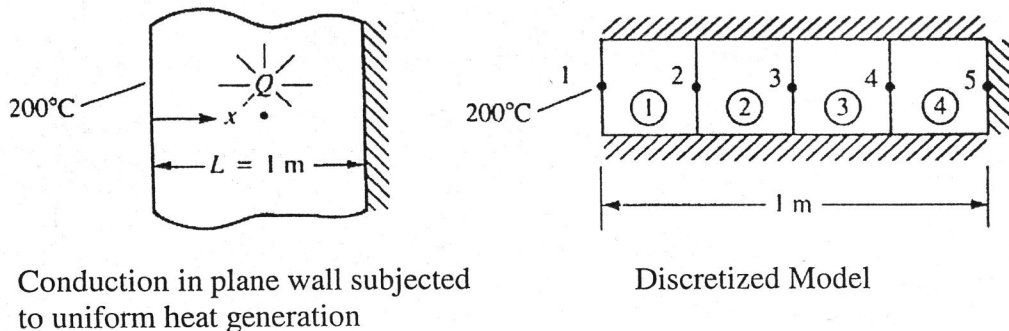


Figure 4

5. The plane wall shown in Figure is 1 m thick. The left surface of the wall ($x=0$) is maintained at a constant temperature of 200°C , and the right surface ($x=L=1 \text{ m}$) is insulated. The thermal conductivity is $K_{xx} = 25 \text{ W/(m}^\circ\text{C)}$ and there is a uniform generation of heat inside the wall of $Q = 400 \text{ W/m}^3$. Determine the temperature distribution through the wall thickness using **Galerkin method**. [5]



Conduction in plane wall subjected to uniform heat generation

Discretized Model

Figure 5

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6. Find the nodal displacements in the propped beam shown in Figure. Idealize the beam into two CST elements as shown in the figure. Assume plane stress condition. Take $\mu = 0.25$, $E = 2 \times 10^5 \text{ N/mm}^2$, Thickness = 15mm. [6]

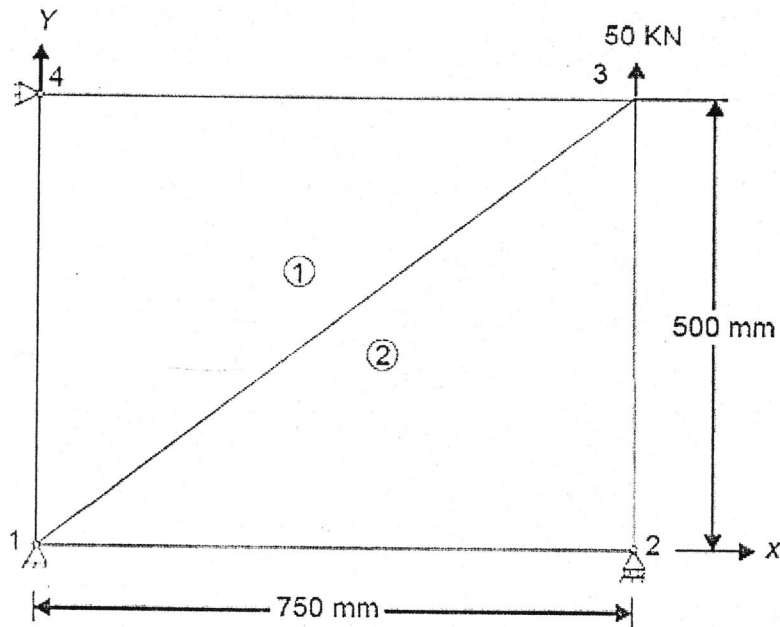


Figure 6

