KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2017

JUL 3 0 2017

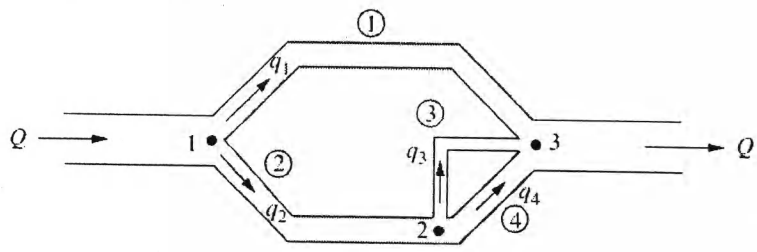
Level : B.E.
Year : IV
Time : 2 hrs.

Course : MEPP 430
Semester : II
F. M. : 30

SECTION "C"
[6Q × 5 = 30 marks]

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

1. In a pipe network as shown in figure, water enters the network at arate of $0.1 m^3/s$ with a viscosity of 0.96×10^{-3} Ns/m^2. The component details are given in Table. Determine the pressure values at all nodes.

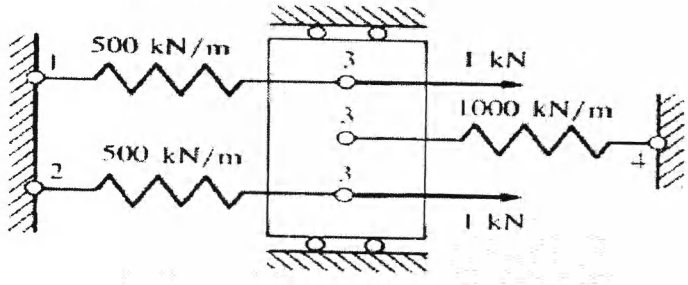


• – Node

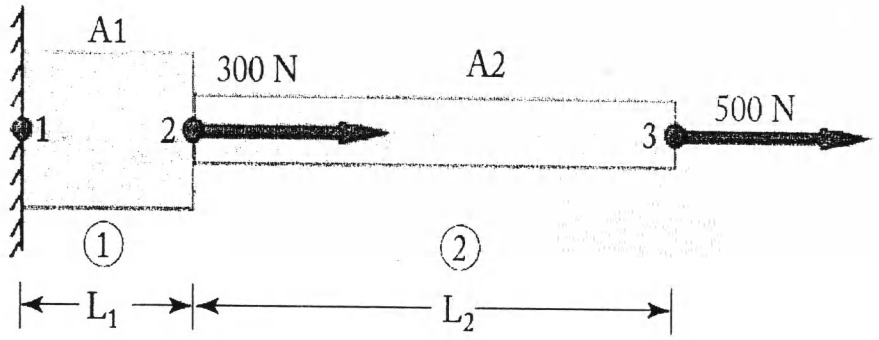
◯ – Element

Details of pipe network		
Component Number	Diameter(cm)	Length(m)
1	2.5	30
2	2	20
3	2	25
4	1.25	20

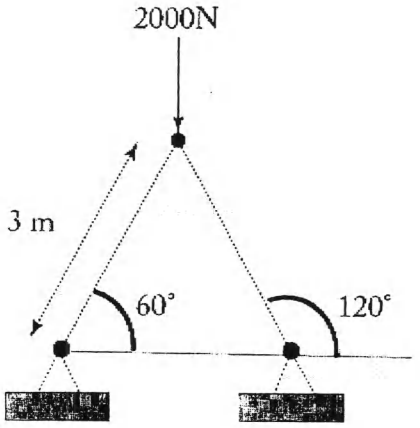
2. For the spring assemblages shown in figure, determine the nodal displacements, the forces and the reactionsby using **variation method.**



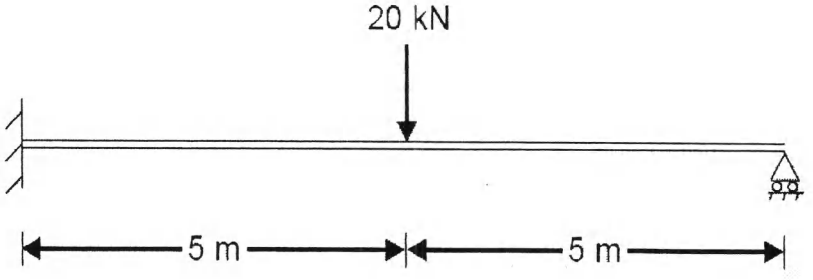
3. A compound axial member is subjected to the loads shown in figure. Given, E_1=50 MN/m^2, E_2= 100 MN/m^2, L_1= 0:5 m, L_2= 1 m, A_1=20 cm^2, and A_2=10 cm^2. Determine (i) reaction force at points 1 (F1) and (ii) displacements at nodes 2 and 3 (u_2 and u_3) usingtwo bar elements model.



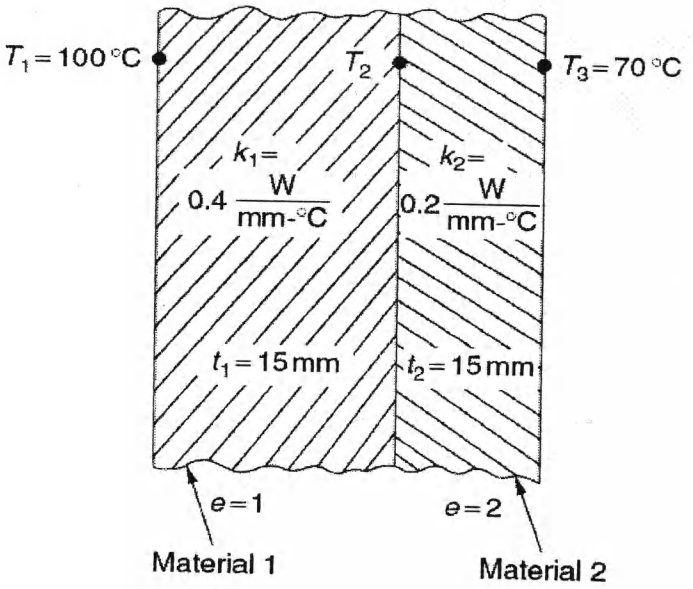
4. A solid 304 Stainless Steel truss has a load applied as shown in figure. Eachmember has a cross sectional area of 27 cm^2 and a Young's modulus of 190 GPa. Find the displacements under the load, reaction forces, and stress in each truss member.



5. A beam of length 10 m, fixed at one end and supported by a roller at the other end carries a 20 kN concentrated load at the center of the span. By taking the modulus of elasticity of material as 200 GPa andmoment of inertia as 24 × 10^{-6} m^4, determine:
   a) Deflection under load
   b) Reactions at supports



6. A composite wall, made up of two materials, is shown in Figure. Thetemperatures on the left and right faces are maintained at constant values of 100 °C and 70 °C, respectively. Find the temperature distribution in the wall using a **Galerkin Method** for each of the two materials.



Marks Scored:

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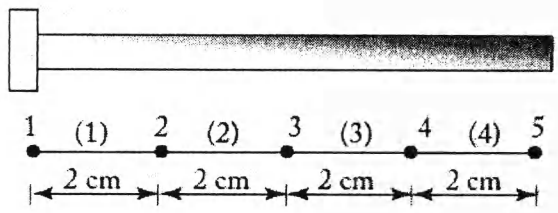
Exam Roll No. : | Time : 30 mins. | F. M. : 10
Registration No. : | Date JUL 30 2017

SECTION "A"
[10 Q. × 0.5 = 5 marks]

Choose most appropriate answer of the following questions.

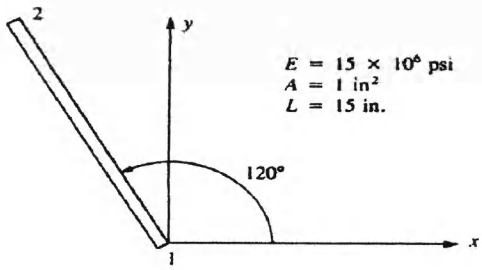
1. The temperature distribution along the fin was approximated using four linear 1 D elements. The nodal temperatures and the corresponding positions are shown in figure. What is the temperature of the fin at the global (X) location (at left support) for X=3 cm?



$$\begin{Bmatrix} T_1 \\ T_2 \\ T_3 \\ T_4 \\ T_5 \end{Bmatrix} = \begin{Bmatrix} 100 \\ 75.00 \\ 60.00 \\ 52.0 \\ 48.00 \end{Bmatrix} {}^{\circ}C$$

a. 66.7 ^{0}C b. 67.5 ^{0}C c. 68.5 ^{0}C d. 69.5 ^{0}C

2. For the bar element shown in figure, the global x-y stiffness matrix is



a. $\frac{10^6}{4}\begin{bmatrix} 1 & -\sqrt{3} & -1 & \sqrt{3} \\ -\sqrt{3} & 3 & \sqrt{3} & -3 \\ -1 & \sqrt{3} & 1 & -\sqrt{3} \\ \sqrt{3} & -3 & -\sqrt{3} & 3 \end{bmatrix} lb/in.$

b. $\frac{10^6}{4}\begin{bmatrix} 1 & -\sqrt{3} & -1 & \sqrt{3} \\ -\sqrt{3} & 3 & \sqrt{3} & -3 \\ -1 & \sqrt{3} & 1 & -\sqrt{3} \\ \sqrt{3} & -3 & -\sqrt{3} & 3 \end{bmatrix} lb/in.$

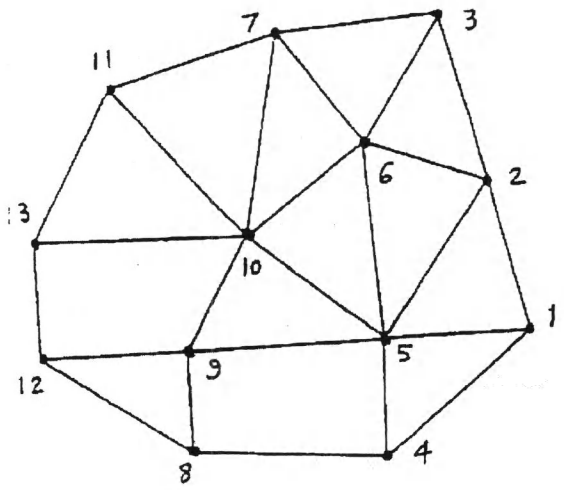
c. $\frac{10^6}{4}\begin{bmatrix} 1 & -\sqrt{3} & -1 & \sqrt{3} \\ -\sqrt{3} & 3 & \sqrt{3} & -3 \\ -1 & \sqrt{3} & 3 & -\sqrt{3} \\ \sqrt{3} & -3 & -\sqrt{3} & 1 \end{bmatrix} lb/in.$

d. $\frac{10^6}{4}\begin{bmatrix} 3 & -\sqrt{3} & -1 & \sqrt{3} \\ -\sqrt{3} & 1 & \sqrt{3} & -3 \\ -1 & \sqrt{3} & 1 & -\sqrt{3} \\ \sqrt{3} & -3 & -\sqrt{3} & 3 \end{bmatrix} lb/in.$

JUL 3 0 2017.

3. Identify the wrong statement
   a. Higher order elements generally gives more accurate solution
   b. Area coordinates depend on the number of nodes used to define the triangular element.
   c. The number of nodes and placement of the nodes for higher order elements must satisfy certain requirements.
   d. Shape function for triangular finite element of any order can be derived using the area coordinates.

4. The plate shown in figure is modeled using 13 triangular elements. Assuming one degree of freedom, the maximum band width of the system matrix is
   a. 2 b. 5 c. 8 d. 11



5. The number of nodes on an element that has polynomial basis functions of order k is
   a. k b. 2k c. k+1 d. k-1

6. Determinant of assembled stiffness matrix before applying boundary condition is
   a. Equal to zero
   b. Less than zero
   c. Greater than zero
   d. Depends on the problem

7. In the finite element analysis, solution is/are valid at
   a. nodes only
   b. every point of the element
   c middle of the element
   d. depends upon type of element considered

8. When utilizing the trial function method for solving differential equations the undermined coefficient of the resulting equation is
   a. Integral equation
   b. Linear equations
   c. Differential equation
   d. Lower order differential equation

9. Which of the following is the most difficult aspect of the analytic method?
   a. Too many variables
   b. The high order of equations
   c. The low accuracy of the result
   d. Complex geometries and difficulties in dealing with boundary conditions

10. The integral of the weighted residual method calculates:
    a. The sum of basis functions on the whole domain
    b. The sum of trial function on the whole domain
    c. Some of the errors on the whole domain
    d. Some of the errors on the partial domain

SECTION "B"

[5 Q. × 1 = 5 marks]

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

11. The coefficient of the basis function is .....

12. Degrees of freedom are defined as the values of a primary variable at ..... points.

13. The truss member is a ..... element when viewed in the local coordinate system.

14. Serendipity elements have.....node.

15. In the global expansion approximation of a function, the selected basis function should be defined in .....