KATHMANDU UNIVERSITY
End-Semester Examinations
February/March, 2019

Marks scored:

Level : B.E.
Year : III

Course : MEEG 325
Semester: I

Exam Roll No.: Time: 30 mins. F.M. : 10

Registration No.: Date : FEB 27 2019

SECTION "A"
[5 Q. × 1 = 5 marks]

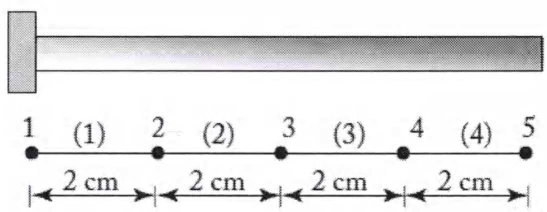
Choose the correct answer from the given options and encircle the letter of your choice.

1. Higher order elements are desirable when:
   a) linear elements is not possible
   b) reduced computational effort is required
   c) domain is simple
   d) gradient of the field variable varies rapidly

2. When locations of nodes are changed by fixing the number of elements, the method is known as:
   a) h-method b) p-method c) r- method d) mixed method

3. Isoparametric elements are extensively used for the analysis of:
   a) truss elements b) plates c) shells d) beams

4. The temperature distribution along the fin was approximated using four linear 1D 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=3cm?



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

   a) 67.5^0C b) 68.5^0 C c) 69.5^0C d) 70.5^0C

5. 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

SECTION "B"
[5 Q. × 1 = 5 marks]

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

1. External equilibrium equations ensure the force and ———— equilibrium along or about the x, y, and z axes.system.

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

3. The basic idea in the Choleski method is the Product————— of a square symmetric matrix into lower and upper triangular matrices.

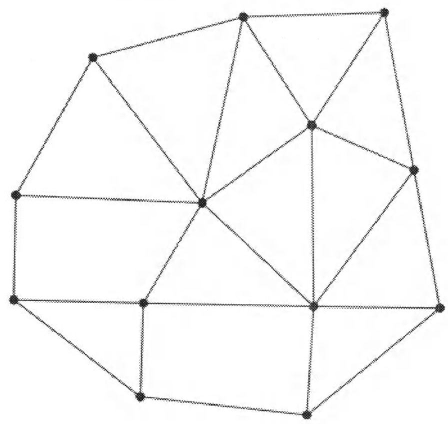
4. Write down the interpolation function for three node triangular element.

    $N_i(x, y) =$ —————————

    $N_j(x, y) =$ —————————

    $N_k(x, y) =$ —————————

5. The plate shown in figure below is modeled using 13 triangular and 2 quadrilateral elements. Label the nodes such that the bandwidth of the system matrix is minimal.



KATHMANDU UNIVERSITY
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FEB 2 7 2019

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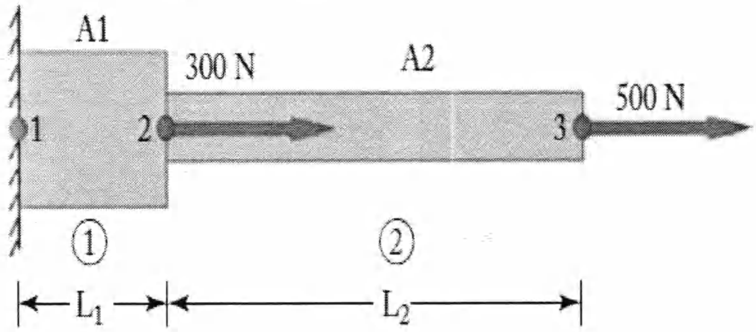
F.M. : 30

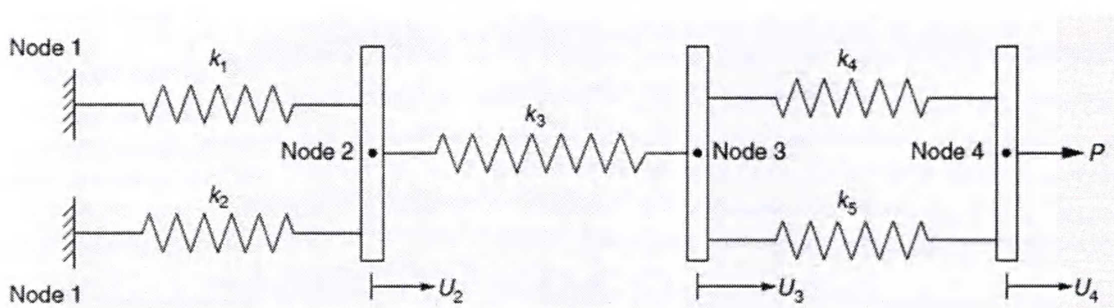
SECTION "C"

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

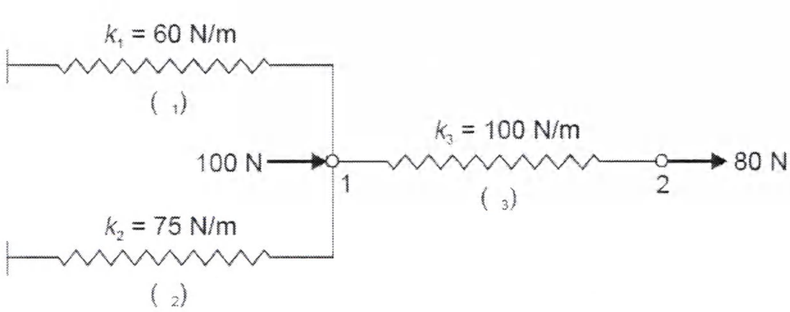
1. A compound axial member is subjected to the loads shown in Figure. Given, $E_1 = 50$ MN/m^2, $E_2 = 100$ MN/m^2, $L_1 = 0{:}5$ m, $L_2 = 1$ m, $A_1 = 20$ cm^2, and $A_2 = 10$ cm^2, Find (i) displacements at nodes 2 and 3 (u_2 and u_3) using two bar **quadratic elements model**. [5]



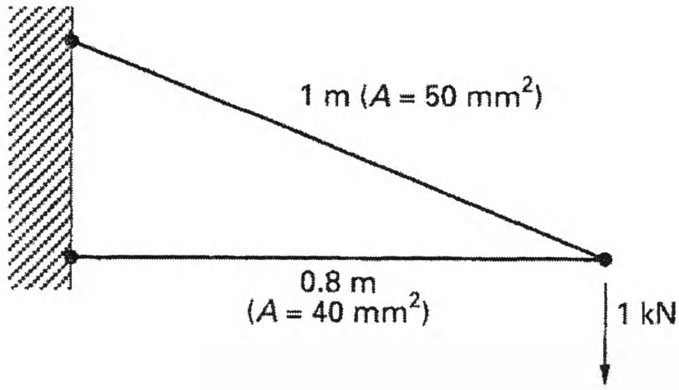
2. Five springs, having stiffness $k_1 = 10^5$ N/m, $k_2 = 2 \times 10^5$ N/m, $k_3 = 3\times10^5$ N/m, $k_4 = 4\times10^5$ N/m, and $k5 = 5\times10^5$ N/m are connected as a parallel-series system, which is subjected to a load P = 1000 N at node 4 as shown in figure. Determine the displacements of nodes 2, 3, and 4 using the finite element method. [5]



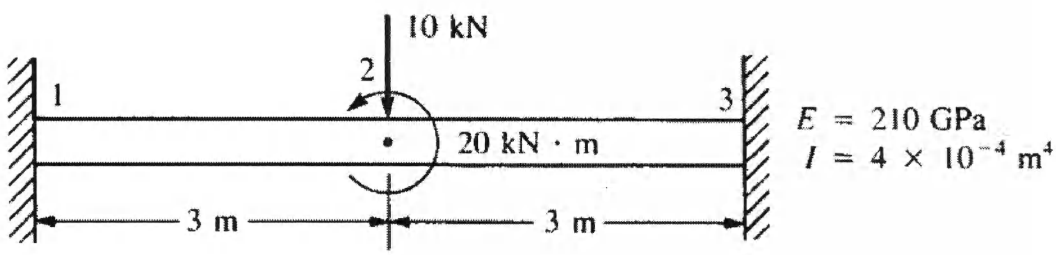
3. Determine the displacements of nodes 1 and 2 in the spring system shown in Figure. Use **minimum of potential energy principle** to assemble equations of equilibrium. [4]



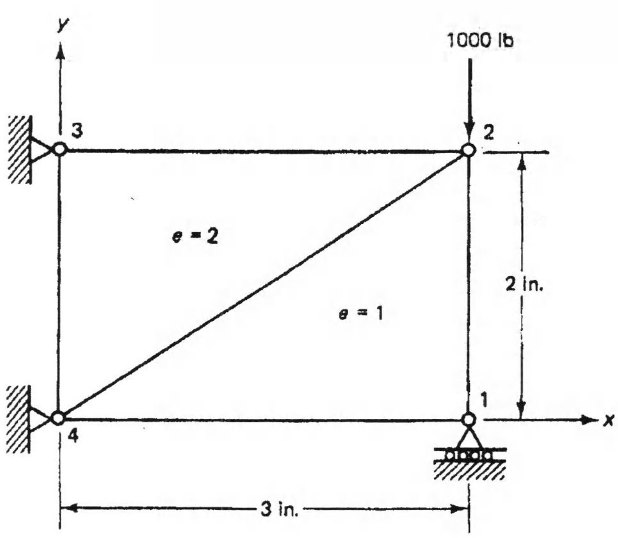
4. Find the axial force in the two member of the simple truss shown in figure. Each member has Young's modulus of 200 $\times 10^3$MPa. [5]



5. For the beams shown in figure, determine the displacements and the slopes at the nodes. [5]



6. Consider a thin plate having thickness t = 0.5 in. being modeled using two CST elements, as shown. Assuming plane stress condition, (a) determine the displacements of nodes 1 and 2. [6]



Thickness t = 0.5 in., E = 30 X 10^6 psi, ν = 0.25