KATHMANDU UNIVERSITY
End Semester Examination
February/March, 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 08 MAR 2019

SECTION "A"

[5 Q. × 1 = 5 marks]

Choose and encircle the most appropriate answer.

1. The solution by FEM is
   a. always exact b. never exact c. sometimes exact d. mostly apporximate

2. Primary variable in FEM structural analysis is
   a. displacement b. force c. stress d. strain

3. Number of terms in the displacement function in relation to the number of nodes in that element is
   a. more b. equal c. less d. unrelated

4. In the electrical circuit, the element characteristic matrix $[K^e]$, denotes the relation between
   a. nodal current and nodal resitance
   b. nodal resistance and nogal voltages
   c. nodal currents and nodal voltages
   d. nodal current only .

5. Interpolation function
   a. gives the value of field variable at nodal
   b. gives the value of field variable at neighbor node
   c. gives the value of field variable at neighbor node
   d. calculate the value of field variable inside an element

SECTION "B"

[5 Q. × 1 = 5 marks]

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

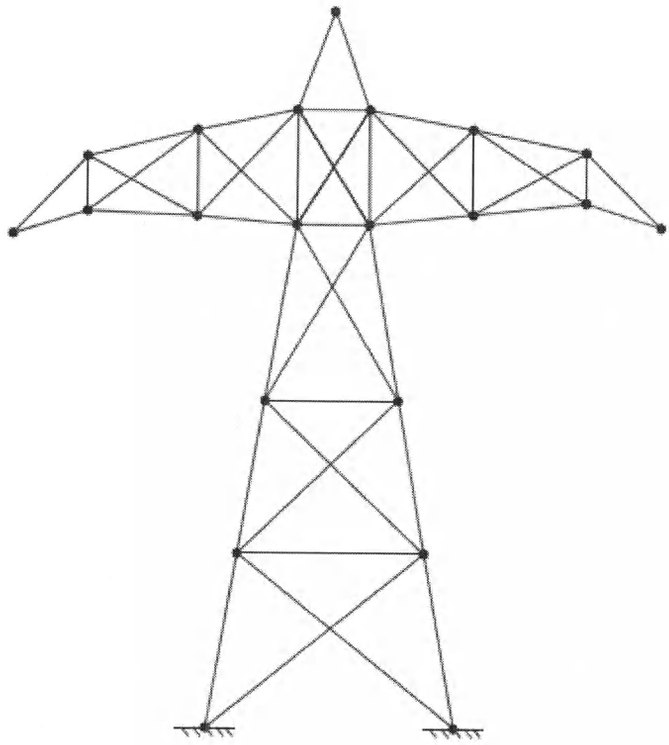
6. A triangular element with cubic displacement function requires _____ nodes to represent the complete polynomial.

7. The deformation in the Z direction of the beam is primarily due to _____ Effects.

8. A general plate element is a superposition of _____elements.

9. Plane stress is defined to be a state of stress in which the normal stress and the shear stresses directed _____ to the plane are assumed to be zero.

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.



KATHMANDU UNIVERSITY
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SECTION "C"

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

1. Develop the weak form for the given strong form of a differential equation.

$$\frac{d}{dx}\left(AE\frac{du}{dx}\right) + 10Ax = 0, \qquad 0 < x < 2$$

$$u_x = \mathrm{u}(0) = 10^{-4}$$

$$\sigma_{x=2} = \left(AE\frac{du}{dx}\right)_{x=2} = 10$$

Starting from the weighted integral statement, derive the weak form that is equivalent to the given differential equation and associated boundary condition. [4]

2. For the spring assemblages shown in Figure 1, determine the nodal displacements, the forces and the reactions by using **variation method**. [5]

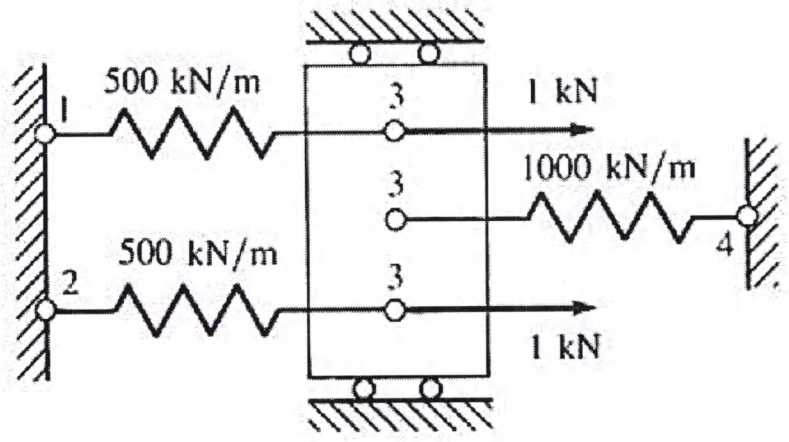

Figure. 1

3. A bar is subjected to the loads shown in Figure 2.
Given, P = 6.0 ×10^{4}N, E = 2.0 × 10^{4}N/mm^2 A =250 mm^2, L = 150 mm, u = 1.2 mm.
Determine (i) reaction forces and (ii) displacements at nodes 2 using two bar quadratic elements model. [5]

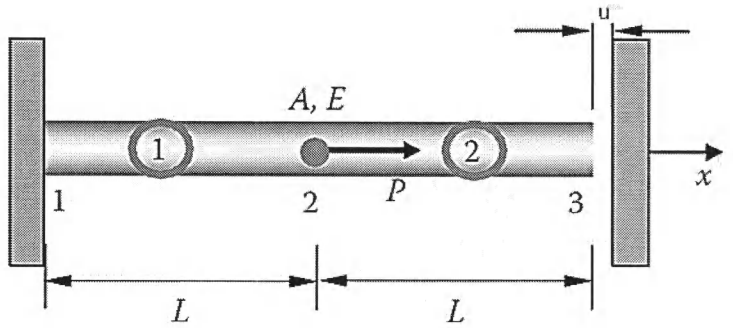

Figure. 2

4. A solid 304 Stainless Steel truss has a load applied as shown in Figure 3. Each member 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]

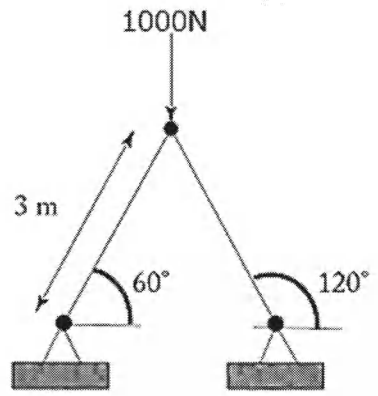

Figure. 3

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 × 106 kN/m2 and moment of inertia as 24 × 10–6 m4, determine:
a. Deflection under load
b. Shear force and bending moment at mid span [5]

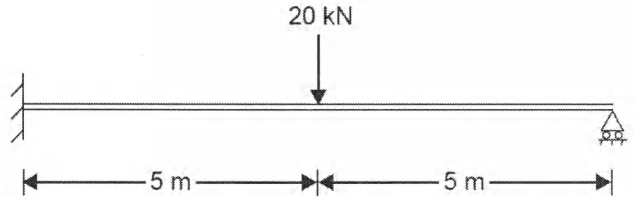

Figure. 4

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 $\mu = 0.25$, $E = 2 \times 10^5$ N/mm^2, Thickness = 15mm. [6]

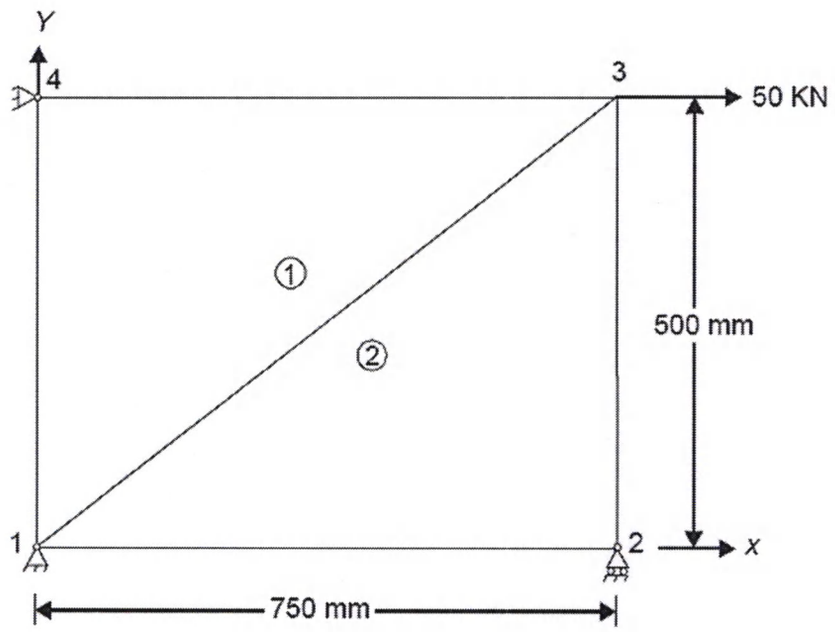

Figure. 5