CLASS: BTECH   SEMESTER: V
BRANCH: MECHANICAL   SESSION: MO/24

SUBJECT: ME351 FINITE ELEMENT METHODS

TIME: 3Hrs   FULL MARKS: 50

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt All question.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1   Determine the temperature distribution in the circular fin shown in Figure 1 k = 2W/(cm°C), h = 0.2   [10]
      W/(cm^2°C), and φ_f= 10°C. Assume that convection heat loss occurs from the end of the fin.
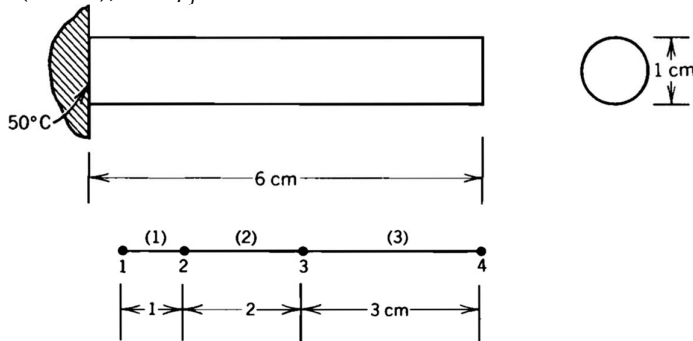

Figure 1

Q.2(a)   Evaluate the following integrals related to the Stiffness and force matrix   [5]
         $\int_A GN_iN_jdA$, and $\int_A QN_idA$
         (a) for the rectangular element.
         (b) for the triangular element.

Q.2(b)   Obtain an approximate displacement equation for the simply supported beam shown in Figure 2   [5]
         using the trial solution y(x)=A sin πx/H. Compare the deflection at the centre (percentage error)
         with the theoretical value y=-0.06415M_0H^2/EI. The governing differential equation is

         $$EI\frac{d^2y}{dx^2} - \frac{M_0x}{H} = 0$$

         Evaluate A by requiring the residual to vanish at (a) x=H/2, and (b) x=0.577H
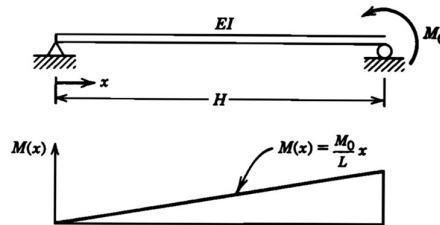

Figure 2

Q.3   The nodal values of the element is summarized below.   [10]
            a.   Calculate the value of φ at the coordinates of the point B.
            b.   Determine three sets of xy coordinates for the specified contour line.
            c.   Evaluate ∂φ/∂x and ∂φ/∂y at point B.
      X_i=0.25, Y_i= 0.06, X_j=0.31, Y_m= 0.13, φ_i=158, φ_j = 130, φ_k= 125, φ_m = 150, Point B: x=0.34,
      y=0.15, contour line 154

Q.4   Derive the shape function for triangular element in Cartesian coordinate   [10]
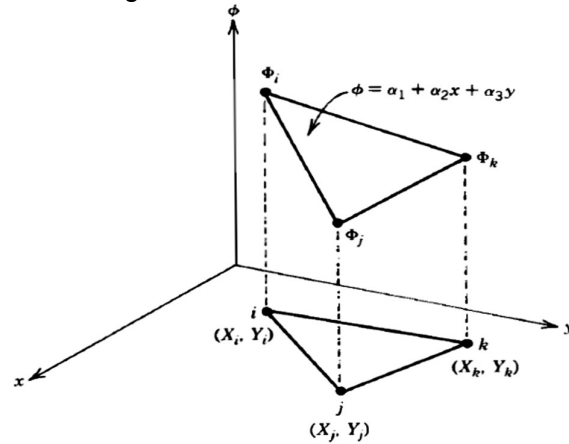

Figure 3

Q.5   Obtain the nodal displacements for the beam shown. The governing differential equation is   [10]

$$EI \frac{d^2\varphi}{dx^2} - M(x) = 0$$

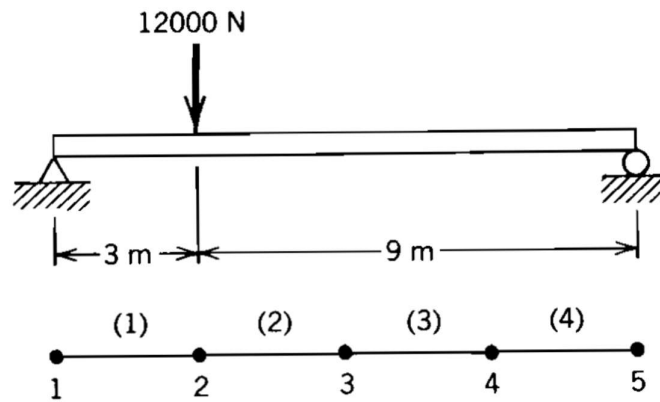Beam is given in the Figure 4. Each element is 300 cm long; $EI=2(10^{10})$ N. cm^2.

Figure 4

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