Registration Number:
Date & session:

ST JOSEPH'S UNIVERSITY, BENGALURU-27
M.Sc. MATHEMATICS – IV SEMESTER
SEMESTER EXAMINATION: APRIL 2024
(Examination conducted in May / June 2024)
MT 0422 - FINITE ELEMENT METHODS
(For current batch students only)

Time: 2 Hours **Max Marks: 50**

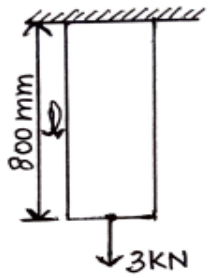
This paper contains THREE printed pages only.

Answer any FIVE FULL questions:

1. a) Solve the differential equation $u''+u+1=0,\ 0\le x\le 1,\ u(0)=u(1)=0$ using point collocation method. **[5m]**

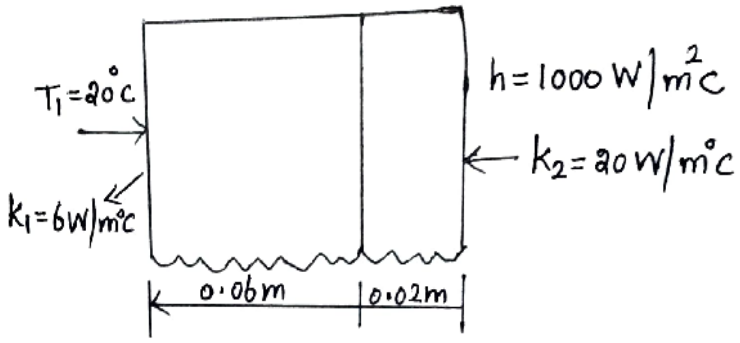
b) Employ Galerkin's method on $\frac{dy}{dx}=x,\ 0<x<1$ for $x=0,\ y=1$ to obtain the solution. **[5m]**

2. A steel bar of 800 mm is subjected to the axial load of 3KN as shown in figure. Find the elongation of the bar by discretizing into two elements. **Data:** $E=2\times10^5\,N/mm^2,\ A=300mm^2$.



[10m]

3. Determine the temperature distribution through the composite wall subjected to convection heat loss on the right side end with convective heat transfer coefficient as shown in figure. The ambient temperature is $-5^{\circ}C$. Assume $A=1m^2$.



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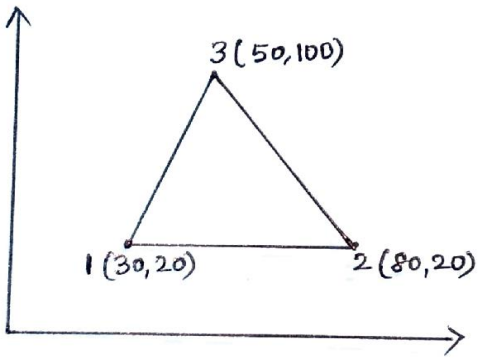
[10m]

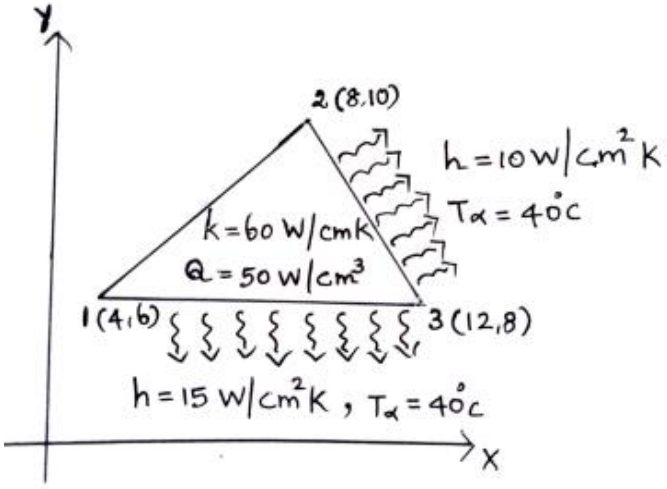
(**OR)**

3. For the plane stress element shown in figure, Evaluate the stiffness matrix. Assume the modulus of elasticity $E = 210 \times 10^3 N/mm^2$, Poisson's ratio $\mu = 0.25$ and element thickness $t = 10mm$. Note that the coordinates are given in millimeters.



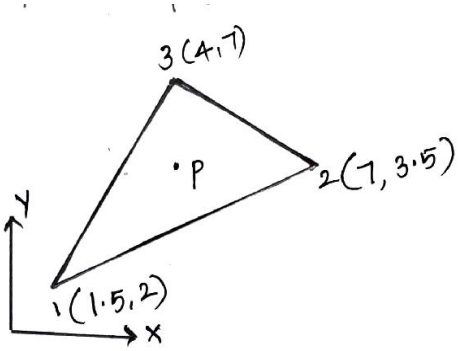
[10m]

4. Compute the element matrices and force vectors for the element shown in figure, when the edges 2-3 and 3-1 experience convection heat loss.



[10m]

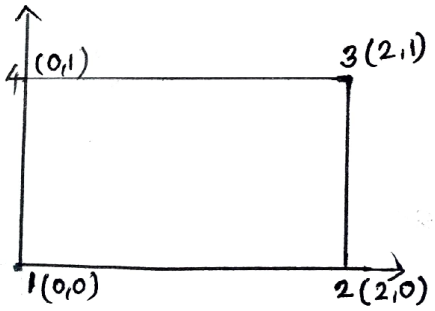
5. a) Determine the shape functions N_1, N_2 and N_3 for the triangular element of isoparametric formulation shown in the figure. The x and y coordinates of interior point p is 3.85 and 4.8 respectively.



[5m]

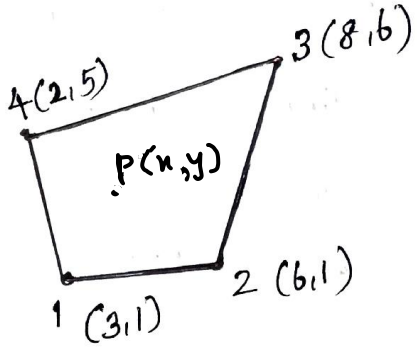
b) Evaluate the integral $I = \int_{-1}^{1} (\zeta^4 + 3\zeta^3 - \zeta)\, d\zeta$ using Gauss quadrature method . **[5m]**

6. For the linear quadrilateral element shown in figure calculate (i) Jacobian matrix (ii) Strain displacement matrix at the point $\zeta = 0, \eta = 0$ in local coordinate system.



[10m]

7. a) For the given four nodal quadrilateral element, determine the Cartesian coordinate of the point p which has local coordinates $\zeta = 0.57735,\ \eta = 0.57735.$ **[5m]**



b) Compute the value of the integral $I = \int_{2}^{4} x\, dx$ using mapping function for change of intervals.

[5m]