SV - 864

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Seat No.	

B.E. (Mechanical) (Semester - VII) (Revised) Examination, April - 2018

FINITE ELEMENT ANALYSIS

Sub. Code : 67503

Day and Date : Thursday, 26 - 04 - 2018 **Total Marks : 100**

Time : 02.30 p.m. to 05.30 p.m.

Instructions :
1) **Draw neat labeled sketch wherever necessary.**
2) **Assume suitable data if necessary and state it clearly.**
3) **Figures to the right indicate full marks.**

Q1) a) Write a note on past, present and future of FEA. **[8]**

b) If a displacement field is described by **[8]**

$$u = 10^{-4}(-x^2 + 2y^2 + 4xy); v = 10^{-4}(2x + 4y - y^2),$$

Determine ϵx, ϵy, γ_{xy} at x = 1; y = 0

OR

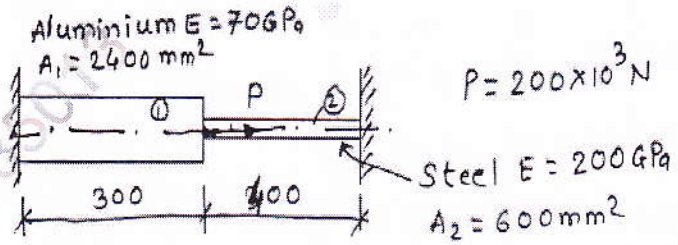
b) Explain Rayleigh Ritz method with the help of an example. **[8]**

Q2) a) Define shape function. Explain properties of shape function. Also draw the variation of each shape function for a one dimensional linear element. **[8]**

OR

Derive the element stiffness matrix and force vector of one dimensional element using potential energy approach. **[8]**

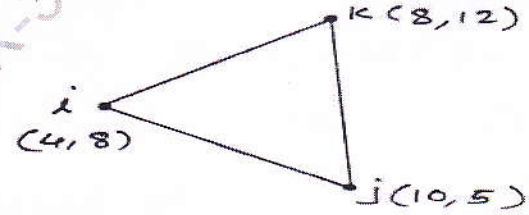
b) For the bar shown below determine nodal displacements and stress in each material **[8]**



P.T.O.

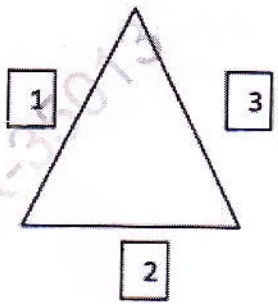
Q3) a) Write a short note on isoparametric element. [6]

b) Find the shape function for the triangular element shown below and show that the sum of all shape function is one at any point within the element. [12]



Q4) a) A long cylinder of 100 mm internal diameter and 130mm external diameter is subjected to hot fluid at 200°C from inside and ambient conditions on outside. Draw the sketch showing actual problem and also model the problem for a sample length of 10mm using axisymmetic element with proper boundary conditions. [6]

b) The stiffness matrices and force vectors of three truss elements shown in figure is as follows:



Element No.	Nodes	
	i	j
1	1	3
2	1	2
3	3	2

Element stiffness matrix and force vector is,

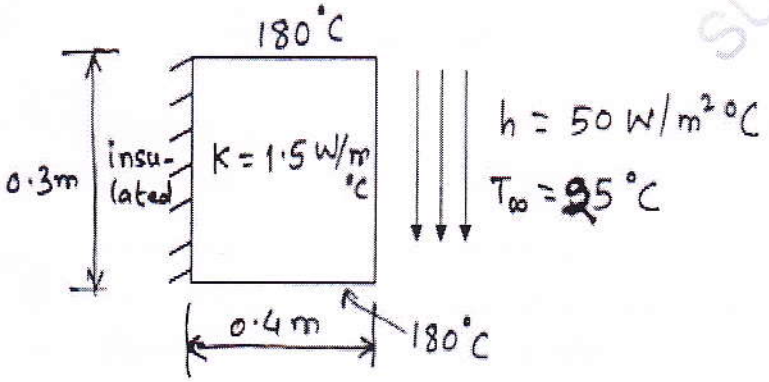
$$K_1 = \begin{vmatrix} 5 & 4 & -5 & -4 \\ 2 & 3 & -2 & -3 \\ -5 & -4 & 5 & 4 \\ -2 & -3 & 2 & 3 \end{vmatrix} \quad F_1 = \begin{vmatrix} 1 \\ -2 \\ -1 \\ 2 \end{vmatrix} \quad K_2 = \begin{vmatrix} 6 & -7 & -6 & 7 \\ -7 & 6 & 7 & -6 \\ -6 & 7 & 6 & -7 \\ 7 & -6 & -7 & 3 \end{vmatrix}$$

$$F_2 = \begin{vmatrix} 3 \\ 4 \\ -3 \\ -4 \end{vmatrix} \quad K_3 = \begin{vmatrix} 6 & 1 & -6 & -1 \\ 1 & 3 & -1 & -6 \\ -6 & -1 & 6 & 1 \\ -1 & -6 & 1 & 3 \end{vmatrix} \quad F_3 = \begin{vmatrix} 2 \\ -3 \\ -2 \\ 3 \end{vmatrix}$$

Obtain the global stiffness matrix and global force vector. [10]

Q5) a) Derive the relation between B matrix and Jacobian. J matrix for a linear triangular element for a heat transfer problem. **[6]**

b) A bar of rectangular cross-section having thermal conductivity of 1.5 W/m °C is subjected to boundary conditions as shown in figure. **[10]**



Mesh the domain with three triangular elements and obtain the conductivity matrix of each one.

Q6) a) Write short notes on any two **[10]**

i) Free and mapped meshing

ii) Aspect ratio and distortion

iii) Results validation and data interpretation

b) Explain in detail the steps to be carried out in commercial FEA software for a simple structure made up of two truss elements. **[8]**