T.E./Auto/Sem VI/CBGS/Second half 2018 19/12/2018

Paper / Subject Code: 36306 / FINITE ELEMENT ANALYSIS

Q. P. Code: 39289

(Time: 3 Hours) **Max. Marks: 80**

Note:

1. Question 1 is Compulsory
2. Solve any three from remaining five
3. Figures to right indicate full marks
4. Assume suitable data if necessary

Q.1 a) Explain Global, Local & Natural Co-ordinate System 20

b) What is the significance of shape functions?

c) Prove that the strain in a three node triangular element is constant.

d) Draw lower order and higher order 1D, 2D and 3D elements.

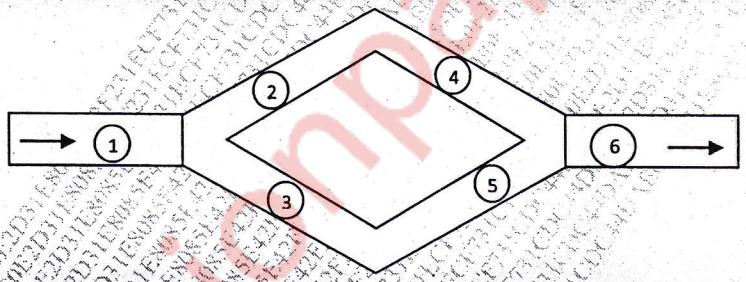
Q.2 a) Solve following differential equation by Galerkin method. 10

$$\frac{d^2\emptyset}{dx^2} = x + 1 \qquad 0 < x < 1$$

Boundary conditions: $\emptyset|_{x=0} = 0$ and $\emptyset|_{x=1} = 1$

Find values for $\phi(0.3)$ & $\phi(0.6)$

b) For the fluid network shown in figure write the global matrix equation. 10



Element No.	1	2	3	4	5	6
L cm	70	50	50	70	60	55
d cm	10	7.5	7.5	5	8	5

Pipe resistance is given by R^e.

$$R^e = \frac{128\mu h_e}{\pi {d_e}^4}$$

Q.3 a) Solve using Rayleigh ritz method , the fin equation 10

$$\frac{d^2\theta}{dx^2} - m^2\theta = 0$$

where $\theta = T_x - T_\infty$ and $m^2 = h\,P / k\,A_c$ for $0 \le x \le L$

B.C.s are $\theta|_{x=0} = \theta_0$ and $\left.\frac{d\theta}{dx}\right|_{x=L} = 0$

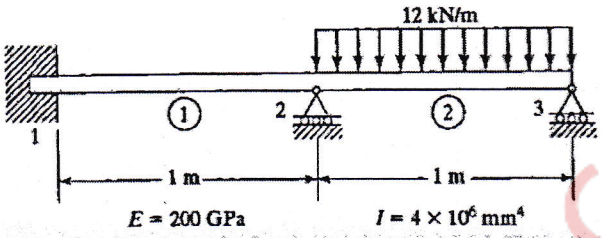
After getting EME substitute following data and solve:

L= 12 cm, no. of elements = 3, $\theta_0 = 500°C$, $T_\infty = 27°C$,

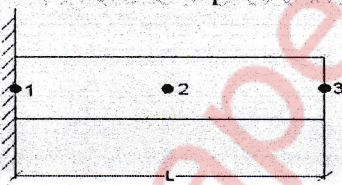
h= 100 W/ m^2 K, k = 60 W/ m K, D = 2.5 cm

b) Derive the shape function for a rectangular element in local coordinate system. 10

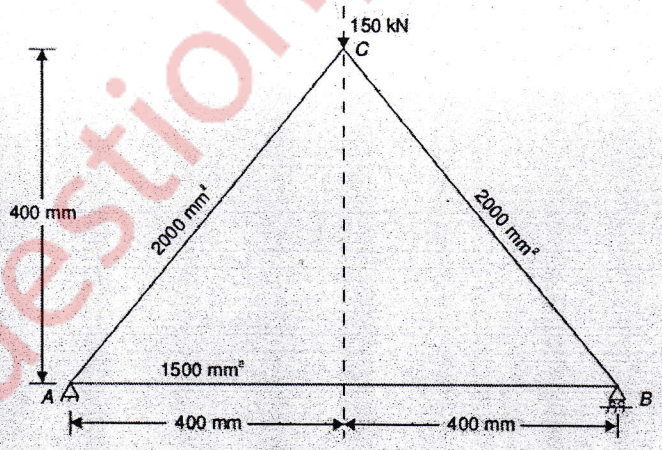
Q.4 a) For the beam shown with given loading determine the slopes at 2 & 3 and the vertical deflection at the midpoint of distributed load. 10



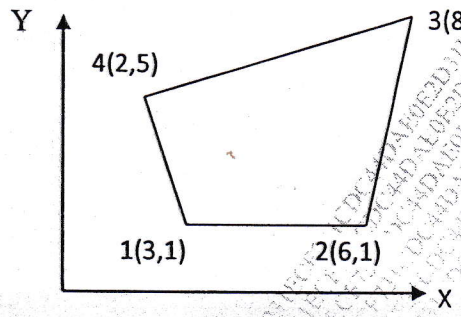
b) A uniform cross section bar as shown below has a length L=1 m ad made up of a material having $E=2x10^{11}$ N/m^2 & $\rho = 7800$kg/m^3. Estimate the natural frequencies of axial vibration of the bar using a two element mesh. A= 30 x10^{-6} m^2. Compare the natural frequencies with exact frequencies. 10



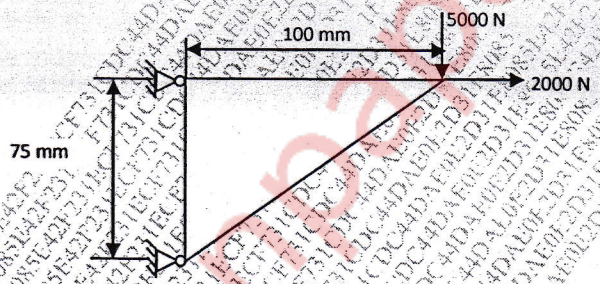
Q.5 a) For the three bar truss shown in fig, determine the nodal displacements and stress in each member. Also find the support reactions. Take E = 200GPa 10



b) For the iso-parametric quadrilateral elements shown in figure determine cartesian coordinates of the point P which has local coordinates (ξ = 0.9125 and η = 0.2106) 10



Q.6 a) A triangular plate of size 100 x 75 mm x 12.5mm is subjected to the load as shown in figure. The modulus of elasticity and Poisson's ratio for the plate material are 200GPa and 0.3 respectively. Model the plate with CST element and determine the element stiffness matrix and nodal displacements. 14



b) Obtain the strain-nodal displacement relationship for one dimensional linear element. 06