TE/Sem VI/CBSGS/MECH/AUTO/FEA/M-J-18 11/06/18

Auto

Q. P. Code: 39287

(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) Discuss the different types of coordinate systems used in finite element method of analysis. 20

b) What is the significance of shape functions?

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

d) Explain Weak & Non Weak form method used in FEA.

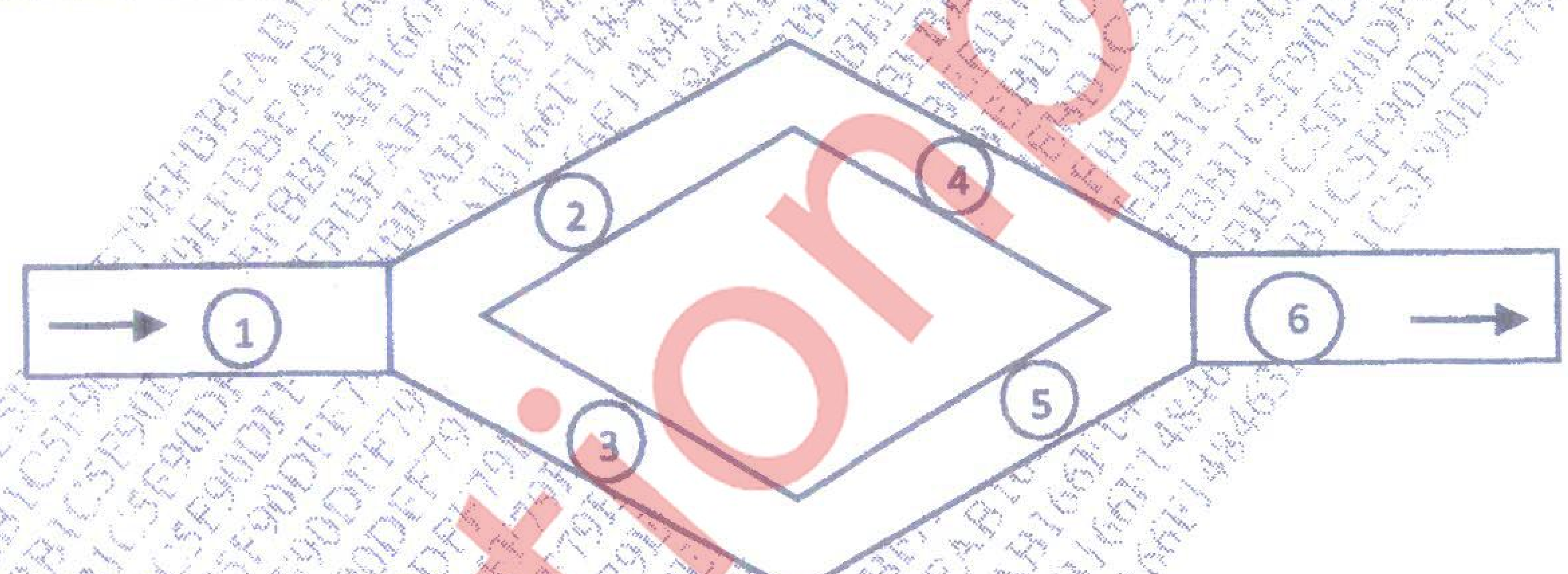
Q.2 a) Solve following differential equation by Galerkin method. 10

$$-\frac{d^2y}{dx^2} - 9y + 2x^2 = 0;\ 0 \le x \le 1$$

Given Boundary Conditions are: $y = 0$ at $x = 0$, $\frac{dy}{dx} = 1$ at $x = 1$

Find values for y (0.5) & y (0.7)

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

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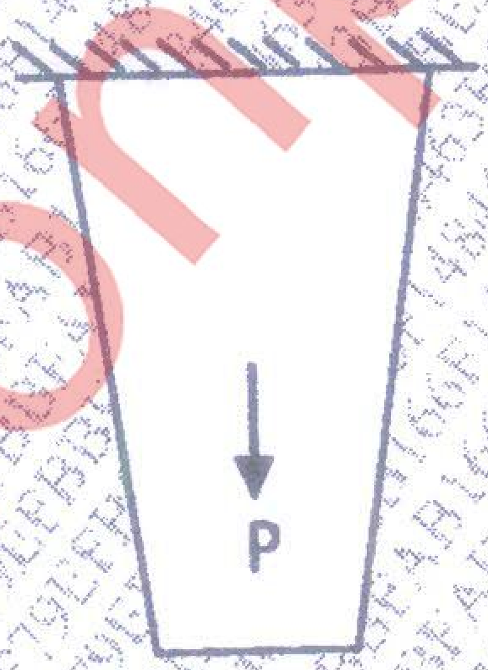
b) The governing differential equation for the steady state one dimensional conduction heat transfer with convection heat loss from lateral surfaces is given by 10

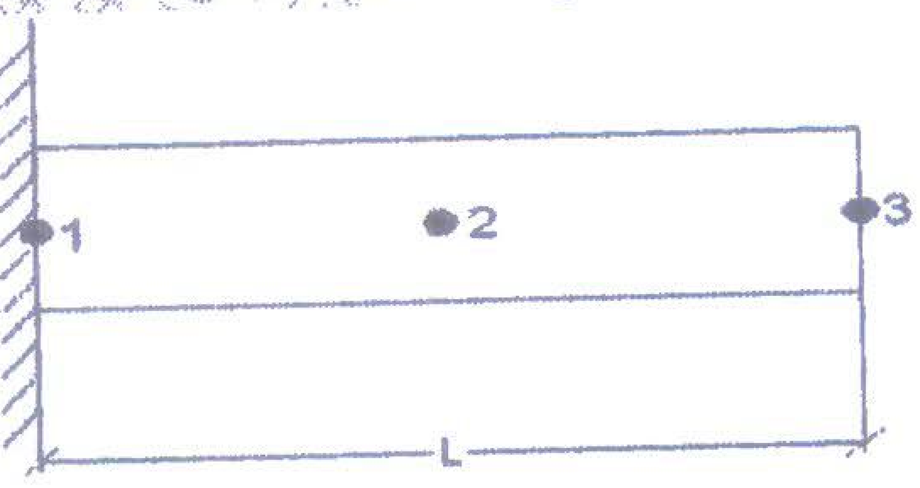
$$k\frac{d^2T}{dx^2} + q = \left(\frac{P}{A_c}\right)h(T - T_\infty)$$

where
K= coefficient of thermal conductivity of the material,
T = Temperature
q= internal heat source per unit volume
P = Perimeter
A_c=the cross-sectional area,
h = convective heat transfer coefficient, and
T_∞= Ambient Temperature
Develop the finite element formulation for linear element. Use Rayleigh Ritz method, mapped over general element. Derive relevant element level matrix equation.

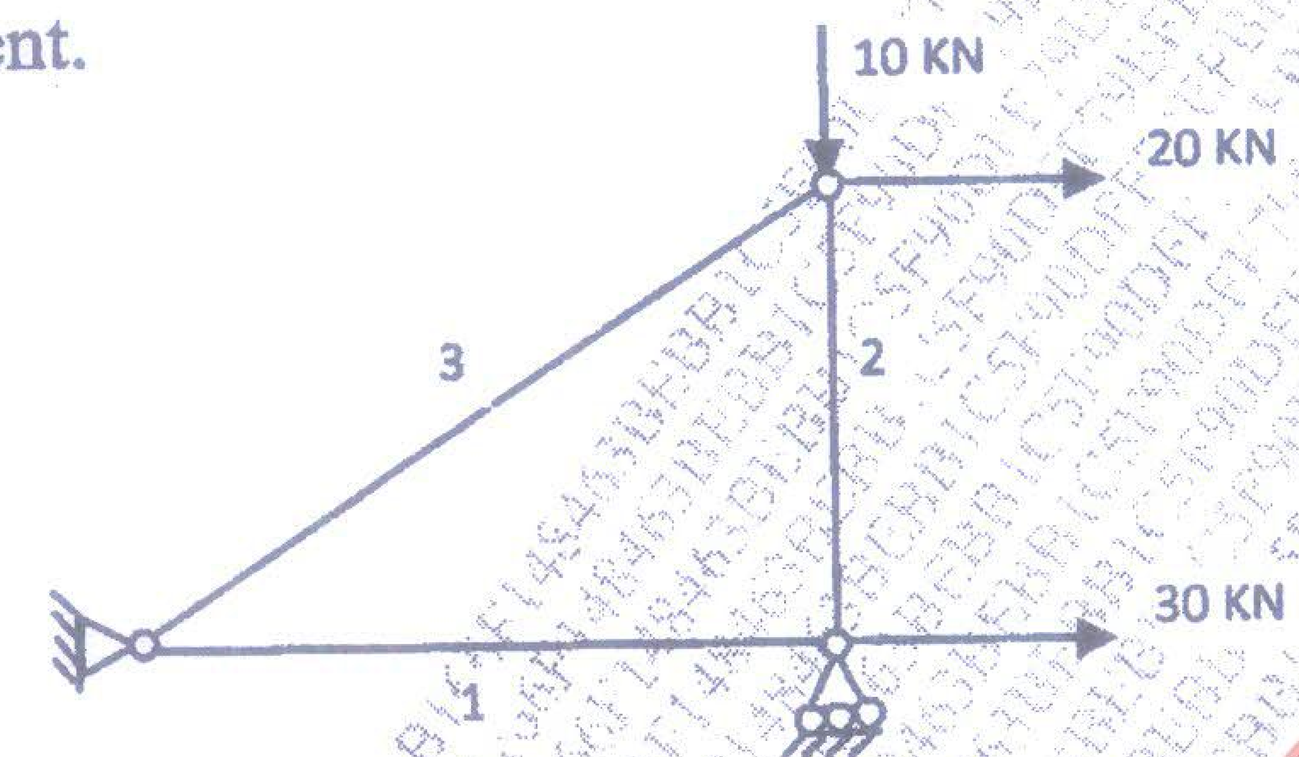
Q.4 a) A tapered thin plate made of steel (E = 200 GPa, ρ = 7800 kg/m³) has a length of 500 mm and a thickness of 20mm. Its width is 180 mm at the fixed end and 80mm at the free end. In addition to its self-weight, it is subjected to a point load P of 50KN at a distance of 300mm from the fixed end. Model the plate with two spar elements and determine the nodal displacements and stresses in each element. 10



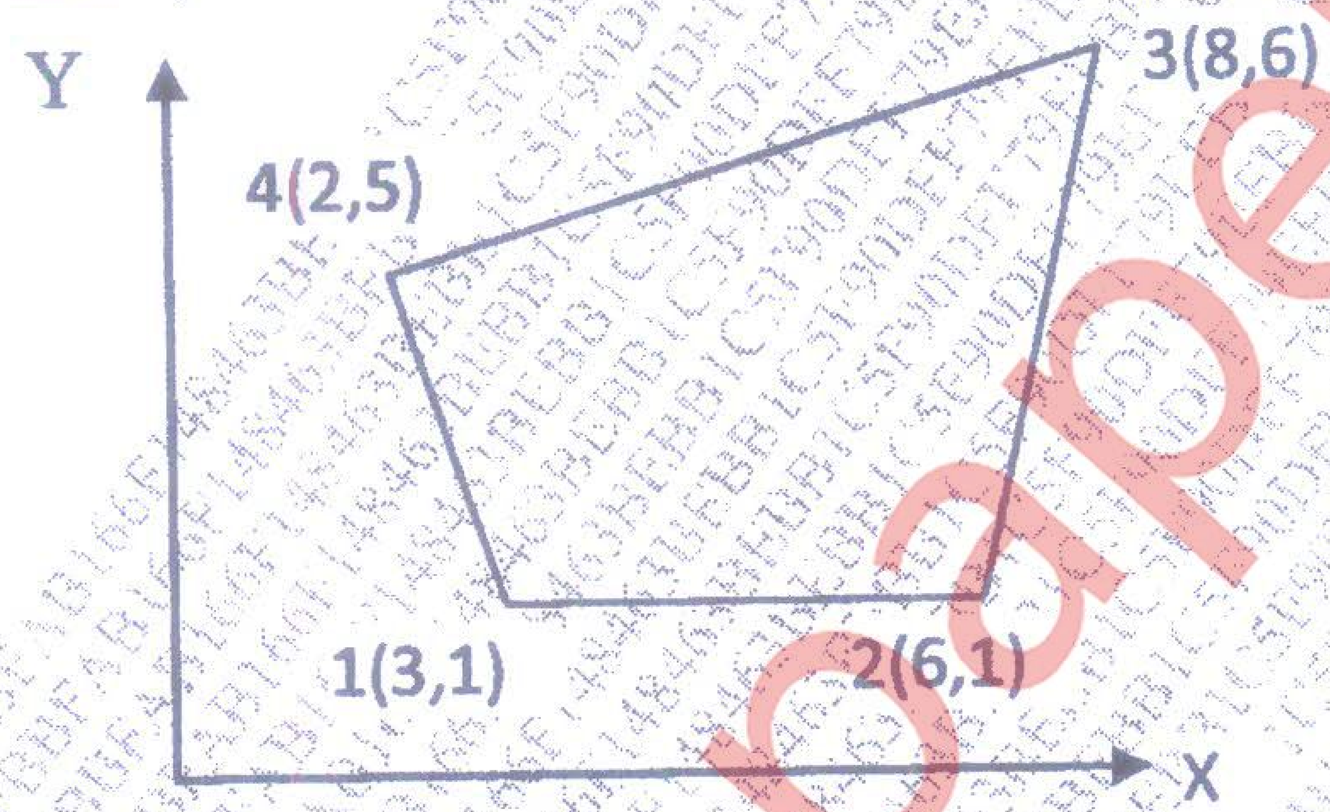
b) A uniform cross section bar as shown below has a length L=1 m and made up of a material having E=2×10^{11} N/m² & ρ = 7800kg/m³. Estimate the natural frequencies of axial vibration of the bar using a two element mesh. A= 30×10^{-6} m². Compare the natural frequencies with exact frequencies. 10



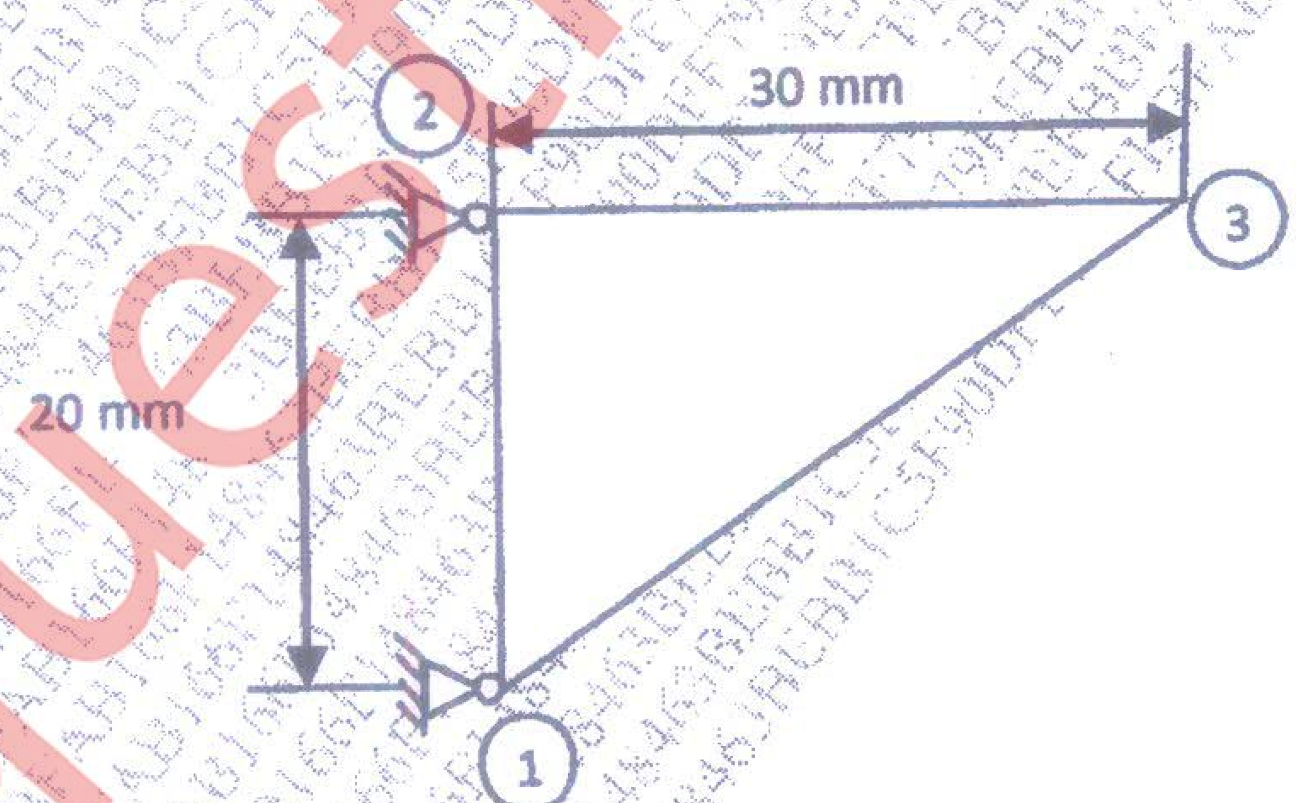
Q.5 a) A three bar truss is subjected to loading as shown. The modulus of elasticity for the bar material is 300 GPa. The cross sectional area of each bar used for truss is 300 mm^2. The length of the elements are l_1=800mm, l_2=600mm and l_3=1000mm. Determine the nodal displacements and stresses in each element. 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 (E = 210 GPa, γ = 0.3) of thickness 10 mm is as shown in figure. Node 1 and 2 are fixed and the displacements at node 3 are 1.95 x 10^{-4} mm and -1.114 10^{-3} mm in x and y direction respectively. Determine the element stresses. 12



b) Obtain the strain-nodal displacement relationship for one dimensional linear element. 08
