T.E. (SEM.-VI)(CBSGS) (MECHANICAL ENGG.) 09th June 2015

FINITE ELEMENT ANALYSIS

QP Code : 5003

(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

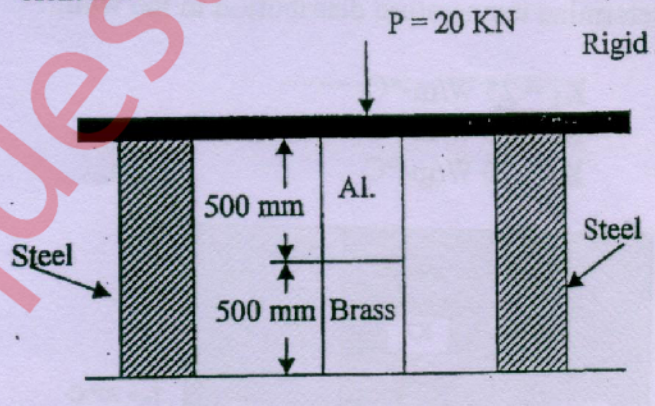
Question No.		Max. Marks
Q.1	a) Explain Pre and post processing in FEM	5
	b) Derive shape function for 1D quadratic element in natural co-ordinates	5
	c) Explain the significance of Jacobian matrix.	5
	d) Explain Convergence of results	5
Q.2	a) Solve the following differential Equation using Galerkin Method.	10

$$\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} - 6y = 0 \qquad 0 < x < 1.$$

Boundary Conditions are: $y(0)=1$, $y'(1)=0.1$

Find y(0.2) and compare with exact solution. 10

b) For the given, steel blocks supporting rigid plates shown in figure, determine displacement matrix and stresses in each element.



Take:

Properties	Steel	Aluminium	Brass
C/S Area (mm^2)	200	370	370
E (N/mm^2)	2×10^5	7×10^4	8.8×10^4

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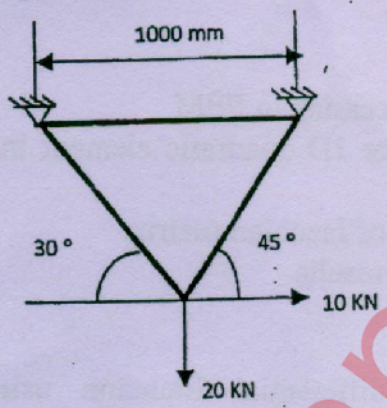
Q.3 a) What do you mean by consistent and lumped mass matrices? Derive the same for linear bar element. 10

b) Consider the truss shown in figure. Given E = 210 GPa and cross section area A = 1 cm^2 for each element. Determine 10

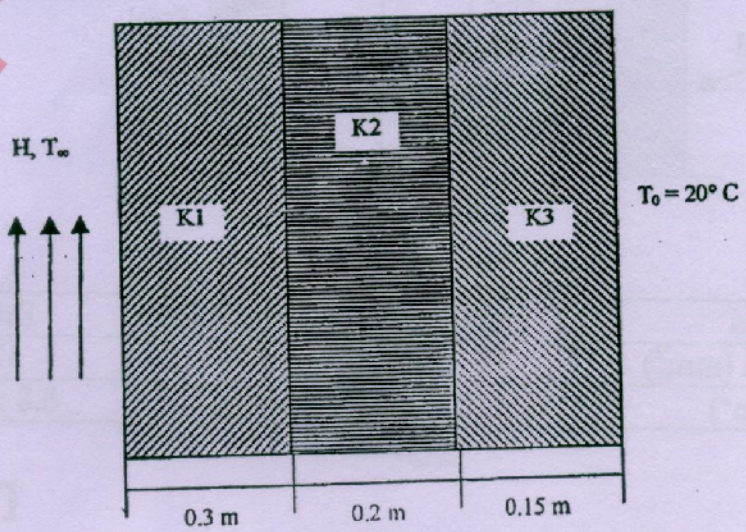
1. Displacement at each node.
2. Stresses induced in each element.
3. Reaction at supports



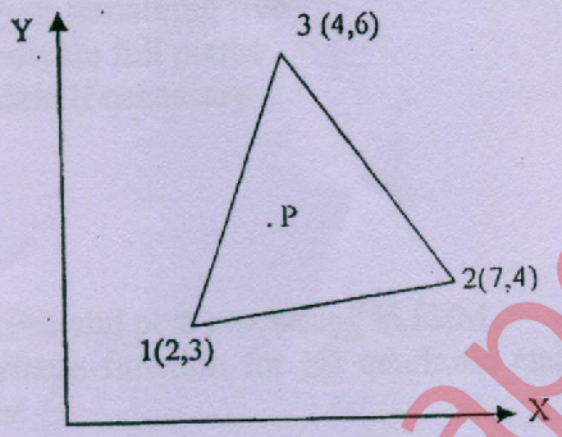
Q.4 a) It is required to carry out one dimensional structural analysis of a circular bar of length 'L', fixed at one end and carries a point load 'P' at other end. Find the suitable differential equation with required boundary condition (justify) and solve it by using Rayleigh – Ritz method for two linear element. 10

b) A composite wall consists of three materials, as shown in figure. The outer temperature $T_0 = 20°C$. Convection heat transfer takes place on the inner surface of the wall with $T_\infty = 800°C$ and h = 30 W/m^2 °C. Determine temperature distribution in the wall. 10

$K_1 = 25$ W/m-°C
$K_2 = 30$ W/m-°C
$K_3 = 70$ W/m-°C



Q.5 a) The nodal coordinate of the triangular element are as shown in figure. At the interior point P, the x-coordinate is (4.5) and N_1=0.3. Determine N_2, N_3 and y-coordinate of point P. 10



b) For a CST element the nodal displacement vector Q^T=[0,0,0,0,2,-0.1] mm. Find the element stress. Take E=200GPa, plate thickness t= 5mm and Poisson's ratio = 0.3 10

Q.6 a) What are serendipity elements? Derive and graphically represent interpolation functions for 8 nodded Quadrilateral elements. 10

b) Find the natural frequency of axial vibrations of a bar of uniform cross section of 20mm^2 and length 1m. Take E = 2 x 10^5 N/mm^2 and ρ = 8000 kg/m^3. Take two linear elements. 10