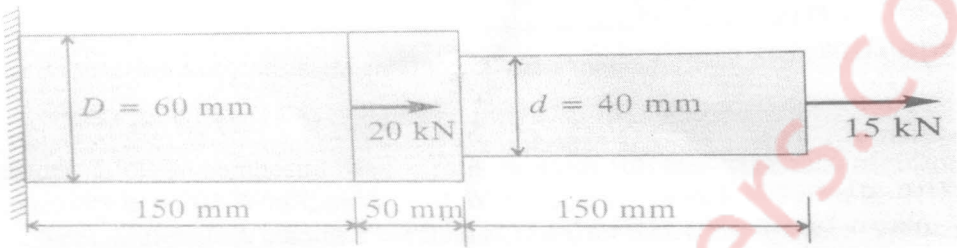
(3 Hours) **Total Marks: 80**

N.B : 1. Question no. 1 is **compulsory**
2. Attempt any **THREE** questions out remaining **FIVE** questions.
3. All questions carry equal marks.
4. Assume suitable data if necessary.

Q.1

a. Solve for Complete Analysis. E = 210 GPa for bar material. **(10)**



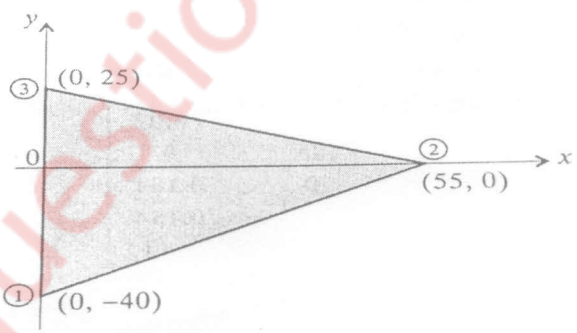
b. Given a differential equation : **(10)**

$$\frac{-d^2y}{dx^2} - 9y + x^2 = 0\,;0 < x < 1; y(0) = 0\,; y'(1) = 1$$

Find of y (0.5) & y (0.7) by using Galerkin method& compare it with exact solution.

Q.2

a. Evaluate the stiffness matrix for the CST element shown below. **(10)**
Coordinates in mm. Assume plain stress conditions. E = 200 GPa γ= 0.3.
Thickness = 1 cm.



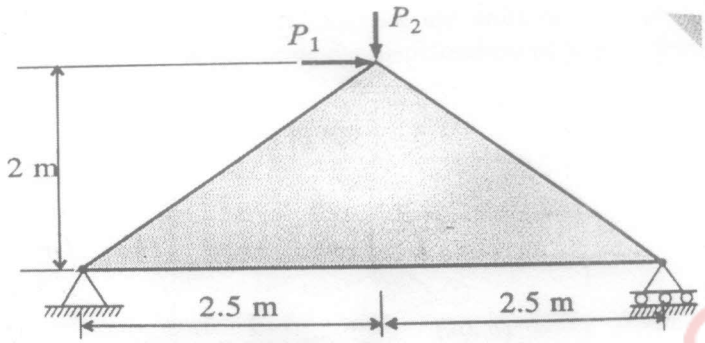
Nodal displacements are given as $U_1 = 2$ mm, $U_2 = 0.4$mm, $U_3 = 3$ mm, $V_1 = 1$ mm, $V_2 = 0$ mm & $V_3 = 1$ mm. Find the stiffness matrix equation.

b. I. What are the rules for discretization? **(05)**

II. Write short note on sources of errors in FEM. **(05)**

Q.3

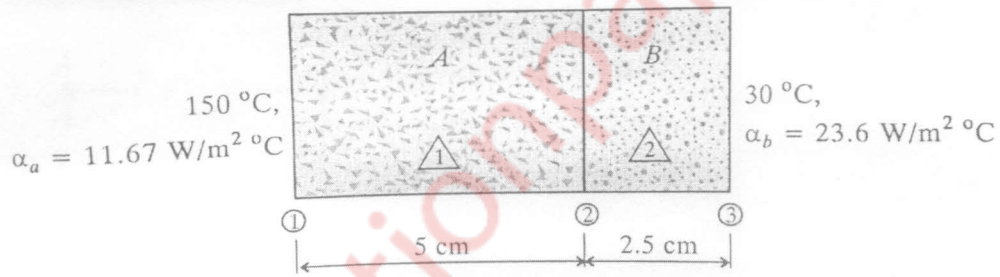
a. Analyze the truss completely i.e. for displacements, reactions, stresses and strains. Area of each member = 1000 mm^2. E for each member = 210 GPa. P_1= 10 KN and P_2 = 20 KN. **(15)**



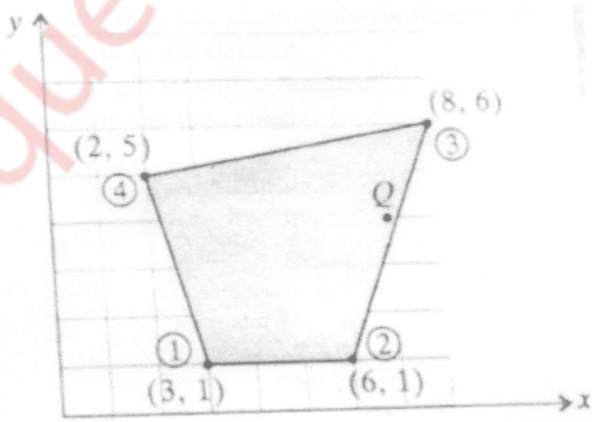
b. What do you mean by consistent and lumped mass matrix? **(05)**

Q.4

a. Consider a plain composite wall which is made of two materials of thermal conductivity k_a = 204 W/m°C and k_b = 46 W/m°C and thickness h_a = 5 cm and h_b =2.5 cm. Materials A adjoins a hot fluid at 150°C for which heat transfer coefficient α_a = 11.67 W/m^2°C and the material B is in contact with a cold fluid at 30°C and heat transfer coefficient α_b = 23.6 W/m^2°C. Calculate rate of heat transfer through the wall and the temperature at the interface. The wall is 2 m high and 2.5 m wide. **(10)**

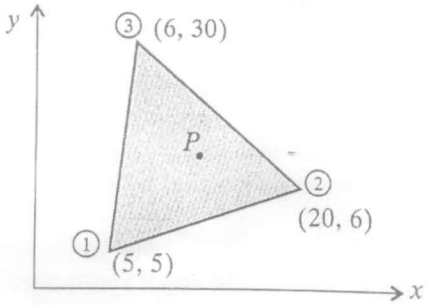


b. For the isoparametric quadrilateral element shown in fig, determine the local coordinates (ε, η) of the point Q which has Cartesian coordinates (6.5, 3.8). **(10)**



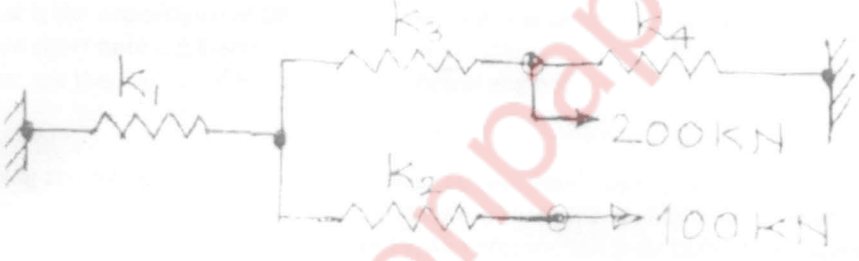
Q.5

a. For the triangular element defined by nodes 1 (5,5), 2 (20,6) and 3 (6,30), obtain the strain displacement relation matrix B and determine the strains ε_x ,ε_y & γ_{xy}. The displacements at the nodes are: U_1 = 0.4 mm, U_2 = 0.1 mm, U_3 = 0.5mm, V_1= -0.2 mm, V_2 = -0.5 mm & V_3 =-0.3 mm. Assume the units of displacements and the coordinates are the same. Also determine the displacement at point P (8,12). **(10)**



b. Figure show cluster of springs. One end of the assembly is fixed and force is applied at the end. Using the finite element method, determine:The reaction forces at supports. **(10)**

When K_1=50N/mm, K_2=150N/mm,K_3=75N/mm,K_4=120N/mm.



Q.6 **Attempt any Five.** **(20)**

a. What are the advantage and disadvantage of FEM?

b. How weight functions tell us about error in FEM?

c. What are plane stress condition and plane strain conditions? When are they opted?

d. Write short note on Isoparametric element.

e. What are the properties of global stiffness matrix?

f. Explain the significance of Jacobian matrix.

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