U.S.N.										

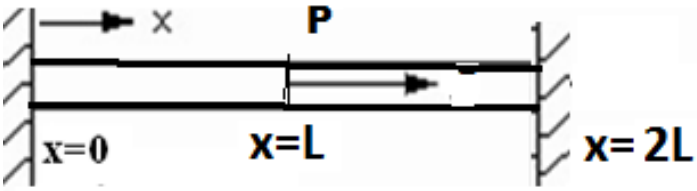
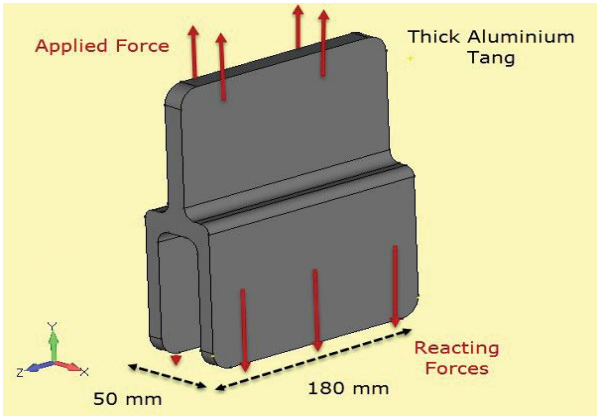
B.M.S. College of Engineering, Bengaluru-560019

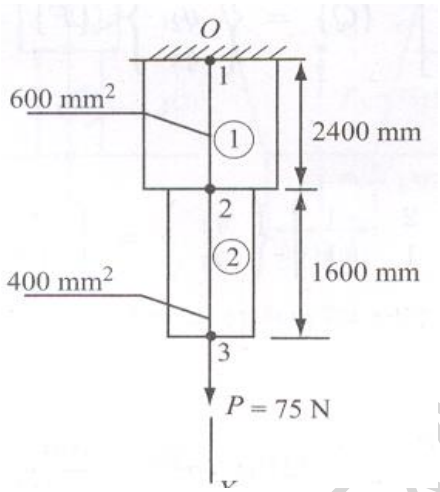
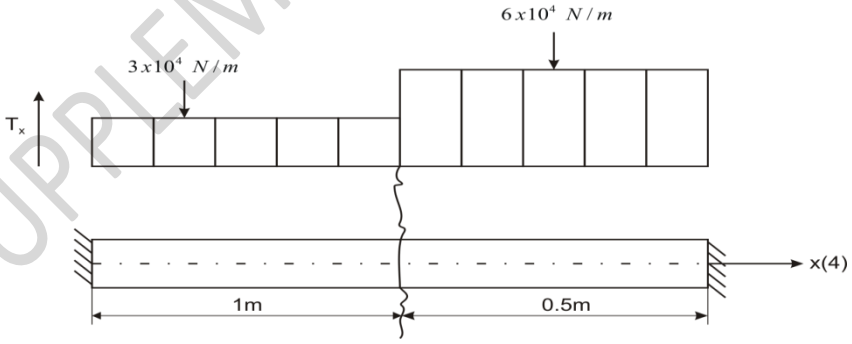
Autonomous Institute Affiliated to VTU

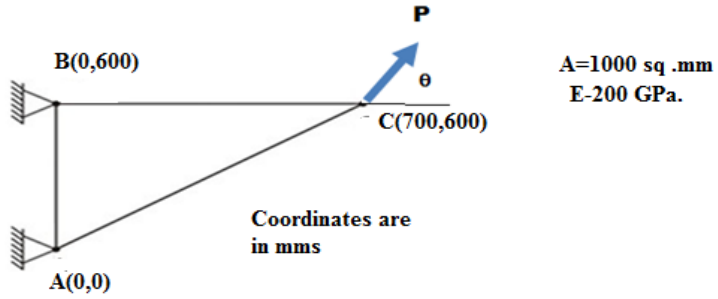
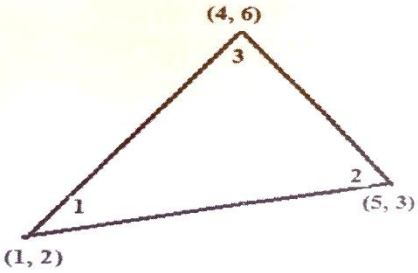
September / October 2024 Supplementary Examinations

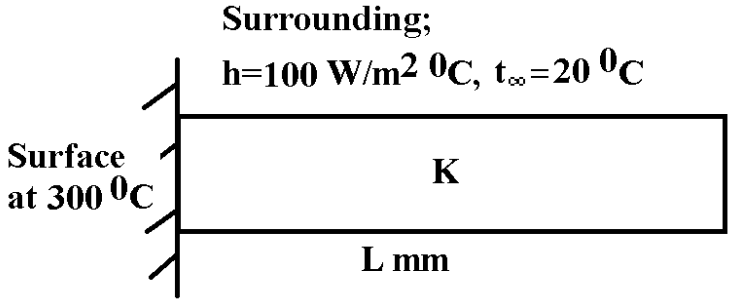
Programme: B.E. **Semester: V**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME5PCMFE **Max Marks: 100**
Course: Modelling and Finite Element Analysis

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

		UNIT - I	*CO*	*PO*	Marks
1	a)	Using the Rayleigh-Ritz method obtain expressions for displacement and stress for the uniform bar shown in the figure 1a. Normalize the values if P=A=L=E=1  Figure 1a	*CO1*	*PO1*	**10**
	b)	Sketch the variation of stresses in a 3D differential element subjected to body forces. Establish the equations of force equilibrium in differential form.	*CO1*	*PO1*	**10**
		OR			
2	a	Stress Analysis of the thick Aluminum tang shown in the figure 2a is to be carried out. Identify the idealization of 2D problem. State the geometric and corresponding stress/strain conditions and write stiffness matrices.  Figure 2a	*CO1*	*PO1*	**06**

		b	Using Gaussian Quadrature formula, evaluate $\int_0^3 (1+2r+3r^2+4r^3)dr$	*CO1*	*PO1*	**06**
		2c	Adopt Rayleigh Ritz method and obtain tip deflection in Cantilever beam subjected to UDL (q).	*CO1*	*PO1*	**08**
			UNIT - II			
	3	a)	Identify and sketch indicating the degrees of freedom of the line element to be used in the analysis of stepped bar shown in fig.3a.  Figure 3a a. Calculate Nodal Displacements Stresses and reaction forces. Young's Modulus $2X10^{11}$ N/m^2 b. Estimate the new displacement field caused considering self-weight also. ρ =7848 kg/m^3. c. Figure out the increase in displacement caused if an uniform temperature rise of 40^0 C is applied.α = 11.7 x 10^{-6} per°C	*CO3*	*PO1*	**16**
		b)	Determine the load vector in Newton due to surface traction for the bar shown in figure 3b  Figure 3b	*CO2*	*PO2*	**04**

			UNIT - III			
	4	a)	Determine the displacement field and reactions in the truss member shown in figure 4a. P =70 kN and θ=25^o  Figure 4a	*CO3*	*PO1*	**12**
		b)	Discuss the need for Hermitian shape function for a beam, derive and sketch their variation	*CO2*	*PO1*	**08**
			UNIT - IV			
	5	a)	Using shape functions of CST element, derive strain displacement matrix and stiffness matrix under plane stress condition.	*CO3*	*PO1*	**12**
		b)	The nodal coordinates of the triangular elements are shown in figure 5b.At point P inside the element, x coordinate is 3.3 and shape function is N_1=0.3. Determine the shape function N_2, N_3 and Y coordinate of point P.  Figure 5b	*CO4*	*PO1*	**08**
			OR			
	6	a)	Obtain the Jacobian matrix for 3 noded axisymmetric triangular element.	*CO3*	*PO1*	**06**
		b)	Using Lagrange interpolation function, formulate the shape functions for 9-noded quadrilateral element.	*CO3*	*PO1*	**08**
		c)	Explain convergence criteria and compatibility requirements for finite element solution.	*CO3*	*PO1*	**06**
			UNIT - V			
	7	a)	Derive shape functions for temperature field in natural coordinate system.	*CO3*	*PO1*	**06**
		b)	Determine the temperature distribution and amount of heat transfer in a rectangular fin as shown in figure 7b. Use two 2	*CO4*	*PO2*	**14**

			noded 1-D heat transfer elements. Also obtain the temperature at mid-point of the 1st element. Assume that the end face of the fin is insulated. L=0.05 m, d=0.01 m, K=50 W/m^{0}C  Figure 7b			