Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B. TECH (MECHANICAL/IP ENGG.) MAKE UP EXAMINATIONS, DECEMBER 2019

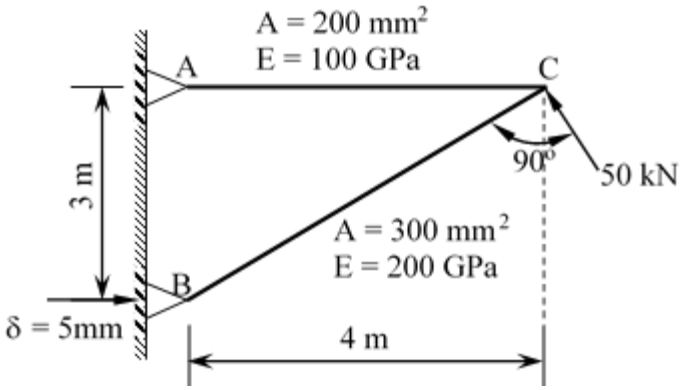
SUBJECT: FINITE ELEMENT METHOD [MME 4102]

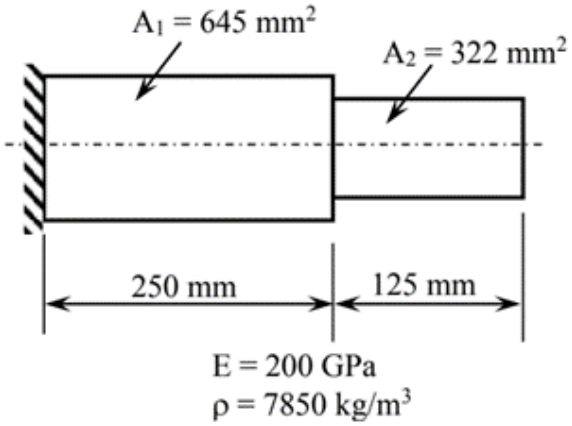
REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Draw neat and labelled diagrams wherever necessary.

1A.	Write the Potential Energy expression for 1D element. Derive the expression for body force vector and element traction force vector in case of a 1D structural link element using potential energy approach.	**04M**
1B.	Distinguish between Plane Stress and Plane Strain problem. Provide the constitutive equation for both.	**03M**
1C.	For the 3 noded triangular element the (x,y) coordinates of nodes 1,2 and 3 are (35,20),(80,45), and (55,80) respectively. The values of shape functions N_1 and N_2 are 0.212 and 0.392 respectively. i) Find the (x,y) coordinates of the point P ii) Show that you get the same values of the shape functions N_1,N_2, & N_3 at point P using area coordinates.	**03M**
2A.	For the structural configuration shown in figure Q2A, use FEM to evaluate the displacements at C. The support at B settles horizontally rightwards by 5mm. Use minimum number of elements.  **Figure Q2A**	**05M**
2B.	Derive the stiffness matrix for 1D fluid element considering the steady state fluid flow.	**03M**
2C.	Differentiate between bar and beam element (Note: any four differences).	**02M**

3A.	Consider a circular cross section pin-fin. The base of the pin-fin is held at a constant temperature of 100^{o}C. The free-end and the lateral surface of the pin-fin undergo convection to a fluid at ambient temperature Ta. The convection coefficients for the free-end and the lateral surface are equal. Given that K (thermal conductivity) = 380 W/m-^{o}C, Length of pin fin = 8 cm, h (Convection coefficient) = 2500 W/m^2-^{o}C, diameter of pin-fin = 2 cm and Ta = 30^{o}C. Using two equal length elements prepare the finite element model (two-node element) and determine the nodal temperatures.	**05M**
3B.	Derive the shape functions for a 1D 3 noded vertical element in natural coordinate system by using a polynomial displacement function.	**03M**
3C.	Write a short note on higher order elements.	**02M**
4A.	The corners (nodes) of a triangular element are A (30, 20), B (60,10) & C (45,50). Assuming it to be a CST element, evaluate the stiffness matrix using the following details: Assume Plane strain condition with Plate thickness = 10 mm.	**05M**
4B.	Obtain the Element stiffness matrix for a CST element using energy method.	**03M**
4C.	Explain the benefits of Galerkin's method over other methods of FE formulations.	**02M**
5A.	Determine the Eigen values and the Eigen vector for first mode for the stepped bar shown in **figure Q5A**:  **Figure Q5A**	**05M**
5B.	Derive shape functions for beam element assuming a cubic displacement function.	**03M**
5C.	Explain the procedure followed in Weighted Residual Method.	**02M**