Code: 9A03703 **R09**

B.Tech IV Year I Semester (R09) Regular & Supplementary Examinations December 2015

FINITE ELEMENT METHODS

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions
All questions carry equal marks

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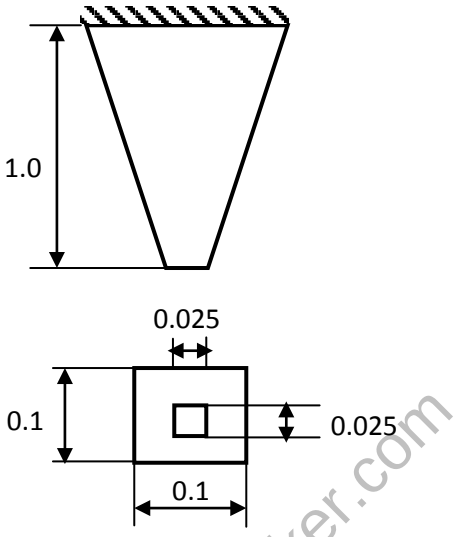
1 Explain the general procedure of solving field problems using FEM.

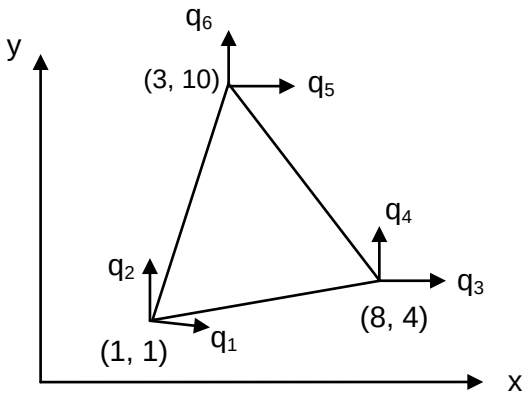
2 Find the deflection at the free end for the member shown in figure under its own weight. Take Young's modulus as 200 GPa and density as 7700 kg/m^3.



All dimensions are in meters

3 Derive the shape functions for a 1D beam element.

4 For the CST element shown in figure, obtain the strain displacement relation matrix B and determine the strains ε_x, ε_y and ε_{xy}. The numbers in bracket show the coordinate positions (in mm) in x and y directions. The element displacement matrix, q^T = [0.001, - 0.004, 0.003, 0.002, -0.002 and 0.005] mm.



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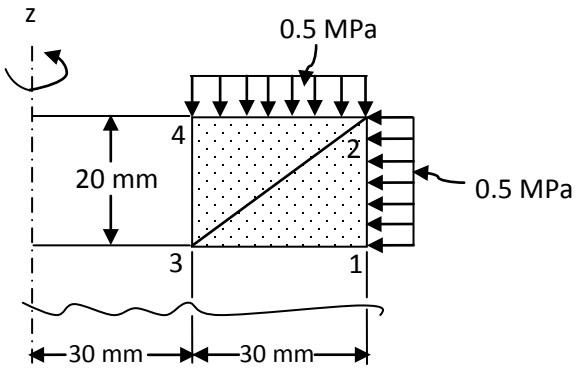
5 Establish the stiffness matrix for the axisymmetric element with nodes 1, 2 and 3 shown in figure.



6 A composite slab consists of three materials of thermal conductivities 12 W/mK, 20 W/mK, 40 W/mK and lengths 0.15 m, 0.3 m, and 0.2 m respectively. The composite slab has a uniform cross section of 0.05 m^2. The left end of the slab is at 500℃ and the right end is exposed to the convective heat transfer coefficient of 12 W/m^2K at 25℃. Determine the temperature distribution within the wall.

7 Discuss the general methodology of solving 1D fluid flow problems mentioning the stiffness matrix and load vectors.

8 A vertical plate of thickness 15 mm is tapered with widths of 120 mm and 60 mm at top and bottom ends respectively. The plate is fixed at the top end. The length of the plate is 350 mm. Take Young's modulus as 200 GPa and density as 7800 kg/m^3. Determine the natural frequencies of longitudinal vibration and the mode shapes.

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