



Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025

Finite Element Analysis

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. Explain the basic steps involved in Finite Element Method. (10 Marks)
- b. What are the advantages and disadvantages of Finite Element Method? (10 Marks)

OR

- 2 a. Explain plane stress and plane strain conditions. (10 Marks)
- b. Explain simplex, complex and multiplex elements. (10 Marks)

Module-2

- 3 a. Derive shape functions for 1D quadratic bar elements in natural coordinates. (10 Marks)
- b. Derive shape functions for constant strain triangle in natural coordinates. (10 Marks)

OR

- 4 For the stepped bar shown in Fig.Q.4. Determine the nodal displacement and stressed at each node. (20 Marks)

Take

For element ①

$E_1 = 200 \text{ GPa}$

for element ②

$E_2 = 70 \text{ GPa}$

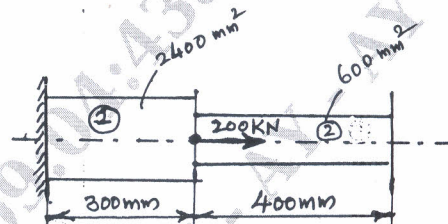


Fig.Q.4

Module-3

- 5 a. Derive H_1 and H_2 Hermite shape functions for beam elements. (10 Marks)
- b. A cantilever beam subjected to point load of 250 kN as shown in Fig.Q.5(b). Determine the deflection at free end. Take $E = 200 \text{ GPa}$, $I = 4 \times 10^6 \text{ mm}^4$. (10 Marks)

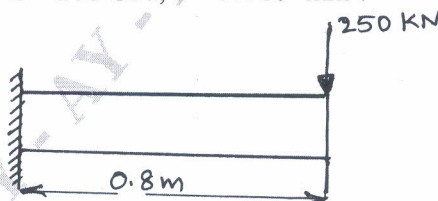


Fig.Q.5(b)

OR

- 6 a. Derive stiffness matrix equation for torsion of shaft. (10 Marks)
 b. For the circular stepped shaft shown in Fig.Q.6(b). Determine stresses and angle of twist.
 Take : $E = 200 \text{ GPa}$, $G = 70 \text{ GPa}$ (10 Marks)

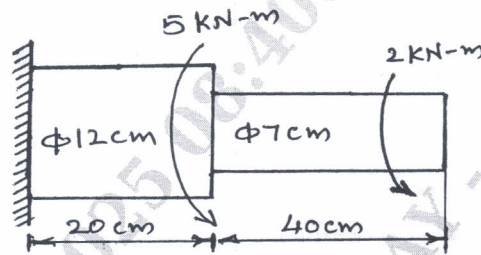


Fig.Q.6(b)

Module-4

- 7 a. Derive stiffness matrix or conductivity matrix for 1-D bar element. (08 Marks)
 b. Determine the temperature distribution in the rectangular fin as shown in Fig.Q.7(b). Assume steady state and only conduction process. Take heat generated inside the fin as 400 W/m^2 . (12 Marks)

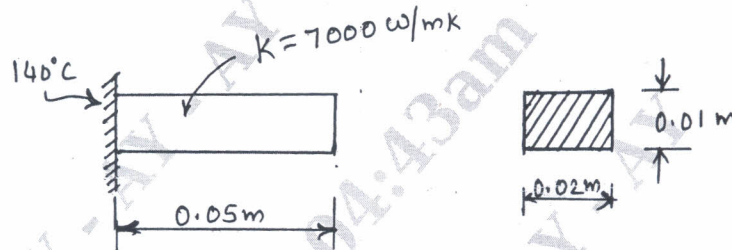


Fig.Q.7(b)

OR

- 8 For smooth pipe of variable cross section shown in Fig.Q.8. Determine the potential at the junctions, velocities in each section of pipe and volumetric flow rate. Potential at left end $P_1 = 10 \text{ m}^2/\text{s}$, right end $P_4 = 1 \text{ m}^2/\text{s}$. Fluid flow through the pipe $K_x = 1$. (20 Marks)

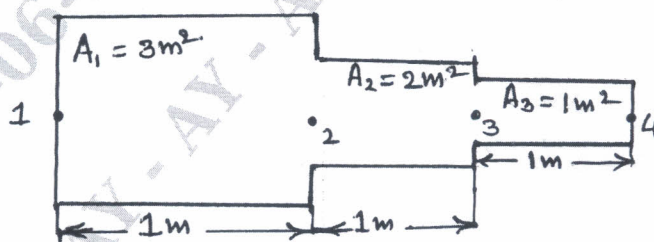


Fig.Q.8

Module-5

- 9 a. Derive stiffness matrix of axisymmetric bodies with triangular elements. (12 Marks)
 b. For the element of an axisymmetric body rotating with a constant angular velocity $\omega = 1000 \text{ rev/min}$ as shown in Fig.Q.9(b). Determine the body force vector, include the weight of the material, where the specific density is 7850 kg/m^3 . (08 Marks)

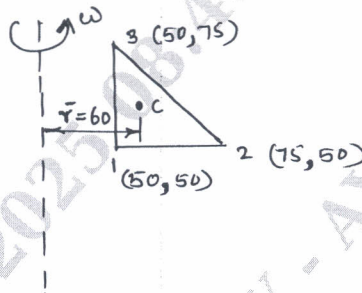


Fig.Q.9(b)

OR

- 10 a. Derive the consistent mass matrix for 1-D bar element. (10 Marks)
 b. Evaluate eigen values of longitudinal vibration of the constrained uniform circular bar shown in Fig.Q.10(b). Take minimum two elements and $E = 210 \text{ GPa}$ and $\rho = 7860 \text{ kg/m}^3$. (10 Marks)

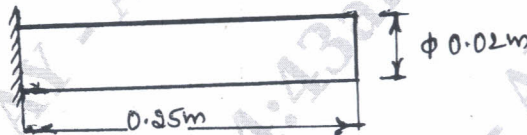


Fig.Q.10(b)

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