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21ME53

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Finite Elements Analysis

Time: 3 hrs.

Max. Marks: 100

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

Module-1

1   a.   Explain briefly the general steps involved in finite element method.   **(10 Marks)**
    b.   Explain convergence criteria and discritization process in F.E.M.   **(10 Marks)**

OR

2   a.   Explain 1D, 2D and 3D elements in F.EM.   **(10 Marks)**
    b.   Explain plane stress and plane strain conditions.   **(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   A stepped bar as shown in Fig Q4. Determine the nodal displacement and stresses at each node. Take $E = 2 \times 10^5$ N/mm^2.
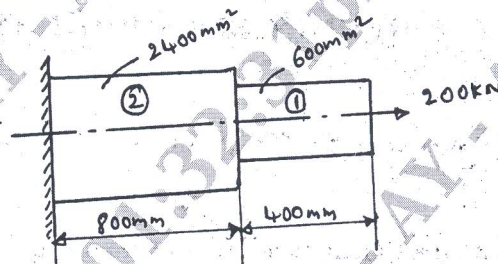

Fig Q4

(20 Marks)

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 250kN as shown in Fig Q5(b). Determine the deflection at free end Take $E = 200$GPa, $I = 4 \times 10^6$mm^4.
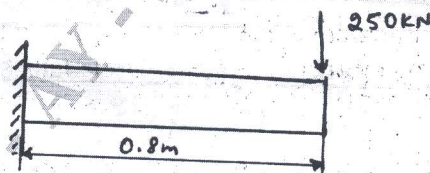

Fig Q5(b)

(10 Marks)

OR

6   a.   Derive stiffness matrix equation for torsion of shaft.   **(10 Marks)**
    b.   A solid stepped bar of circular cross section as shown in Fig Q6(b), is subjected to a torque of 1kN-m at its free end and a torque of 3kN-m at its change in C/S. Determine the angle of twist in the bar. Take $E = 2 \times 10^5$MPa, $G = 7 \times 10^4$MPa.
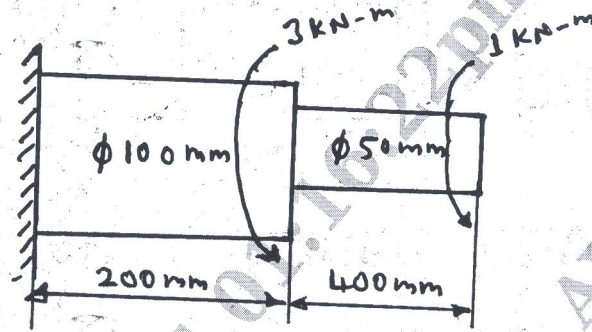
Fig Q6(b)   (10 Marks)

Module-4

7. Determine the temperature distribution is the wall using 1D heat elements. Give $K_1 = 25W/m^oC$, $K_2 = 35W/m^oC$, $h = 30w/m^2C$, $T_\infty = 900^oC$, $A = $ unit area.

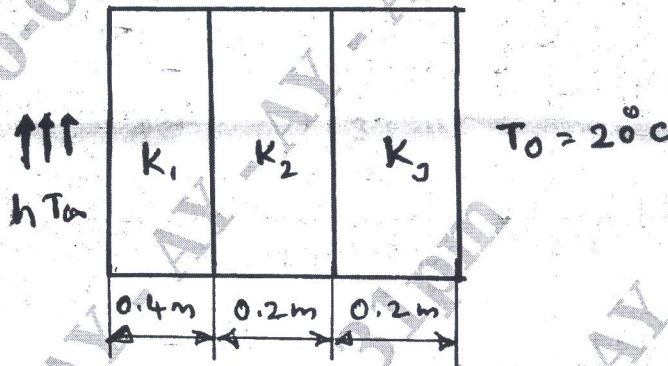Fig Q7   (20 Marks)

OR

8. For smooth pipe of variable c/s shown in Fig Q8. Determine potential at junctions, Velocities in each section of pipe and volumetric flow rate. Potential at left end $P_1 = 10m^2/s$, right end $P_4 = 1m^2/sec$, fluid flow through pipe $K_x = 1$.

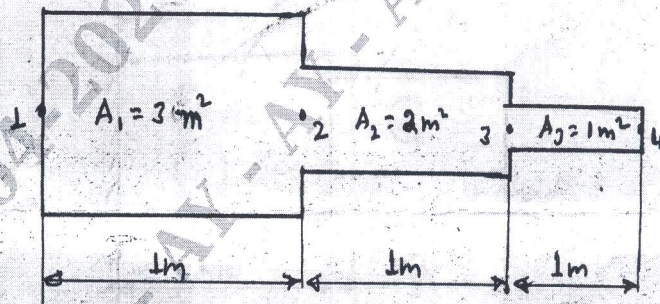Fig Q8   (20 Marks)

Module-5

9. a. Derive stiffness, matrix of axisymmetric bodes with triangular elements.   (10 Marks)
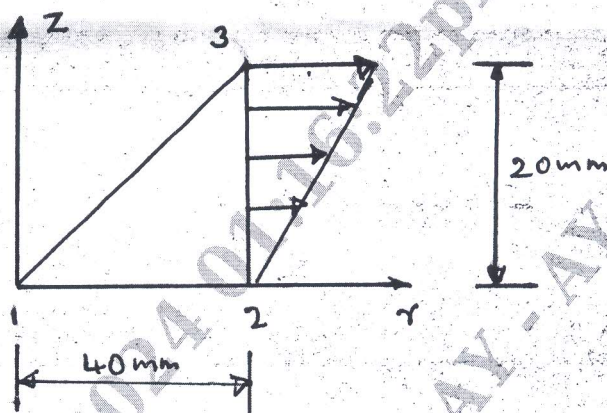   b. Evaluate nodal forces used to replace the linearly varying surface traction shown in Fig Q9(b)

Fig Q9(b)   (10 Marks)

OR

10   Find Eigen values and Eigen vectors for stepped bar when it is subjected to axial vibration
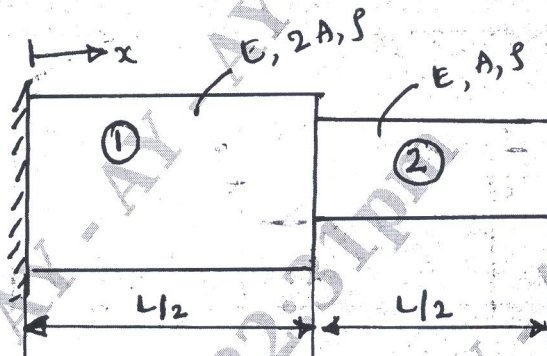with fixed free end condition as shown in Fig Q10.

Fig Q10   (20 Marks)

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