Code No: **R1641033** **R16** **Set No. 1**

IV B.Tech I Semester Advanced Supplementary Examinations, May - 2022

FINITE ELEMENT METHODS

(Common to Aeronautical Engineering, Automobile Engineering and Mechanical Engineering)

Time: 3 hours **Max. Marks: 70**

Question paper consists of Part-A and Part-B
Answer ALL sub questions from Part-A
Answer any FOUR questions from Part-B
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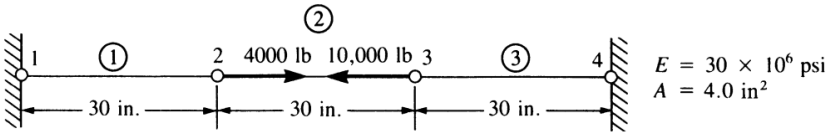
PART–A *(14Marks)*

1. a) Derive and plot the shape functions of 2 node 1D bar element. [2]
   b) Write a note on local and global coordinates. [2]
   c) Derive the equivalent load vector of a 2 node beam element with point load at the center. [3]
   d) Under what conditions a problem can be treated as axisymmetric? [2]
   e) What is an Isoparametric element? Write the applications. [2]
   f) Derive the consistent mass matrix of a 2 node bar element. [3]

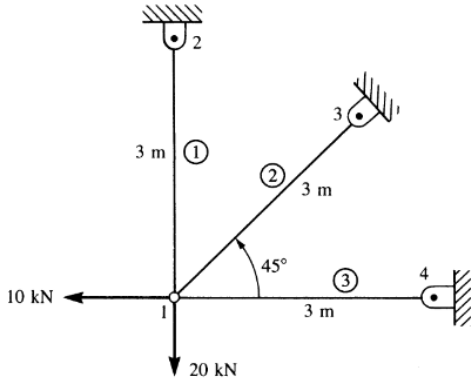
PART–B *(4x14 = 56 Marks)*

2. a) Discuss about Galerkin's Weighted residual method. [4]
   b) Evaluate the displacements and reactions at the supports for the loaded structure given below [10]



3. a) Discuss the types of elements used in FEM with relevant sketches. [4]
   b) Explain the convergence requirements. [5]
   c) Write a note on Node numbering and Banded matrix. [5]

4. For the plane trusses shown in the figure, determine the horizontal and vertical displacements of node 1 and the stresses in each element. All elements have E=200 GPa and A=4.0 X 10^{-4} m^2. [14]



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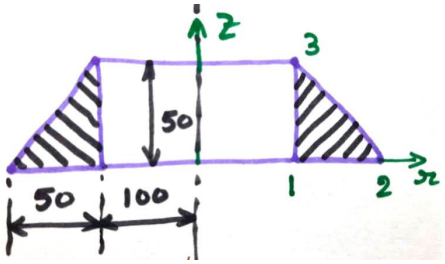
Code No: **R1641033** **R13** **Set No. 1**

5. a) An axisymmetric ring (triangle element) is shown in the figure. Derive the B & D matrices. Take $E = 2.5 \times 10^5$ N/mm^2 and $\upsilon = 0.3$. All dimensions are in mm. [10]



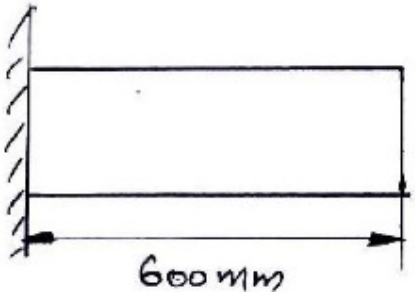
b) Derive and plot the shape functions of CST element. [4]

6. a) Derive the shape functions and Jacobian matrix of a 2D 4 node quadrilateral element. [10]

b) Evaluate the given integral using 1 point and two point Gauss quadrature method and compare with exact solution. [4]

$$\int_{-1}^{1} (8x^3 + 3x^2 - 9)\ dx$$

7. a) Derive the natural frequent of longitudinal vibration of the bar shown. Take E = 200 GPa, ρ = 7000 kg/m^3, A = 2400 mm^2. Consider 2 elements for analysis. [10]



b) Derive the shape function of 2 node 1D element with temperatures T_1 and T_2 at the nodes. [4]