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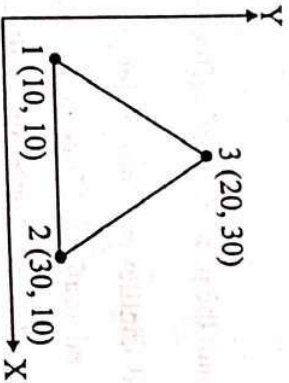
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(b) Derive the strain displacement matrix and equation for element stiffness for a LST element.

8. A plate of dimensions $16 \text{ cm} \times 8 \text{ cm} \times 2 \text{ cm}$ is subjected to an axial pull of 25 kN . Assuming a typical element is of dimensions as shown in figure. Find shape functions at point $(15, 20)$. Determine the strain displacement matrix and constitutive matrix. $E = 200 \text{ GPa}$, $\mu = 0.3$.

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M.Tech. 2nd Semester Civil Engg. (Computer Aided
Structural Engg.) Examination,
July-2022

FINITE ELEMENT ANALYSIS

Paper-21MTCASE22C1

Time allowed : 3 hours]

[Maximum marks : 100

Note : Attempt five questions in total.

- Using Rayleigh-Ritz method find the approximate displacement of uniform bar (EA constant) fixed at one end and subjected to a static point load at the other end. The bar is also subjected to a linearly varying axial load $q(x) = cx$, where c is a given constant. Compare the linear and quadratic solution. 20
- Using minimum potential energy approach, derive the stiffness matrix and consistent load matrix.
 - Taking a differential equation, explain the process of weak formulation. 10+10=20
- Write the steps involved in FEM for a structural mechanics problems solution with formulations.

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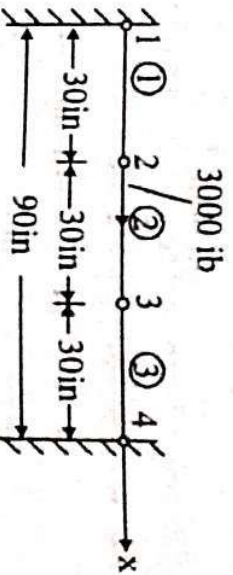
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- (b) Write the concept of FEM with example. Explain the Software's based on FEM. $10+10=20$
4. (a) Derive the shape functions of four node and eight node bar elements. $8+12=20$
- (b) For the three-bar assemblage shown in figure below, determine
- (i) The global stiffness matrix,
 - (ii) The displacements of nodes 2 and 3, and
 - (iii) The reactions at nodes 1 and 4
 - (iv) Stress in each element. A force of 3000 lb is applied in the x direction at node 2. The length of each element is 30 in. Let $E = 30 \times 10^6$ psi and $A = 1 \text{ in}^2$ for elements 1 and 2, and let $E = 15 \times 10^6$ psi and $A = 3 \text{ in}^2$ for element 3. Nodes 1 and 4 are fixed.



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5. (a) For the plane trusses with inclined supports shown in figure below, solve for the nodal displacements and element stresses in the elements. Let $A = 3 \text{ in}^2$, $E = 30 \times 10^6$ psi, and $L = 32 \text{ in}$. For each truss. $12+8=20$
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- (b) Explain the properties of stiffness matrix.
6. A propped cantilever beam of length 12m carries a concentrated load of 25kN at the centre of span. $EI = 48 \times 10^6 \text{ N-m}^2$. Determine deflection under the load and shear force and bending moment at mid span. 20
7. (a) Explain the concept of plane stress and plane strain with examples. $10+10=20$

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[P.T.O.]