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QUESTION BANK

Subject with Code :FEM IN STRUCTURAL ENGINEERING(19CE1005) **Regulation:** R19

Course & Branch: M.TECH- STRUCTURAL ENGINEERING **Year & Sem:** I-M.TECH & II-Sem

UNIT-I

INTRODUCTION AND PRINCIPLES OF ELASTICITY

1. Explain the different steps involved in FEM [12M]
2. (a) What are the merits, demerits and limitations of Finite Element Methods? [6M]

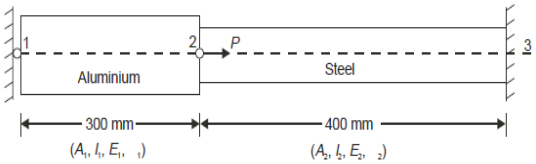
   (b) Explain in detail finite element method procedure with an example. [6M]
3. What is potential energy? State and explain the principle of minimum potential energy.[12M]
4. Using Rayleigh – Ritz method determine the expression for maximum displacement, when The cantilever beam subjected to point W,KN at the free end. Also, compare it with the standard expression. [12M]
5. Using Rayleigh-Ritz method determine the expression for deflection and B.M in a SSB Subjected to udl over entire span. Find the deflection and moment at mid span and Compare with exact solution. [12M]
6. Draw a typical three-dimensional element and indicate state of stress in their positive Sense and also derive the equations of equilibrium in case of a 3-D stress system. [12M]
7. A beam AB of span L simply supported at ends and carrying a concentrated load W at the Centre C .Determine the deflection At mid span by using Rayleigh-Ritz method and compare with exact solution. [12M]
8. (a) Explain plane stress problem and plane strain problems. [6M]
   (b) Explain axi-symmetric problem. [6M]
9. (a) Explain discretization and classification of discretization. [6M]
   (b) Explain nodes at discontinuities. [6M]
10. A bar of uniform cross section is clamped at one end and left free at other end and free at End is Subjected to a uniform axial load P. Calculate the displacement and stress in a bar by Using two terms polynomial and 3 terms polynomial. Compare with exact solution.[12M]

UNIT-II

ONE DIMENSIONAL FEM

1. Derive Stiffness matrix for 1D – two noded linear bar element. [12M]
2. A 2 Noded truss element having the nodal displacement are u_1=5mm and u_2=8mm at the ends. Calculate the displacement at x=L/4,L/3 and L/2. [12M]
3. Determine the nodal displacements at node 2, stresses in each material and element stiffness matrix for each element as shown in Fig., due to applied force [12M]

P = 400 × 10^3N.
A1 = 2400 mm2 & A2 = 1200 mm2
L 1 = 300 mm & L2 = 400 mm
E1 = 0.7 × 105 N/mm2 & E2 = 2 × 105 N/mm2



4. Briefly explain shape function and derive shape function for 1D – two noded line element. **[12M]**
5. Consider a bar as shown in figure. Cross sectional area of the bar is 750 mm^2 and E= 2x10^5N/mm^2

If u_1=0.5 mm and u_2= 0.625 mm.Calculate the following [12M]

i) Displacement at point(p) 1●----------P●----------●2

ii) Starin x_1=375mm x_2=500mm x_3=575mm

iii) Stress

iv) Element Stiffness Matrix

v) Strain Energy

6. Derive of the displacement function(u) and shape function (N) for 1-D linear bar element based on global coordinate approach. [12M]
7. Derive the shape function, strain displacement matrix element stiffness matrix for a two noded 1-D Element. [12M]
8. A 1-D 3 noded bar element at X_1=20mm at first node, X=24mm at middle node and X_2=36mm.Calculate the following [12M]
   (i) shape function N_1 and N_2 at the middle point P.
   (ii) if u_1=3mm and u_2=-5, calculate the displacement u at point P.
9. A 2 Noded truss element having the nodal displacement are u_1=6mm and u_2=9mm at the ends. Calculate the displacement at x=L/4,L/3 and L/2. [12M]

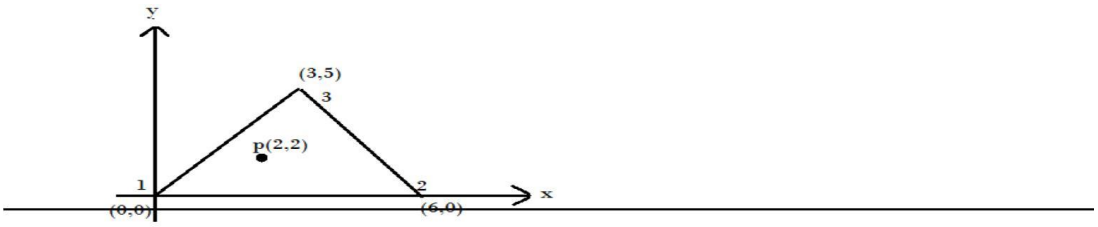
10. What is static condensation? Explain procedure of static condensation . [12M]

UNIT-III

TWO DIMENSIONAL FEM

1. Derive matrix equation for 2-D element(CST element). [12M]

2. (a) Differentiate between CST and LST elements. [12M]
   (b) Evaluate the shape functions N_1, N_2 and N_3 at the interior point P for the triangular element shown in the figure below.



3. Derive shape functions for four noded rectangular elements. Use natural co-ordinate system.[12M]

4. Write and briefly explain the different types of elements for plain stress and plain strain analysis. [12M]

5. Derive the shape function for the Constant strain triangle element(CST) element. [12M]

6. Derive the strain-displacement matrix for CST element. [12M]

7. Explain about [12M]

   (a) Geometric invariance

   (b) Convergent and compatibility requirements

8. Derive the shape function and strain-displacement for an rectangular 4-noded element.[12M]

9. Write down the following? [12M]

   (c) Global coordinate system

   (d) Local coordinate system

   (e) Natural coordinate system

   (f) Discretization

10. Derive the Shape functions for the 3-noded triangle element (or) L.D.T (or) C.S.T. [12M]

UNIT-IV

ISOPARAMETRIC FORMULATIONS AND AXI-PARAMETRIC ANALYSIS

1. Explain the isoperimetric concept in finite element analysis. [12M]
2. Explain the terms isoperimetric, sub parametric and super parametric elements. [12M]
3. Derive the Jaccobian matrix for 4-noded rectangular element. [12M]
4. Explain the formulation of 4-noded 2-D iso-parametric quadrilateral element. Derive the strain displacement matrix and stiffness matrix. [12M]
5. Derive the shape function for 4-Noded isoperimetric quadrilateral element. [12M]
6. Derive the strain-displacement matrix for 4-Noded isoperimetric quadrilateral element. [12M]
7. Derive the shape function for 8-Noded isoperimetric quadrilateral element. [12M]
8. Explain the lagrangian and serendipity elements. [12M]
9. Derive the shape function for Axisymmetric (Rectangular) element. [12M]
10. Explain the axi symmetric analysis and axi-symmetrical formulation [12M]

UNIT-V

THREE DIMENSIONAL FEM AND FINITE ELEMENT ANALYSIS OF PLATES

1. Explain the basic theory of plate bending. [12M]
2. Explain the basic relationships in plate bending theory. [12M]
3. Explain about different types of 3-D solid elements. [12M]
4. Explain about Hexahedral Isoperimetric elements. [12M]
5. What are the three dimensional stresses and strains explain the relation between them. [12M]
6. Write the stiffness matrix for a hexahedral element. [12M]
7. Explain basic relations in thin plate theory. [12M]
8. Briefly explain about Mindlin's approximations. [12M]
9. Explain finite element formulation for 8-noded isoperimetric solid element [12M]
10. Explain stress resultants in thin plates. [12M]