SIDDHARTH GROUP OF INSTITUTIONS :: PUTTUR
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QUESTION BANK

Subject with Code: FI NITE ELEMENT METHODS (FEM) (16CE2012)

Course & Branch: M. Tech - Structural Engineering

Year & Sem: I M.TECH & II-Sem **Regulation:** R16

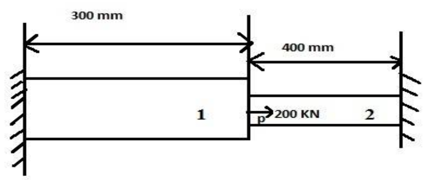
UNIT-I
INTRODUCTION AND PRINCIPLES OF ELASTICITY

1. State and explain general steps used in the solution using the finite element method.
2. (a) What are the merits, demerits and limitations of Finite Element Methods?
   (b) Write the applications of finite element analysis.
3. What is potential energy? State and explain the principle of minimum potential energy.
4. If a displacement field is described as follows: $u = (-x^2+2y^2+6xy)10^{-4}$ and $v = (3x + 6y - y^2)10^{-4}$, Determine the strain components €xx , €yy , and €xy at the point x = 1; y = 0.
5. Derive the formula for maximum deflection for a simply supported beam carrying a UDL load on entire span using Rayleigh-Ritz method of functional approximation.
6. Explain the terms plane stress, plain strain and derive their constitutive relations.
7. With the help of a neat diagram, describe the various components of stress and strains.
8. In a plane strain sitation σ_x=150 Mpa, σ_y=100MPa, $E=2x10^5$. Find the values of σ_z,€x, €y.
9. Give the constitutive laws for 3-D problems of
   (a) Orthotropic materials
   (b) Isotropic materials
10. Explain discretization and different types of elements in FEM

UNIT-II
ONE DIMENSIONAL FEM

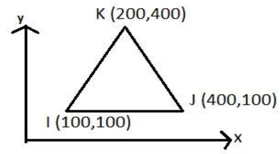
1. What are shape functions? Write down the condition to be satisfied by such a function for 1-D elements. Illustrate these conditions with examples.
2. Write element stiffness matrix for beam element.
3. What is static condensation? Explain procedure of static condensation.
4. Derive shape functions for a 1-D quadratic bar element.
5. Derive the stiffness matrix for one dimensional 3-noded quadratic element.
6. (a) Discuss the stress-strain relation for plain strain problems
   (b) Explain the term "axi-symmetric problems" and give constitutive law for such problems
7. Define strain-displacement matrix. Generate the equation for strain displacement matrix for 1-D bar element.

8. Derive the shape function for 2-noded 1-D line element.
9. Derive the stiffness matrix for a 1-D quadratic bar element.
10. Consider a bar as shown in figure. An axial load of 200kN is applied at point P. Take A_1=2400mm^2, E_1= 70x10^9 N/m^2,A2=600mm^2, E_2= 200x10^9 N/m^2. Calculate the following
    (a) The nodal displacement at point p
    (b) Stress in each material



UNIT-III
TWO DIMENSIONAL FEM

1. (a) Write about equilibrium and compatibility requirements.
   (b)Explain area and volume coordinate systems.
2. Derive expression for natural coordinates in a CST element. Show that they are nothing but area coordinates.
3. Derive shape functions for four noded rectangular elements. Use natural co-ordinate system.
4. Write and briefly explain the different types of elements for plain stress and plain strain analysis.
5. Derive the shape function for CST element.
6. Derive the strain-displacement matrix for CST element.
7. Explain about
   (a) Geometric invariance
   (b) Convergent and compatibility requirements
8. Derive the shape function and strain-displacement for an rectangular 4-noded element.
9. Write down the following?
   (a) Global coordinate system
   (b) Local coordinate system
   (c) Natural coordinate system
   (d) Discretization
10. For the constant strain triangular element shown in figure assemble strain-displacement matrix. Take t=20mm and E=2x10^5 N/mm^2



UNIT-IV
ISOPARAMETRIC FORMULATIONS AND AXI-PARAMETRIC ANALYSIS

1. Explain the isoperimetric concept in finite element analysis.
2. Explain the terms isoperimetric, sub parametric and super parametric elements.
3. State and explain the three basic laws on which isoperimetric concept is developed.
4. Derive an expression for the stain-displacement matrix for axi-symmetric triangular element.
5. Derive the shape function for 4-Noded isoperimetric quadrilateral element.
6. Derive the strain-displacement matrix for 4-Noded isoperimetric quadrilateral element.
7. Derive the shape function for 8-Noded isoperimetric quadrilateral element.
8. Explain the lagrangian and serendipity elements.
9. Derive the shape function for Axisymmetric (Triangular) element.
10. Explain the axi symmetric analysis and axi-symmetrical formulation.

UNIT-V
THREE DIMENSIONAL FEM AND FINITE ELEMENT ANALYSIS OF PLATES

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

Prepared by
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