Register Number: ……………………..

B.E DEGREE EXAMINATIONS: APRIL/MAY 2014

(Regulation 2009)

Fifth Semester

AUTOMOBILE ENGINEERING

AUE111**:** Finite Element Analysis

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Identify variational approach method?
   a) Ritz method
   b) Least square method
   c) Galerkin's method
   d) All of them

2. How many nodes and elements for a quadratic finite element?
   a) Three node and two element
   b) Three node and one element
   c) Three element and three node
   d) None of them

3. How many degrees of freedom for a beam element?
   a) 3
   b) 4
   c) 2
   d) 8

4. How many degrees of freedom for a line element?
   a) 3
   b) 4
   c) 2
   d) 8

5. Identify the following element used for analysis the axisymmetric problems.
   a) Linear bar element
   b) Linear CST element
   c) Four node quadrilateral element
   d) Both b and c

6. How many degrees of freedom for quadratic CST element?
   a) 3
   b) 6
   c) 7
   d) 9

7. What is isoparametric element?
   a) Field variables equal geometric variables
   b) Field variables greater than geometric variables
   c) Field variables less than geometric variables
   d) None of the above

8. What is four node quadrilateral element?
   a) No of node is four
   b) No of node is five
   c) No of node is eight
   d) All of the above.

9. A cylinder is subjected to internal pressure. What type of element used to analysis the problems?
   a) Four node quadrilateral element
   b) Three node CST element
   c) Four node CST element
   d) All of the above.

10. Which method is very popular for solving the given differential equation? and form the weak formation for derives the finite element equation.
    a) Least square method
    b) Galerkin's method
    c) Minimum potential energy method
    d) Newton forward metho

PART B (10 x 2 = 20 Marks)

11. List out the properties of stiffness matrix.
12. What is meant by Pascal's triangle?
13. What is meant by interpolation function?
14. Write the shape function for beam element.
15. What is meant by principal of virtual works?
16. Give few examples for plat stress and plane strain problems for FEA.
17. What is Q9 and Q8 elements?
18. What is meant by isoparametric elements?
19. Write the finite element equation for heat transfer 1D bar element.
20. What is meant by total potential energy?

PART C (5 x 14 = 70 Marks)

21. a) Solve the differential equation for a physical problem expressed as

$$\frac{d^2y}{dx^2} + 500 = 0, 0 < x < 40$$

with boundary conditions as y(0)=0 and y (10) =0 using point collocation, sub domain collocation and Galerkin's method.

(OR)

b) A cantilever beam is subjected to uniformly distributed load throughout its length and a concentrated load at the free end. Find the deflection using Rayleigh – Ritz method.

22. a)   Derive the 1D finite element equation using Galerkin's approach.

(OR)

b)   Determine the displacement and the slope at the nodes and also the forces and reactions for the beam. E=70GPa, I=2*10e^{-4} m^4
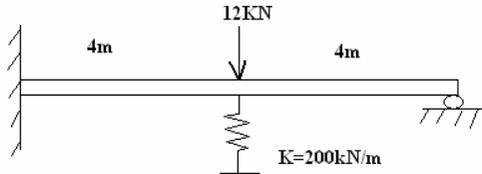
23. a)   Evaluate the stiffness matrix for the triangular element for the coordinates of A (0, 0), B (6, 0) and C (3, 5) under plane strain condition. Assume the following values: E = 200GPa, t = 1mm and μ = 0.25.

(OR)

b)   Derive the shape function for CST element using polynomial type interpolation functions.

24. a)   Calculate the thermal vector for the plane stress element for the following coordinates of triangular element of (0, 0), (2, 0) and (1, 3). The element experiences a 10°C increase in temperature. Assume Youngs modulus E = 15 x 10^6 N/cm^2, μ = 0.25, α = 6 x 10^{-6} cm/cm °C and t =0.5 cm. All coordinates are in cm.

(OR)

b)   For the given constant strain triangular element, assemble stiffness matrix for plane stress condition. Take t=20mm, E=2 × 10^{5}N/mm^2 and γ= 0.3.

k (200,400)

i (100,100)   j (400,100)
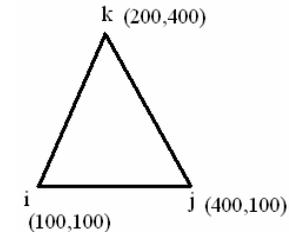
25. a)   For a four nodal rectangular element of the coordinates of (0, 0), (3, 0), (3, 2) and (0, 2). Compute the following

   1. Jacobian matrix
   2. Strain-displacement matrix
   3. Element strains

   Element stresses

(OR)

b)   Evaluate the integrals. I=$\int_{-1}^{+1}\left[X^2 +\frac{\cos x}{2}\right]dx$ and I=$\int_{-1}^{+1}[3^x - x]dx$ using 3 point Gaussian quadrature x$_1$=x$_3$=±0.77459, x$_2$=0, w$_1$=w$_3$=$\frac{5}{9}$ and w$_2$=$\frac{8}{9}$.

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