



Register Number:.....

B.E DEGREE EXAMINATIONS: NOV / DEC 2014

(Regulation 2009)

Sixth Semester

MECHANICAL ENGINEERING

MEC119 Finite Element Analysis

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

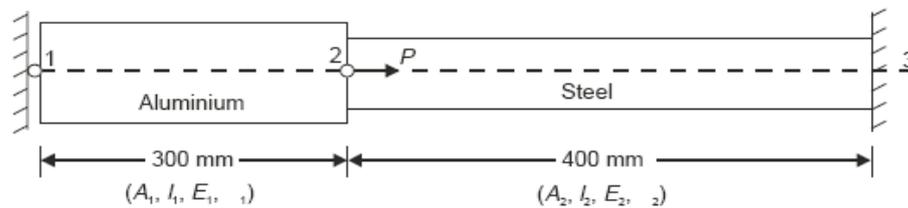
PART A (10 x 1 = 10 Marks)

1. The Inverse of a non singular square matrix can be found by _____
 - a) Rayleigh Ritz method
 - b) Galerkins method
 - c) Gauss Jacobi method
 - d) Gauss Jordan method
2. Displacement method is based on minimum
 - a) Potential energy
 - b) Strain energy
 - c) Complementary strain energy
 - d) Work done
3. The entire point in the structure are defined in coordinate system is known as
 - a) Global co - ordinate
 - b) local co - ordinate
 - c) natural co - ordinate
 - d) Cartesian co - ordinate
4. A frame with distributed loads along members is modeled by an assembly of ----
 - a) Truss element
 - b) Beam element
 - c) Spar element
 - d) Spring element
5. _____ elements are preferred for plane stress applications and relatively small number of nodes.
 - a) Iso parametric
 - b) CST
 - c) LST
 - d) Sub Parametric
6. ----- is defined to be a state of strain in which the strain normal to the xy - plane and the shear strain are assumed to be zero
 - a) Plane stress analysis
 - b) Plane strain analysis
 - c) Strain – displacement analysis
 - d) Stress – strain analysis

- b) A simply supported beam is subjected to uniformly distributed load over entire span. Determine the bending moment and deflection at the mid span using Rayleigh-Ritz method and compare with exact solution. Use a two term trial function ,

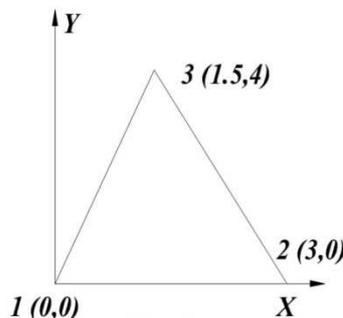
$$y = \alpha_1 \sin \frac{\pi x}{l} + \alpha_2 \sin \frac{3\pi x}{l}$$

22. a) Determine the nodal displacements at node 2, stresses in each material and support reactions in the bar shown in Fig. due to applied force $P = 600$ KN and temperature rise of 30° C. Given: $A_1 = 2000$ mm² $A_2 = 900$ mm² $l_1 = 300$ mm $l_2 = 400$ mm $E_1 = 0.7 \times 10^5$ N/mm² , $E_2 = 2 \times 10^5$ N/mm² and $\alpha_1 = 22 \times 10^{-6}$ $\alpha_2 = 12 \times 10^{-6}$ $^\circ$ C .



(OR)

- b) Derive the finite element equation of a one dimensional steady state heat conduction and convection with heat generation problem using Galerkins approach.
23. a) Evaluate the element stress, principal stresses and principal angle for the CST element shown in fig. Assume plane stress condition. Take, $t = 20$ mm, $E = 2 \times 10^5$ N/mm² and $\gamma = 0.25$. The coordinates are given in mm.



(OR)

- b) The nodal coordinates of the triangular element are 1(1, 2), 2(4, 3) and 3(6, 4). At the interior point 'P', the x coordinate is 3.5 and the shape function $N_1 = 0.25$.

Determine

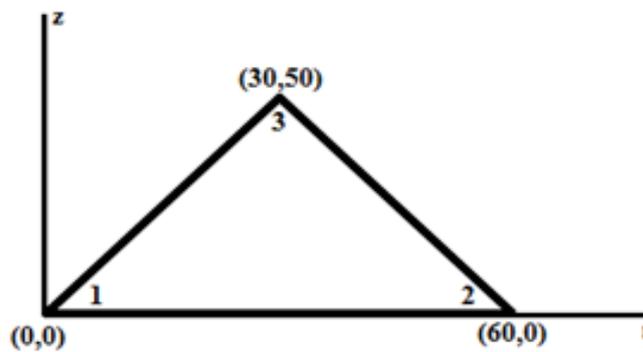
(i) The shape functions N_2 and N_3 and the y coordinate of the point 'P'. (7)

(ii) Strain displacement matrix [B] (7)

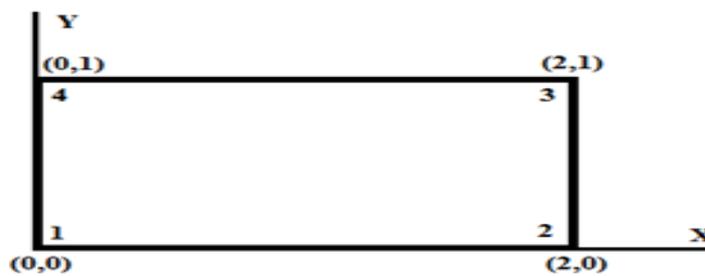
24. a) Derive the shape functions and strain displacement matrix [B] for axisymmetric triangular element.

(OR)

- b) For an axisymmetric element shown in fig, determine the thermal load vector. Take $E=2.1 \times 10^5 \text{ N/mm}^2$ and $\gamma = 0.3$. Take $\alpha = 11 \times 10^{-6} \text{ } ^\circ\text{C}$ and $\Delta T = 25^\circ \text{C}$.



25. a) A four noded rectangular element shown in fig, determine Jacobian matrix, Strain displacement matrix and Element stresses. Take $E= 2 \times 10^5 \text{ N/mm}^2$, $\mu = 0.25$, $u = [0,0,0,0.003,0.004,0.006,0.004,0,0]^T$, $\varepsilon = 0.0$ and $\eta = 0.0$. Assume plane stress condition.



(OR)

- b) (i) The coordinates of an isoparametric quadrilateral element are 1(3, 1), 2(6, 1), 3(8, 6) and 4(2, 5). Determine the local coordinate of point 'P', which has Cartesian coordinate (7, 4). (10)
- (ii) Evaluate the integral $\int_{-1}^1 (2 + x + x^2) dx$ and compare with exact solution. (4)
