Code: 9A01701

R09

B.Tech IV Year I Semester (R09) Supplementary Examinations, May 2013

FINITE ELEMENT METHODS IN CIVIL ENGINEERING

(Civil Engineering)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

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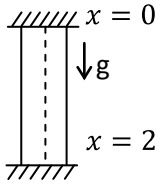
1 (a) Write the differences between FEM and classical methods.

(b) Use the Rayleigh-Ritz method to find the displacement of the midpoint of the rod shown in fig:



Body force per unit volume $\rho g = 1$

$E = 1$

$A = 1$

2 (a) Discuss the stress-strain relation for plane strain problems.

(b) Explain the term "axi - symmetric problems" and give consecutive law for such problems.

3 (a) Write the difference between beam element and bar element.

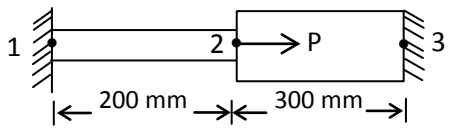
(b) An axial load $P = 300 \text{ X } 10^3$ N is applied at $20°C$ to the rod shown in fig. temperature is then raised to $60°C$.

(i) Assemble stiffness matrix, force matrix.

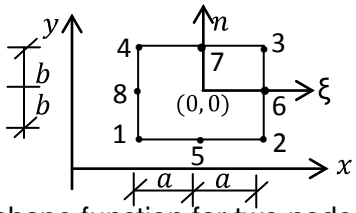
(ii) Find the nodal displacements and element stresses.

$E_1 = 70 \text{ X } 10^9 \text{ N/mm}^2$, $E_2 = 200 \text{ X } 10^9 \text{ N/mm}^2$, $A_1 = 900 \text{ mm}^2$, $A_2 = 1200 \text{ mm}^2$

$\alpha_1 = 23 \text{ X } 10^{-6}/°c$, $\alpha_2 = 11.7 \text{ X } 10^{-6}/°c$.



4 (a) Determine the shape functions for quadratic element shown in fig:



(b) Determine the shape function for two noded beam elements.

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5 Find the displacements and stresses in a beam shown in fig 1. Idealize the beam into two 'CST' elements shown in fig 1. Assume plane stress condition take $\mu = 0.25$, $E = 2 \text{ X } 10^5 \text{ N/mm}^2$, thickness $= 20$ mm.

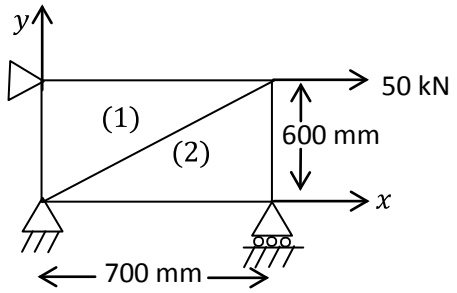

Fig 1.

6 (a) State and explain the three basic laws on which isoparametric concept is developed.
(b) Form a Jacobian matrix for 4-noded isoparametric quadrilateral element.

7 Formulate element equations for the axisymmetric element shown in fig 2. Take $E = 100$ Gpa, $\gamma = 0.3$, $\alpha = 5 \text{ X } 10^{-4}$ Per°C. $\Delta T = 60°C$, $P = 8 \text{ N/mm}^2$ acting ⊥ler to side 'JK'. Nodal co-ordinates in "mm" are $\gamma_i = 5$, $\gamma_j = 1$, $\gamma_k = 3$, $z_i = 5$, $z_j = 5$, $z_k = 2$.

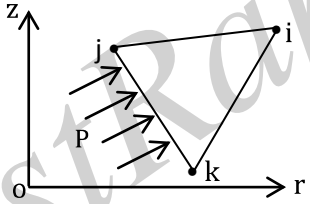

Fig 2.

8 (a) Write short notes on Gaussian quadrature integration technique.
(b) Evaluate $\int_{\xi=-1}^{+1} [N]^T [N] \, d\xi$ for one dimensional quadratic element to illustrate the application of Gaussian quadrature method. Take the following which is suitable for above problem of $n = 2$ take $\xi_1 = -0.57735$, $\xi_2 = 0.57735$, $\omega_1 = 1$, $\omega_2 = 1$ of $n = 3$ take $\xi_1 = -0.7746$, $\xi_2 = 0$, $\xi_3 = +0.7746$, $\omega_1 = 5/9$, $\omega_2 = 8/9$, $\omega_3 = 5/9$.

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