Code: 13A03703

R13

B.Tech IV Year I Semester (R13) Regular Examinations November/December 2016

FINITE ELEMENT METHODS

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

PART - A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) What are 'h' and 'p' versions of finite element method?

(b) Write down the expression of shape function N and displacement u for one dimensional bar element.

(c) State the principle of virtual work.

(d) What are the characteristics of shape function?

(e) Differentiate between boundary value problem and initial value problem.

(f) What is the purpose of isoparametric elements?

(g) Write down the element force vector equation for four noded quadrilateral elements.

(h) What is axisymmentric element?

(i) Define streamline.

(j) Write down the governing equation for 2D heat conduction.

PART - B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT - I

2 The following differential equation in available for physical phenomenon $\frac{d^2y}{dx^2} + 500x^2 = 0 \;\; 0 \leq x \leq 1$

Trial function $y = a_1 x\,(10 - x)$

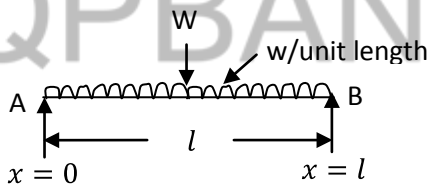
Boundary conditions $y(0) = 0,\; y(1) = 0$

Find the values of a_1 for the following methods.

(a) Point collocation. (b) Subdomincollacation. (c) Least square method. (d) Galerkin method.

OR

3 A simply supported beam is subjected to uniformly distributed load over entire span. Determine the bending moment and deflection at mid span by using Rayleigh Ritz method.



UNIT - II

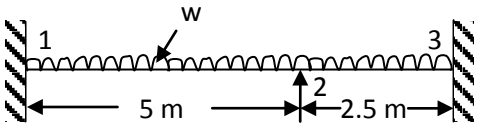
4 Derive the stiffness matrix for a one dimensional axial bar element.

OR

5 Consider a beam as shown below with area of cross section 6000 mm^2, depth 300 mm, moment of inertia I = 120 x 10^{-6} mm^4. The beam is subjected to uniformly distributed load of 20,000 N/m. Calculate:

(a) Rotation at node 2 and 3.

(b) Displacement at node 3. Take E = 2 x 10^5 N/mm^2.



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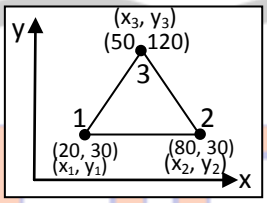
UNIT - III

6 Determine the stiffness matrix for the constant strain triangular (CST) element shown in figure. The coordinates are given in units of millimeters. Assume plane stress conditions. Take E = 210 GPa; Poisson's ratio (v) = 0.25; Thickness (t) = 10 mm.



OR

7 What are Lagrangian interpolations functions? Using Lagrangianpolynomial derive the shape functions for ID quadratic element/cubic element.

UNIT - IV

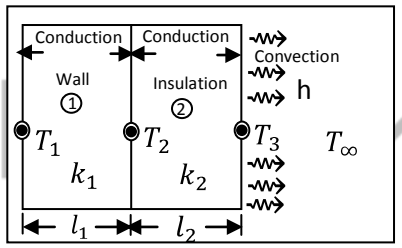
8 Explain with an example of each of the following:
(a) Sub parametric element.
(b) Iso parametric element.
(c) Super parametric element.

OR

9 Evaluate the integral $\int_{-1}^{1} cos\frac{x}{2}dx$ by applying 3 point Gaussian quadrature.

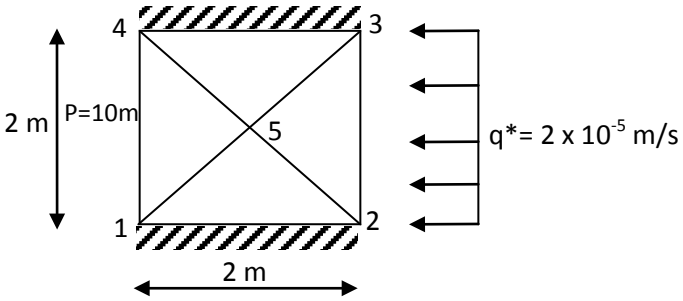
UNIT - V

10 A wall of 0.6 m thickness having a thermal conductivity of 1.2 W/mK. The wall is to be insulated with a material of thickness 0.06 m having an average thermal conductivity of 0.3 W/mK. The inner surface temperature is 1000℃ and outside of the insulation is exposed to atmospheric air at 30℃ with heat transfer coefficient of 35 W/m^{2}K. Calculate the nodal temperature.



OR

11 For the two dimensional fluid flow as shown in the figure, determine the potentials at the center and right edge. Take k = 2 x 10^{-5} m/s.



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