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Question Paper Code : X 67625

B.E./B.Tech. DEGREE EXAMINATIONS, NOV./DEC. 2020
Seventh Semester
Mechanical Engineering
ME 1401 – FINITE ELEMENT ANALYSIS
(Common to Automobile Engineering)
(Regulations 2008)

Time : Three Hours Maximum : 100 Marks

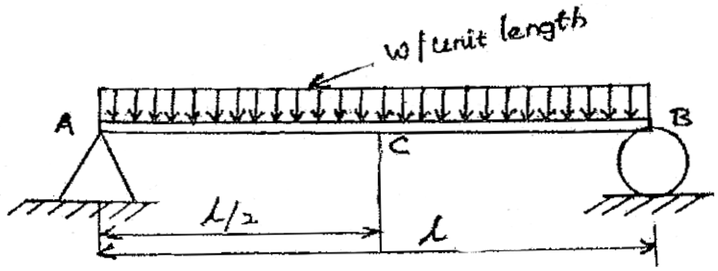
Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. Write any four applications of FEM in engineering problems.
2. What is Ritz technique ?
3. State the principle followed in Galarkin method used to solve a problem in structural mechanics.
4. What are the features of shape functions and why is the summation of shape functions equal to unity ?
5. Give the Jacobian matrix for a constant strain triangular (CST) element and state its significance.
6. What is meant by consistent and lumped mass strategy ?
7. Define element capacitance matrix for unsteady state heat transfer problem.
8. State the conditions to be satisfied in order to use axisymmetric elements.
9. Distinguish sub parametric and super parametric elements.
10. Define band width.

PART – B **(5×16= 80 Marks)**

11. a) Determine the deflection at the centre of a simply supported beam of span length/subjected to uniformly distributed load throughout its length as shown in figure. Use Rayleigh-Ritz method. **(16)**



(OR)

b) Solve the equations using Gauss-Elmination method. **(16)**

$2x_1 + 4x_2 + 2x_3 = 15$

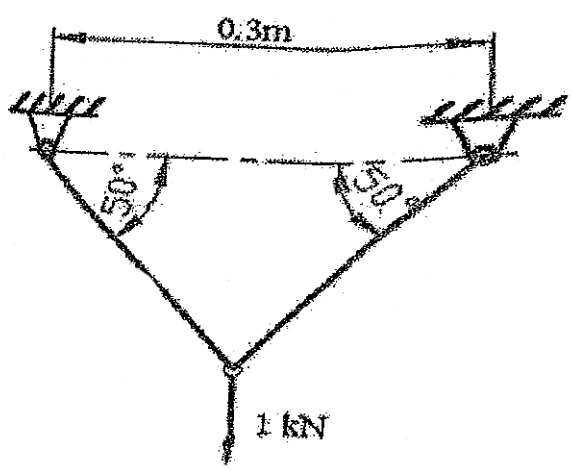
$2x_1 + x_2 + 2x_3 = -5$

$4x_1 + x_2 - 2x_3 = 0.$

12. a) A link of 2 m, pin-jointed at one end, is rotating at angular velocity 5 rad/sec. The cross-sectional area of link is 2×10^{-3} m^2. Determine the nodal displacements using two linear spar elements. Take E = 200 GPa and ρ = 7850 kg/m$^{-3.}$

(OR)

b) Each of the three bars of the pin-jointed frame shown in fig. 1 has a cross-sectional area of 1000 mm^2 with E = 200 Gpa. Solve for the displacements.



13. a) Determine the stiffness matrix for the Constant Strain Triangular (CST) element shown in Fig. Q. 13 (a) the co-ordinates are given in Units of millimeters assume plane stress conditions. Take E = 210 GPa 0.25 and t = 10 mm.

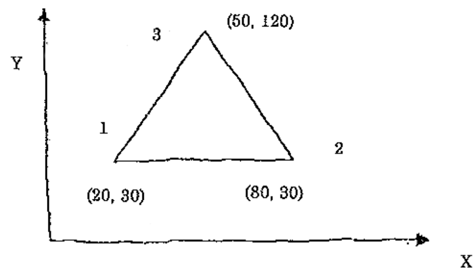


Fig. Q 13(a)

(OR)

b) Consider heat Transfer in a plane wall of total thickness L. The left surface is maintained at temperature T_0 and the right surface is exposed to ambient temperature T_∞ with heat transfer Coefficient β. Determine the temperature distribution in the wall and heat input at the left surface of the wall for the following data : L = 0.1 m, k = 0.01 W/m°C, β = 25 W/m^2 C, T_0 = 50°C, and T_∞ = 5° SC. Solve for nodal temperatures and the heat at the left wall using two linear finite elements.

14. a) i) Derive the expression for consistent load vector due to self-weight in a CST element. **(8)**

ii) Find the expression for nodal vector in a CST element subject to pressures Px_1, Py_1 on side 1, Px_2, Py_2 on side 2, Px_3 Py_3 on side 3 as shown in Fig. Q. 14 (a) (ii) . **(8)**

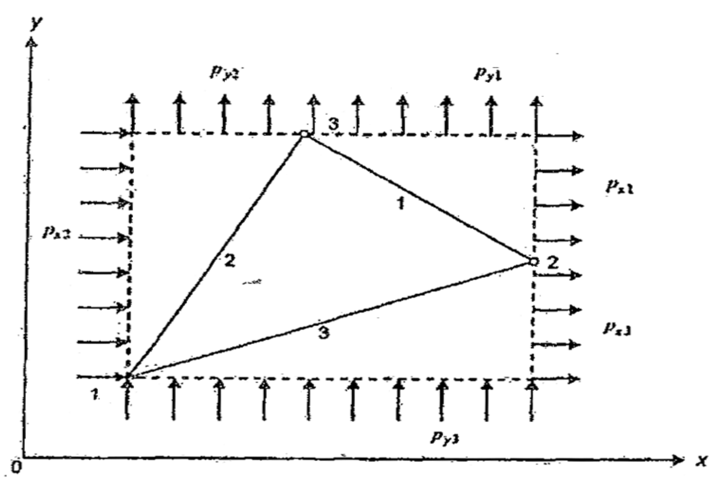


Fig. Q.14(a)(ii)

(OR)

b) Briefly discuss about finite element modelling for axisymmetric solid and also derive the expression for the element stiffness matrix for an axisymmetric shell element.

15. a) i) Derive the isoparametric representation for a triangular element. **(10)**

ii) Write short notes on lagrangean and serendipity elements. **(6)**

(OR)

b) i) Explain the one point and two point Gaussian quadrature methods of numerical integration. **(8)**

ii) Derive the interpolation function of a corner node in cubic serendipity element. **(8)**
