Reg. No. :

Question Paper Code : X86918

M.E./M.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2021
Second Semester
Structural Engineering
ST5204 – FINITE ELEMENT ANALYSIS OF STRUCTURES
(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

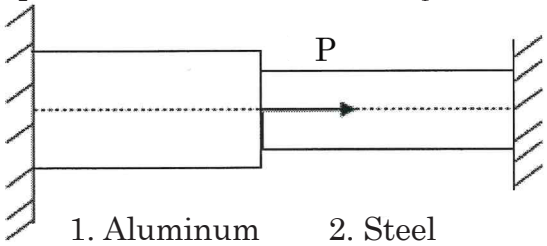
1. How to analysis Degrees of freedom with examples ?
2. Differentiate between global and local axes.
3. Write down the stress strain relationship matrix for plane stress condition.
4. Distinguish between essential boundary condition and natural boundary.
5. Differentiate between CST and LST.
6. Why higher order elements are necessary ?
7. What are the assumptions for thin shell theory ?
8. Draw the kirchoff plate after bending.
9. List the methods of meshing.
10. What are the types of non-linearity ?

PART – B **(5×13=65 Marks)**

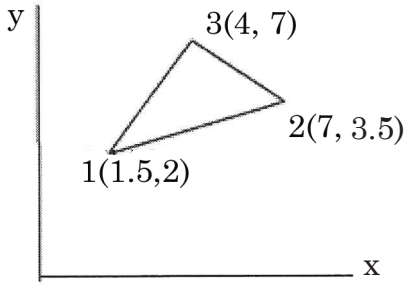
11. a) The following differential equation is available for a physical phenomenon AE $(d^2y/dx^2 + q_0) = 0$ with the boundary conditions $y(0) = 0 (dy/dx)_{x=L} = 0$. Find the value of f(x) using the weighed residual method.

(OR)

b) For the bar shown in fig, evaluate the nodal displacement, stress in each Material and reaction forces. L_1 = 350 mm and L_2 = 450 mm. A_1 = 2450 mm^2, A_2 = 650 mm^2, P = 250 kN, E_1 = 70 GPa, E_2 = 200 GPa.



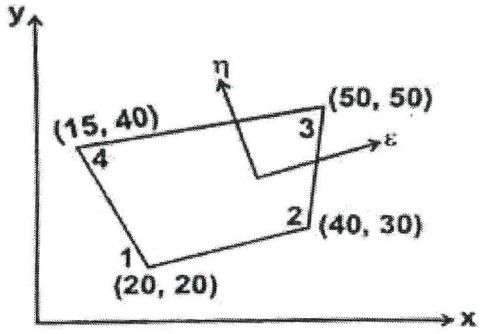
12. a) Evaluate the shape functions N1, N2, N3 at the interior point P (3.85, 4.8) for the triangular element shown in fig.



(OR)

b) Derive the shape functions for four noded bar element using Lagrangian interpolation function. Nodes are equally spaced.

13. a) For the four noded quadrilateral element shown in fig. determine the Jacobian and evaluate its value at the point (1/2, ½).



(OR)

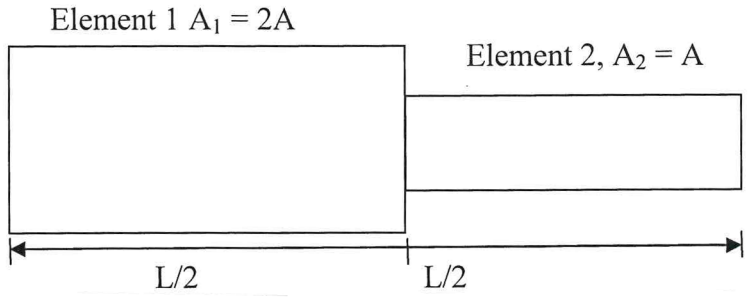
b) Figure depicts a system of three linearly elastic springs supporting three equal weights W suspended in a vertical plane. Treating the springs as finite elements, determine the vertical displacement of each weight.

14. a) Explain in detail the finite element analysis of skew plate. Find the K Value.

(OR)

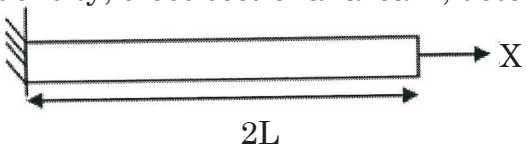
b) Explain in detail the basic relationships and consecutive equations of thin plate theory.

15. a) Find the natural frequency of longitudinal vibration of the unconstrained steeped bar as shown in fig.



(OR)

b) For the bar as shown in fig with length 2L, modulus of elasticity E, mass density, cross sectional area A, determine the first two natural frequencies.



PART – C **(1×15=15 Marks)**

16. a) The differential equation of a physical phenomenon is given by $(d^2y/dx^2) + y = 4x$; $0 \le x \le 1$. The boundary conditions are: $y(0) = 0$ and $y(1) = 1$. Obtain one term approximation solution by using Galerkin's method of weighed residuals.

(OR)

b) Consider the eight nodded quadrilateral element defined by the following nodal coordinates : $x_1 = 5$, $y_1 = 7$, $x_2 = 1$, $y_2 = 4$, $x_3 = 2$, $y_3 = 1$, $x_4 = 8$, $y_4 = 4$, $x_5 = 3$, $y_5 = 3$, $x_6 = 6$, $y_6 = 5$, $x_7 = 2.5$, $y_7 = 3$, $x_8 = 1.5$, $y_8 = 2$. Determine the global coordinates $\eta = 1$, $\varepsilon = 0.75$.

———————