



3. In structural idealization, it is recommended to use relatively \_\_\_\_\_ elements in areas where \_\_\_\_\_ stress gradients occur. CO<sub>1</sub> [K<sub>2</sub>]  
 1. Small 2. Low 3. Big 4. High
- a) 1,3 b) 1,4  
 c) 1,2 d) 2,3
4. The size of element stiffness matrix of pin jointed space truss element is CO<sub>1</sub> [K<sub>2</sub>]  
 a) 3X3 b) 4X4  
 c) 2X2 d) 6X6
5. Assertion (A): The elements of the strain displacement matrix of LST element are expressed in terms of nodal coordinates and linear shape functions CO<sub>2</sub> [K<sub>3</sub>]  
 Reason (R): In the natural coordinate system, there are two shape functions for the LST element.
- a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A  
 c) A is true but R is false d) A is false but R is true
6. The dimension of the global stiffness matrix 'k' is (N X N) where N is \_\_\_\_\_. CO<sub>2</sub> [K<sub>1</sub>]  
 a) No. of nodes in system b) No. of elements in the system  
 c) Nodal degrees of freedom for the system d) No. of nodes & elements of the system
7. Sequencing type item in terms of solution flow in FEA problems CO<sub>1</sub> [K<sub>2</sub>]  
 1. Displacement 2. Stress  
 3. Strain 4. Force
- a) 2-3-1-4 b) 4-1-3-2  
 c) 3-1-2-4 d) 4-2-3-1
8. The shape function used for displacement is the same as that which relates the cartesian and the natural coordinates in CO<sub>1</sub> [K<sub>1</sub>]  
 a) higher order elements b) isoparametric formulation  
 c) skyline approach d) lagrangian formulation
9. Assertion (A): The Equation for heat flow by convective heat transfer is  $h(T - T_{\infty})$  CO<sub>2</sub> [K<sub>3</sub>]  
 Reason (R): Where T refers to Temperature of the solid surface at the solid/fluid interface
- a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A  
 c) A is true but R is false d) A is false but R is true

10. The chassis frame of a vehicle when it encounters a pot hole needs to be analyzed using the following analysis type: CO<sub>3</sub> [K<sub>2</sub>]
- a) Transient dynamic b) Harmonic  
 c) Static d) Modal

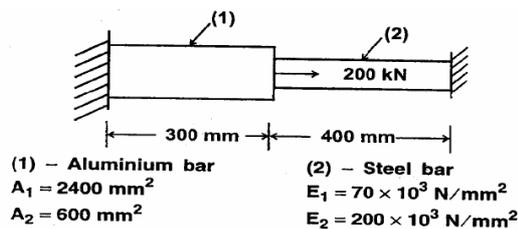
**PART B (10 x 2 = 20 Marks)**  
**(Answer not more than 40 words)**

11. Distinguish between Rayleigh Ritz method and finite element method. CO<sub>1</sub> [K<sub>1</sub>]
12. What are 'h' and 'p' methods used in FEA? CO<sub>1</sub> [K<sub>1</sub>]
13. Illustrate the shape functions of one dimensional quadratic spar element. CO<sub>2</sub> [K<sub>1</sub>]
14. Write the principle of minimum potential energy. CO<sub>1</sub> [K<sub>1</sub>]
15. Distinguish between CST and LST elements used in FEM. CO<sub>1</sub> [K<sub>1</sub>]
16. Mention the thermal load vector for a two dimensional heat transfer problem. CO<sub>2</sub> [K<sub>1</sub>]
17. Mention a typical problem where axisymmetric formulation is applied. Sketch the finite element model. CO<sub>2</sub> [K<sub>3</sub>]
18. Illustrate the axisymmetric boundary conditions for a cylinder subjected to internal pressure. CO<sub>2</sub> [K<sub>2</sub>]
19. List any two salient features of an isoparametric element. CO<sub>1</sub> [K<sub>1</sub>]
20. List the properties of stiffness matrix. CO<sub>2</sub> [K<sub>1</sub>]

**Answer any FIVE Questions:-**  
**PART C (5 x 14 = 70 Marks)**  
**(Answer not more than 300 words)**

**Q.No. 21 is Compulsory**

21. A stepped bar shown in Figure is subjected to an axial load of 200 kN. Find the displacement at the point of application of load and the stresses induced in the entire bar. CO<sub>4</sub> [K<sub>2</sub>]



22. Solve the following system of equations by Gauss elimination method. CO<sub>3</sub> [K<sub>2</sub>]
- $$3x_1 + x_2 + x_3 = 4$$
- $$x_1 + 4x_2 - x_3 = -5$$
- $$x_1 + x_2 - 6x_3 = -12$$

23. A triangular plate of thickness 10 mm has vertices P(20,30), Q(80,30) and R(50,120). The nodal displacements of P,Q and R are (2,1), (0.5,0) and (3,1) respectively. Determine the element stresses,  $\sigma_x$ ,  $\sigma_y$ ,  $\tau_{xy}$ ,  $\sigma_1$ ,  $\sigma_2$ . Let  $E = 210 \text{ GPa}$ ,  $\mu = 0.25$ , Where  $E$ =young 's modules,  $\mu$ =passions ratio. CO<sub>3</sub> [K<sub>2</sub>]
24. For the axisymmetric element having vertices A(0,0), B(60,0), C(30,50) in mm, determine the element stresses based on the following data: Take  $E = 2.1 \times 10^5 \text{ N/mm}^2$  and  $\mu = 0.25$ . The nodal displacements are, (0.05, 0.03), (0.02, 0.02), (0,0) in mm. CO<sub>4</sub> [K<sub>2</sub>]
25. A four nodal quadrilateral plane stress isoparametric element is defined by the nodes 1(1,1), 2(5,2), 3(4,5) and 4(2,4). Determine the strain displacement matrix corresponding to the Gauss point (0.57735, -0.57735) for the above element. CO<sub>5</sub> [K<sub>2</sub>]
26. A rectangular plate of size 4mx2mx1m is subjected to a uniform heat source of  $1000 \text{ W/m}^3$  acting over the whole body. The temperature of the top side of the body is maintained at  $100^\circ\text{C}$ . The body is insulated on the other edges. Take the thermal conductivity of the material as  $25 \text{ W/m}^\circ\text{C}$ . Determine the temperature distribution using triangular elements. CO<sub>3</sub> [K<sub>3</sub>]
27. A long hollow cylinder of inside diameter 100 mm and outside diameter 140 mm is subjected to an internal pressure of  $4 \text{ N/mm}^2$ . Using two axisymmetric elements of 15 mm length, determine the strain displacement matrix for both elements. Take Young's modulus as 200 GPa and Poisson's ratio as 0.3. CO<sub>4</sub> [K<sub>3</sub>]

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