8. (a) Explain the different types of non-linearities encountered in structural analysis. 10

(b) State and explain the concept of 3D modeling. 10

Roll No. .....

23731

M. Tech. 2nd Sem. (Civil Engg.) (Computer Aided Structural Engineering) Examination – June, 2023

FINITE ELEMENT ANALYSIS

Paper : 21MTCASE22C1

Time : Three Hours] *[Maximum Marks : 100*

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt any *five* questions in all.

1. (a) Explain the concept of FEM briefly and outline the procedure. 8

   (b) Find out deflection at centre of a simply supported beam of length (L) subjected to a uniformly distributed load w. Use Rayleigh Ritz method. Take EI is constant. 12

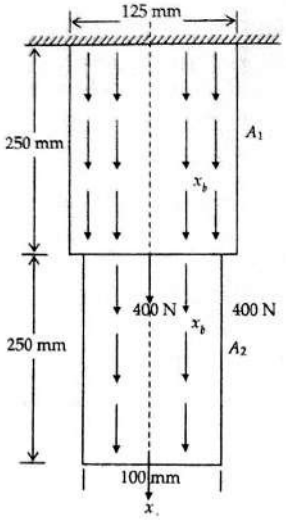
2. (a) Derive the equations of equilibrium in case of a three dimensional stress system. 10

   (b) State and explain the principle of minimum potential energy. 10

3. (a) State and explain the convergence requirements of polynomial shape functions. 10

(b) Derive the expression for shape function for a four noded bar element taking natural coordinate as varying from –1 to 1. 10

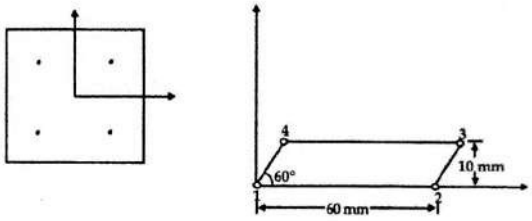
4. The thin plate of uniform thickness 20 mm, is as shown in Figure. In addition to the self-weight, the plate is subjected to a point load of 400 N at mid-depth. The Young's modulus $E = 2 \times 10^5 N/mm^2$ and unit weight $\rho = 0.8 \times 10^4 N/mm^2$. Analyse the plate after modelling it with two elements and find the stresses in each element. Determine the support reactions also : 20



5. (a) Explain the terms isoparametric, subparametric and superparametric elements. 10

(b) Write short notes on serendipity elements with necessary figure. 10

6. Assemble Jacobian matrix and strain displacement matrix corresponding to the Gauss point (0.57735, 0.57735) for the element shown in below figure. Then indicate how you proceed to assemble element stiffness matrix : 20



7. (a) Describe briefly about basic theory of plate bending with neat sketch and derive flexural rigidity equation. 10

(b) Explain the term Mindlin's CO-continuity plate element and briefly explain stiffness matrix formulation for such elements. 10