Printed Pages:2 **Sub Code: MTST 202**

Paper Id: 2 7 3 2 0 2 **Roll No.** | | | | | | | | | | |

M. TECH.
(SEM II) THEORY EXAMINATION 2017-18
FINITE ELEMENT METHODS

Time: 3 Hours ***Total Marks: 70***

Note: Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

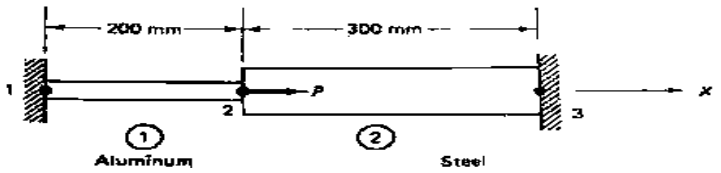
a. Write the merits and demerits of finite elements methods.
b. What is the importance of boundary conditions?
c. Define geometric variance.
d. Define shape function.
e. Write the application of axi-symmetric element.
f. What do you understand by flexibility approach?
g. What is meant by displacement function?

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

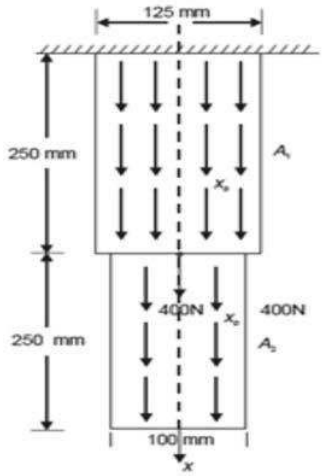
a. Using Rayleigh-Ritz method find the approximate displacement of uniform bar (EA constant) fixed at one end and subjected to a static point load at the other end. The bar is also subjected to a linearly varying axial load $q(x) = cx$, where c is a given constant. Compare the linear and quadratic solution.

b. Determine the displacements and the support reactions for the uniform bar shown in figure. Given P = 300 KN.
For Aluminum : E = 70 x 10^9 N/m^2 ,
A = 900 mm^2
For Steel : E = 200 x 10^9 N/m^2 ,
A = 1200 mm^2



c. Derive the shape functions for a 4 node (corner) rectangular element using Lagrange method.

d. 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 x 10^5 N/mm^2 and unit weight = 0.8 x10^4 N/mm^2. Analyse the plate after modelling it with two elements and find the stresses in each element. Determine the support reactions also.



e. Explain the concept of plane stress and plane strain with examples.

SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

(a) Write the steps involved in the FEM for a structural mechanics problems solution with formulations.

(b) Write the concept of FEM with example. Explain the software's based on FEM.

4. Attempt any *one* part of the following: 7 x 1 = 7

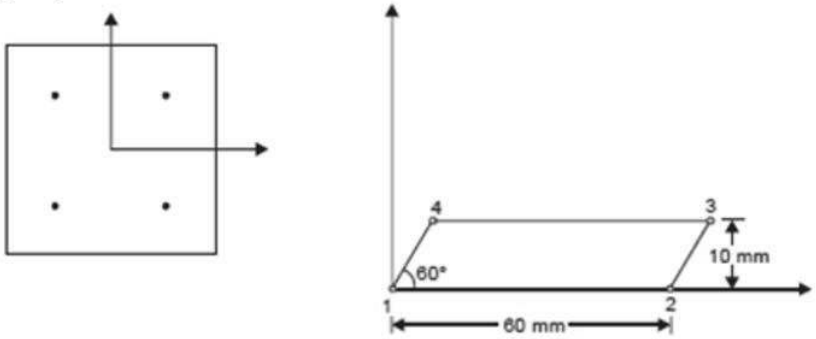
(a) Derive the equations of equilibrium in case of a three dimensional stress system.

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

5. Attempt any *one* part of the following: 7 x 1 = 7

(a) Explain in detail how the element stiffness matrix and the load vector are evaluated in isoparametric formulations.

(b) Assemble Jacobian matrix and strain displacement matrix corresponding to the Gauss point (0.57735, 0.57735) for the element shown in Figure. Then indicate how you proceed to assemble element stiffness matrix.



6. Attempt any *one* part of the following: 7 x 1 = 7

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

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

7. Attempt any *one* part of the following: 7 x 1 = 7

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

(b) Solve the following system of equations by Gaussian-Elimination method:

$$x_1 - 2x_2 + 6x_3 = 0$$
$$2x_1 + 2x_2 + 3x_3 = 3$$
$$-x_1 + 3x_2 = 2$$