MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent unit of MAHE, Manipal)

DEPARTMENT OF CIVIL ENGINEERING

II SEMESTER M.TECH. (STRUCTURAL ENGINEERING)

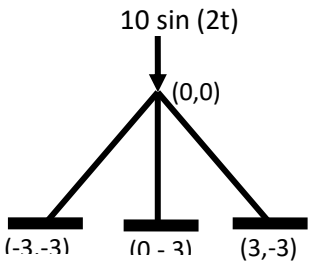
END SEMESTER EXAMINATION

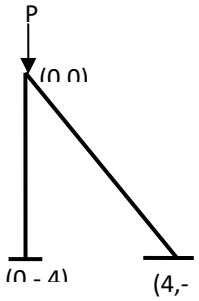
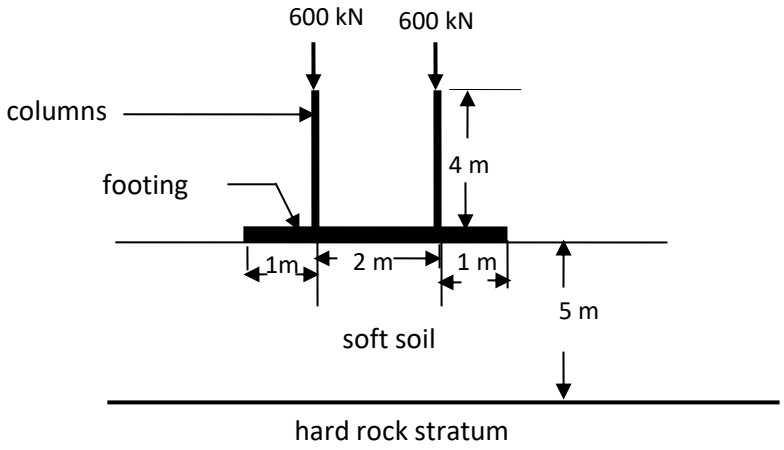
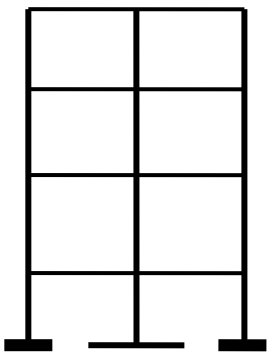
SUBJECT: Applications of FEM for Structural Engineering [CIE 5016]

Time: 2 PM-5PM Date: 28/06/2022 MAX.MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Any data not provided may be suitably assumed.

Sl No	Questions	M	CO
1A	Evaluate the equivalent nodal load vector for eight noded brick element due to the load 500 kN acting along X direction at the natural coordinates r = 0.5, s = 0.5 and t = 0	3	1
1B	Illustrate the procedure to obtain stiffness matrix for four noded quadrilateral plate bending element	4	1
1C	Illustrate the procedure to obtain mass matrix for two noded beam element	3	2
2A	Illustrate the procedure to obtain the mass matrix for three noded triangular element	3	2
2B	Evaluate the Eigen values and Eigen vectors for the pin connected structure shown in figure Fig Q 2B. Also write the dynamic equation in finite difference form. Take E= $2x10^7$ kN/m^2 , mass density = 50 kNses^2/m^2 and c/s area =0.24 m^2 for all the members  **Fig. Q 2B**	7	2
3A	Evaluate the displacement at nodes for a column of length 3.6 m and c/s area 0.36 m^2 due to 600 KN load. Column is provided with a fixed support at the other end. Variation of E with displacement q is defined by the equation E=$2x10^7$ [1- 860q]^2 kN/m^2. Use incremental procedure and three increments	4	3

3B	Evaluate the critical load P for the pin connected structure shown in figure **Fig Q 3B**.Take AE 6000 KN for both the members  **Fig. Q. 3B**	6	4
4A	A combined footing supports two axially loaded columns as shown in figure **Fig Q 4A**. Illustrate finite element descretization for the structure, footing and soil indicating node numbers, element numbers, degrees of freedom at each node and connectivity for all the elements.  **Fig Q 4A**	5	4
4B	Evaluate the band widths for numbering the nodes in different ways for the rigid jointed structure shown in figure **Fig Q 4B**. What is the minimum band width  **Fig Q 4B**	5	5

5A	Illustrate the procedure to obtain shape functions for five noded triangular element using the shape functions of six noded triangular element	4	5
5B	Equation of equilibrium for an element with three degrees of freedom is as follows. Evaluate the equation of equilibrium for an element with two degrees of freedom after eliminating dof u2 $\frac{AE}{3L}\begin{bmatrix} 7 & -8 & 1 \\ -8 & 16 & -8 \\ 1 & -8 & 7 \end{bmatrix}\begin{bmatrix} u1 \\ u2 \\ u3 \end{bmatrix} = \begin{bmatrix} 60 \\ 20 \\ 40 \end{bmatrix}$	3	5
5C	Illustrate mesh refinement v/s higher order elements	3	5