BIRLA INSTITUTE OF TECHNO1LOGY AND SCIENCE, PILANI
SECOND SEMESTER 2022-2023
Comprehensive Examination (Open Book)
Dynamics of Structures-PART B

Course No: CE F432 **Date: 15. 05. 2023 (Room: 6156)**
Duration: 9:30 A.M. - 12:30 P.M. **Max. Marks: 28**

(Attempt all questions)

Q1. Consider the system shown in Fig. Q1. Write the equations of motion from free body diagram in both matrix and expression form. Is this system of equations dynamically coupled, statically coupled, or both? [3.5+1.5]

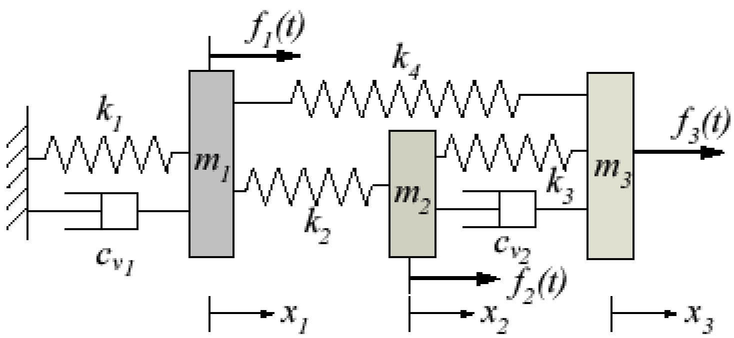

Fig. Q1

Q2. There is a three storey structure. Its properties are given below-

M = (1, 0, 0; 0, 1.5, 0; 0, 0, 2) kips-sec^2/ in

K = 600(1, (-1), 0; (-1), 3, (-2); 0, (-2), 5) kips/in

p = (14.522; 31.048; 46.100) rad/s

$$\varphi = \begin{pmatrix} 1.0000 & 1.0000 & 1.0000 \\ 0.6486 & -0.6066 & -2.5405 \\ 0.3018 & -0.6790 & 2.4382 \end{pmatrix}$$

2.1 The free vibrations, which would result from the following arbitrary initial conditions, have to be evaluated, assuming the structure is undamped. Find free vibration response of each modal coordinate of this undamped structure.

V (t=0) = (0.5; 0.4; 0.3) in AND $\dot{V}$ (t=0) = (0; 9; 0) in/sec

2.2 Find the response of the above structure to sine-pulse blast-pressure load. For this purpose, the load may be expressed as:

$$P = \begin{pmatrix} P1(t) \\ P2(t) \\ P3(t) \end{pmatrix} = \begin{pmatrix} 1 \\ 2 \\ 2 \end{pmatrix}$$

(500 kips) cos((pi/t_1)t) where t_1 = .02 sec and -(t_1/2) < (t_1/2)

Assume 5 percent of critical damping. [8+9]

Q3. For the system of Fig. Q3, using a Caughey series determine the classical damping matrix if the damping ratio is 5% for all three modes. [6]

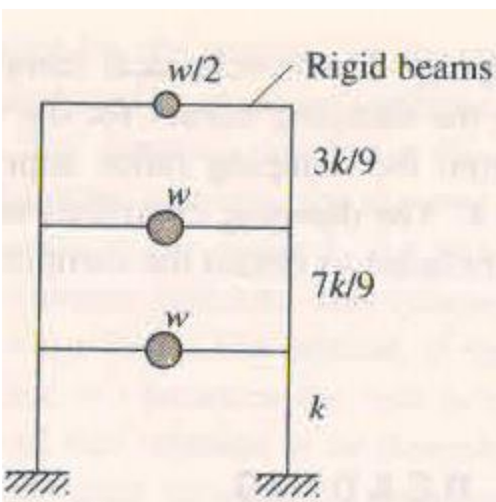

Fig. Q3

Damping in Structures

w = 100 kips; k = 168 kips/in

$$\omega_n = 12.01, 25.47, 38.90 \, rad/s$$

$$\phi_1 = \begin{Bmatrix} 0.6375 \\ 1.2750 \\ 1.9125 \end{Bmatrix}, \ \phi_2 = \begin{Bmatrix} 0.9827 \\ 0.9829 \\ -1.9642 \end{Bmatrix}, \ \phi_3 = \begin{Bmatrix} 1.5778 \\ -1.1270 \\ 0.4508 \end{Bmatrix}$$