Ex/CE/5/T/505A/2024

BACHELOR OF ENGINEERING (CIVIL ENGINEERING) FIFTH YEAR

SECOND SEM. EXAM. -2024

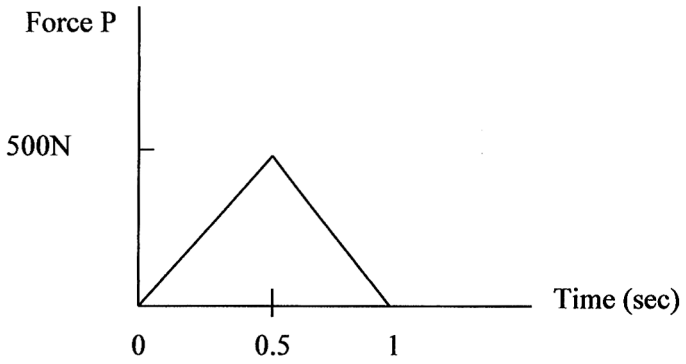
Subject: STRUCTURAL DYNAMICS **Time: 3 Hours** **Full Marks 100**

PART-I (marks-50)

Use a separate Answer-Script for each part

No. of questions	Answer all questions	Marks 15+12+8+15=50
1.	Write short note: a. Logarithmic decrement b. Resonant response c. Viscous damping	15
2.	Deduce the solution of equation of motion of a single degree of freedom system at free vibration condition for critically damped and overdamped system.	12
3.	A SDOF frame has a mass 4500 kg and having lateral stiffness $k = 4.5 \times 10^6$ N/m and damping ratio 4 percent. Determine its un damped and damped natural frequency.	8

[Turn over

4.	A Damped SDOF system has a mass of 5000 N, stiffness of 20 kN/m and damping ratio 5%. It is subjected to a triangular force as shown in figure 1. The initial displacement and velocity are zero. Determine the displacement-time history up to 0.5 second taking time step as 0.1 second.  Fig. 1	15

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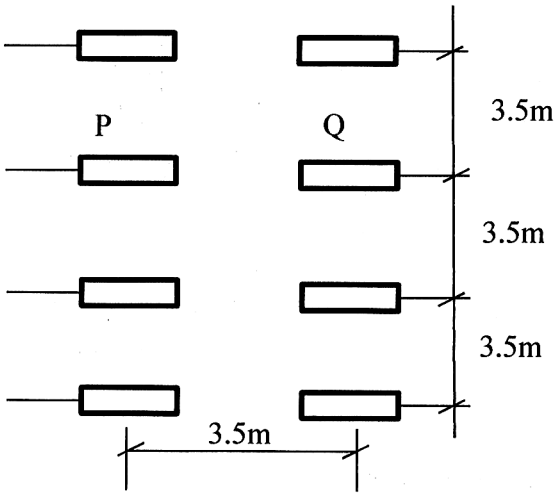
Part- II (Marks 50)

A two storeyed frame ***PQ*** and corresponding plan diagram are shown in Fig. 1. The total gravity load (*DL+LL*) intensity is 22.5 kN/m^2. Formulate the mass and stiffness matrix for this frame and evaluate the followings. Given, $E=2\times10^5\ N/mm^2$, c/s of column is 400mm ×400mm. ***35***

a) Natural frequency and corresponding mode shape.

b) Find displacement of the frame at t=10.6 sec, if frame is subjected to a displacement of $\begin{Bmatrix} V1 \\ V2 \\ V3 \end{Bmatrix} = \begin{Bmatrix} 49 \\ 32 \\ 18 \end{Bmatrix} mm$ at t=0.0 sec.



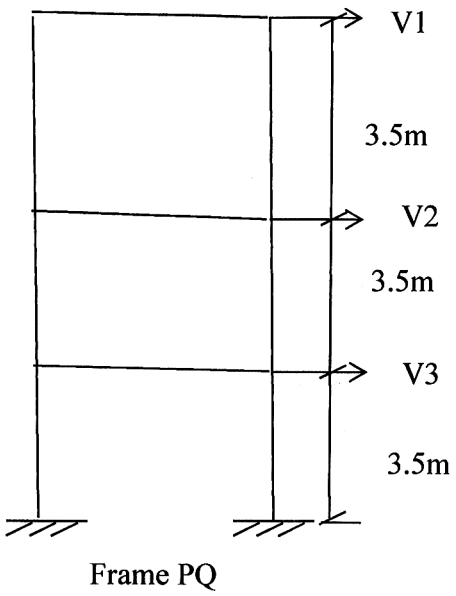


Fig. 1

2. The mass and stiffness matrix of a structure are given as *15*

$$m=\begin{bmatrix}6&0&0\\0&6&0\\0&0&6\end{bmatrix} \quad k=\begin{bmatrix}10&-2&0\\-2&8&-1\\0&-1&4\end{bmatrix}$$ and it is subjected to a force of,

$$F=\begin{bmatrix}0\\6.8\sin 14.6t\\0\end{bmatrix}$$

If the displacement, velocity and acceleration at t=5.00sec are

$$v=\begin{bmatrix}0.8\\0.5\\0.3\end{bmatrix}m \quad \dot{v}=\begin{bmatrix}6.6\\2.8\\1.9\end{bmatrix}m/s \quad \ddot{v}=\begin{bmatrix}1.5\\0.6\\0.2\end{bmatrix}m/s^2$$

Find the responses of the structure at t=*5.25sec.*