Ex/CE/5/T/505A/2023

BACHELOR OF ENGINEERING (CIVIL ENGINEERING) FIFTH YEAR

SECOND SEM. EXAM. -2023

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 14+12x3=50
1.	Deduce the solution of equation of motion of a single degree of freedom system at free vibration at under damped, critically damped and overdamped system.	14
2.	Write short :	4x3=12
a)	Viscous damping	
b)	D'alemberts principle	
c)	Logarithmic decrement	
3. a)	A SDOF frame has a mass 4600 kg and having lateral stiffness k = 4.2 x10^6 N/m and damping ratio 4 percent. Determine its un damped and damped natural frequency.	6+6 =12
b)	A harmonic oscillation test gives the natural frequency of an overhead water tank to be 0.50 Hz. Given that the weight of the tank is 950 kN. What deflection will result if 95 kN horizontal load is applied statically? The mass of the tank staging can be neglected.	

[Turn over

4.	A Damped SDOF system has a mass of 4800 N, stiffness of 19.5 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.	12

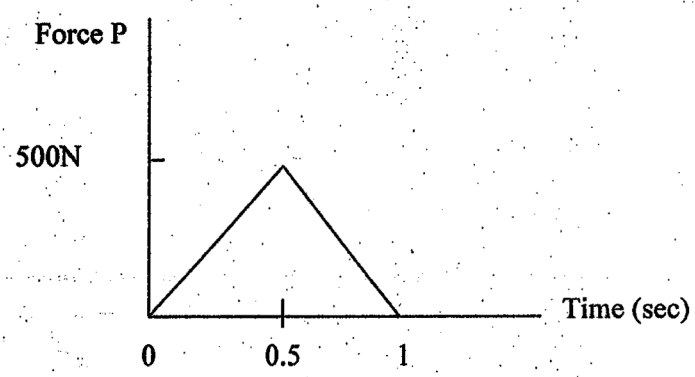


Fig. 1

Ref. No.: Ex/CE/5/T/505A/2023

BACHELOR OF ENGINEERING (CIVIL ENGINEERING) FIFTH YEAR SECOND SEMESTER EXAM 2023

Subject: STRUCTURAL DYNAMICS

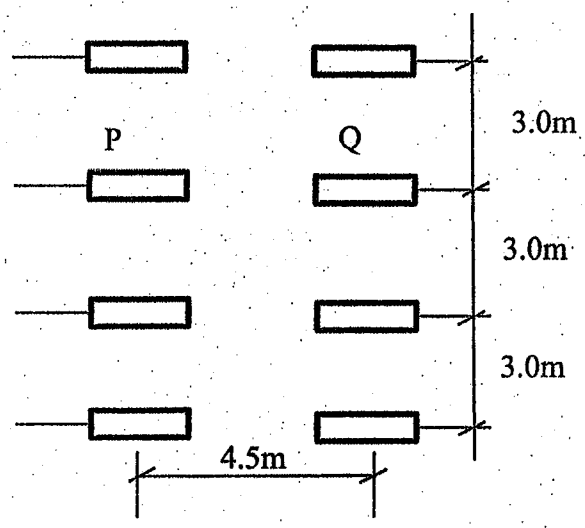
Full Marks:100 **Time: 3hours**

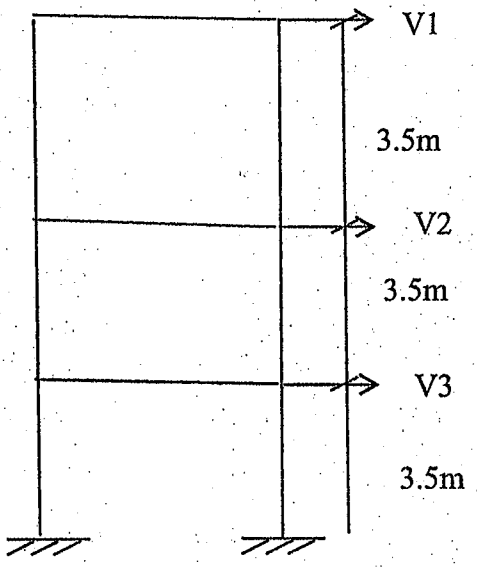
(Use Separate Answer scripts for each Part)

Part- II (Marks 50)

35

1. A two storeyed frame ***PQ*** and corresponding plan diagram are shown in Fig. 1. The total gravity load (*DL+LL*) intensity is 25.5 kN/m^2. Formulate the mass and stiffness matrix for this frame and evaluate the followings. Given, E=2 ×10^5 N/mm^2, c/s of column is 425mm ×425mm.
   a) Natural frequency and corresponding mode shape.
   b) Find displacement of the frame at t=5.6 sec, if frame is subjected to a displacement of $\begin{Bmatrix} V1 \\ V2 \\ V3 \end{Bmatrix} = \begin{Bmatrix} 41 \\ 24 \\ 14 \end{Bmatrix} mm$ at t=0.0 sec.





Frame PQ

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

$$m=\begin{bmatrix}5&0&0\\0&5&0\\0&0&3\end{bmatrix} \quad k=\begin{bmatrix}6&-2&0\\-2&5&-1\\0&-1&3\end{bmatrix}$$ and it is subjected to a force of, $F=\begin{bmatrix}0\\10\sin 14.8t\\0\end{bmatrix}$

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

$$v=\begin{bmatrix}0.6\\0.52\\0.37\end{bmatrix}m \quad \dot{v}=\begin{bmatrix}3.5\\2.2\\1.1\end{bmatrix}m/s \quad \ddot{v}=\begin{bmatrix}3.6\\1.6\\0.9\end{bmatrix}m/s^2$$

Find the responses of the structure at *t=5.25sec* and *t=5.50sec.*