

[4760] - 1029

M.E. (Civil) (Structures)
STRUCTURAL DYNAMICS
(2013 Pattern)

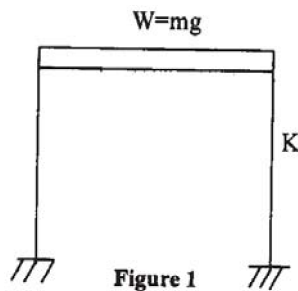
Time : 3 Hours]

[Max. Marks : 50]

Instructions to the candidates:

- 1) Answer any five questions.
- 2) Figures in bold to the right, indicate full marks
- 3) If necessary, assume suitable data and indicate clearly
- 4) Use of electronic pocket calculator is allowed.

- Q1)** a) Define the terms **[3]**
- i) Forced Vibrations
 - ii) Resonance
 - iii) Fundamental Mode of Vibration
- b) Set up the equation of motion for the following undamped SDOF systems without external forces and solve for the response under the given condition. $m=20\text{kN}$, $K = 18 \times 10^3\text{kN/m}$, $x_0 = 0.01\text{m}$, $\dot{x}(0) = -3\text{m/s}$ refer Figure 1. **[7]**



- Q2)** a) Explain the various terms involved in forming a mathematical model for Dynamic system. **[3]**
- b) The displacement of a body performing simple harmonic motion is defined by the following equation $x = A \sin(\omega t + \Phi)$ where A = amplitude, ω = natural frequency & Φ = phase angle. Given $A = 20\text{ mm}$, $\omega = 50\text{ rad/s}$ and $\Phi = \pi/8\text{ radian}$, calculate the following : **[7]**
- i) The frequency.
 - ii) The periodic time
 - iii) The displacement, Velocity and acceleration when $t = T/4$.

P.T.O.

- Q3)** a) Write a note on Dynamic magnification factor. [3]
- b) The two-storey building shown figure 2 has very stiff floor slabs relative to the supporting columns. Calculate the natural frequencies and mode shapes. Take $EI_c = 4.5 \times 10^3 \text{ kNm}^2$. [7]

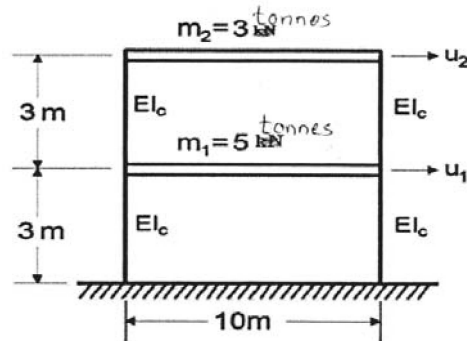


Figure 2

- Q4)** Write a short note on Newmark's method. [10]

- Q5)** a) Write short note on Orthogonality of mode shapes. [3]
- b) Determine the fundamental frequency for the system shown using Stodola's method. [7]

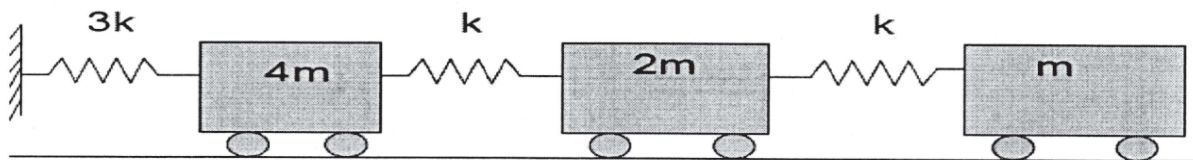


Figure 3

- Q6)** a) What are coupled system? Give suitable example? [3]
- b) Find the natural frequencies of the system shown in Figure. 4 with $m_1 = m$, $m_2 = 2m$, $k_1 = k$, and $k_2 = 2k$. Determine the response of the system when $k = 1000 \text{ N/m}$, $m = 20 \text{ kg}$, and the initial values of the displacements of the masses m_1 and m_2 are 1 and -1, respectively. [7]

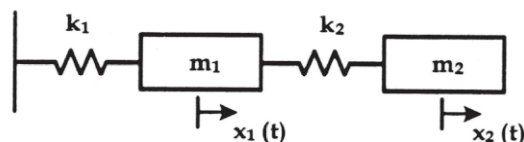


Fig. 4

- Q7)** a) Write note on mode superposition method for MDOF system? [5]
b) What short note on shear buildings with suitable examples? [5]
- Q8)** Calculate the natural frequency for a clamped free rod subjected to axial vibration? [10]

