BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI
FIRST SEMESTER 2023– 2024
Dynamics of Structures – Mid-Semester Examination

Course No: CE G551 **Date: 11-10-2023**
Duration: 90 Mins. (Open book) **Total Marks: 30**

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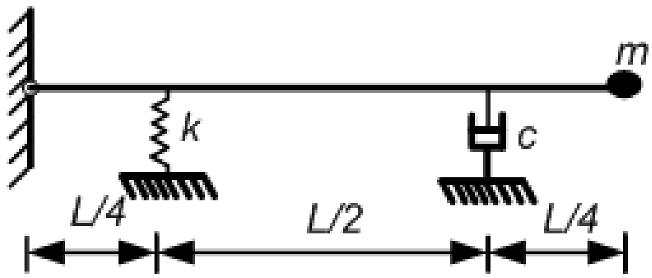
1. Set up the differential equation of motion for the system shown in the figure below. Determine the expressions for (a) natural frequency without damping, (b) damping ratio (c) natural frequency of damped oscillation. **[7]**



Figure

2. Prove that the displacement, velocity, and acceleration resonant frequencies are $\omega = \omega_n\sqrt{1-2\xi^2}$, $\omega = \omega_n$ and $\omega = \omega_n / \sqrt{1-2\xi^2}$ respectively. Also, shows that the maximum values of displacement response factor (R_d), velocity response factor (R_v), and acceleration response factor (R_a) at their respective resonant frequencies are $1/ 2\xi\sqrt{1-\xi^2}$, $1/2\xi$ and $1/ 2\xi\sqrt{1-\xi^2}$. **[6]**

3. An SDOF system with mass 10 kg and stiffness 5 N/cm is subjected to a complex harmonic force (in N) $10e^{i\omega t}$. Find the frequency response function $H(\omega)$, and displacement $u(\omega)$ at $\omega = 10$ rad/s. Also, find the amplitude and phase of the response. Assume damping ratio $\xi = 10$ %. **[5]**

4. A sensitive instrument with a mass of 113 kg is to be installed at a location where the acceleration is $15.24 cm/s^2$ at a frequency of 20 Hz. It is proposed to mount the instrument on a rubber pad with the following properties: k = 2802 N/cm and ξ = 0.10. What acceleration is transmitted to the instrument? **[5]**

5. A cantilever beam of total mass ***m*** is distributed over the length "***l***" of the beam along with concentrated mass ***M*** at the free end. Determine the effective mass of the system at the free end and find its natural frequency. The maximum deflection ($u_{\max}$) under the load due to a concentrated force ***P*** applied at the free end is $\frac{PL^3}{3EI}$. Where *EI* is the flexural rigidity of the beam. **[7]**