COURSE CODE (CREDITS): 11M1WCE112 (3)

MAX. MARKS: 25

COURSE NAME: Structural Dynamics

COURSE INSTRUCTOR: Sugandha Singh

MAX. TIME: 1 Hour 30 minutes

Note: *All questions are compulsory. Marks are indicated against each question in square brackets.*

1. Write the equation of motion of the following system in terms of rotation, θ, at point A. Assume that the mass per unit length is $\bar{m}$. **[5 marks]**
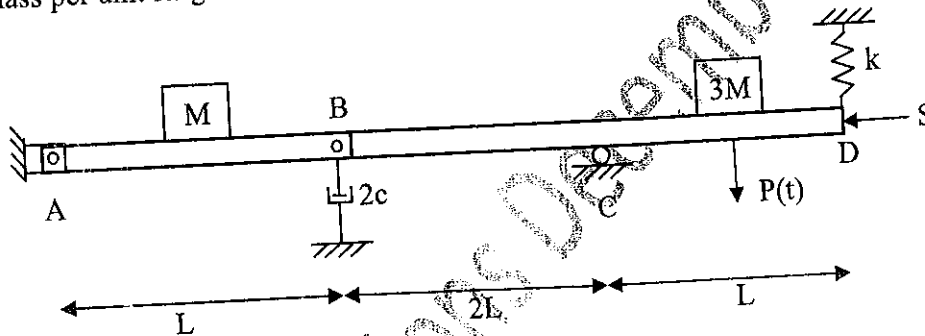
2. For a SDOF system with mass, m, stiffness, k, and damping ratio, ξ, subjected to a harmonic load, $P(t) = P_0 \cos \Omega t$, derive and plot the relationship between the **Frequency Ratio, β, and Dynamic Magnification Factor, A_D.** **[10 marks]**

3. A machine weighing 1 KN is mounted on a supporting system consisting of four springs and four dampers. The vertical deflection of the supporting system under the weight of the machine is measured as 2 cm. The dampers are designed to reduce the amplitude of vertical vibration to one–eighth of the initial amplitude after two complete cycles of free vibration. Find the following properties of the system: **[5 marks]**
   a. Undamped natural frequency
   b. Damping Ratio
   c. Damped Natural Frequency

4. A sensitive instrument with weight 120kg is to be installed in a laboratory where the floor often undergoes vertical accelerations at a frequency of 10Hz. The instrument is mounted on a rigid block which is supported on an isolation pad of artificial material. The isolation pad offers a vertical stiffness of 14000 N/m and provides a damping ratio of 10%. How much should the isolation block weigh so that the amplitude of instrument motion is limited to 5% of the floor motion amplitude. **[5 marks]**