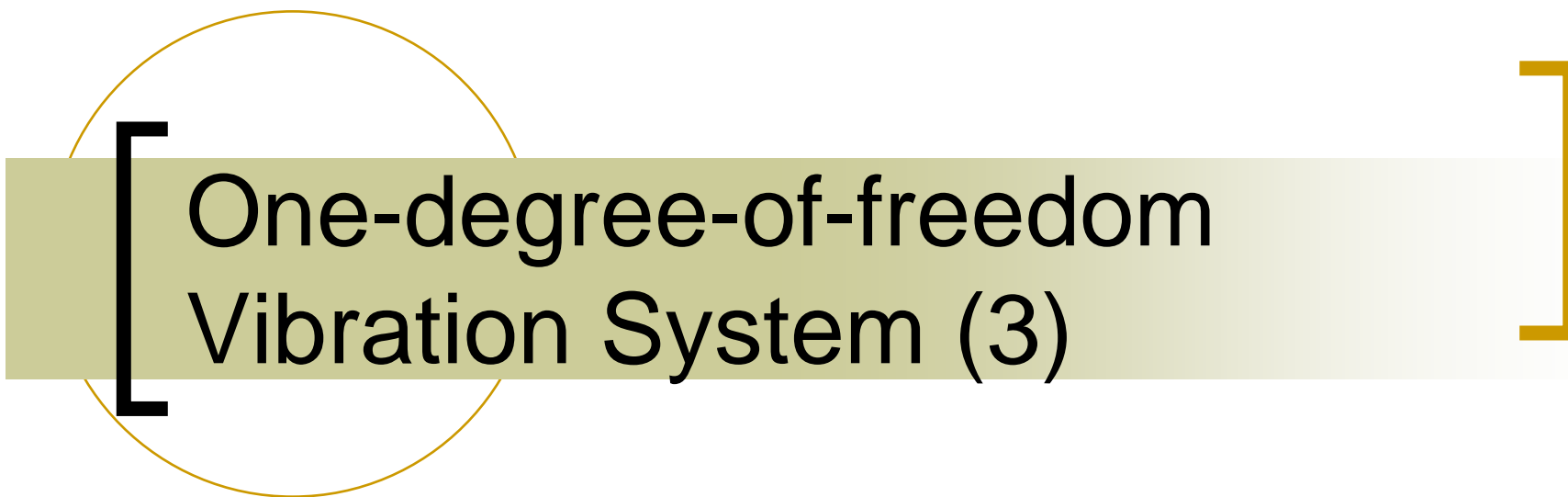


Fundamentals of Dynamics (3)

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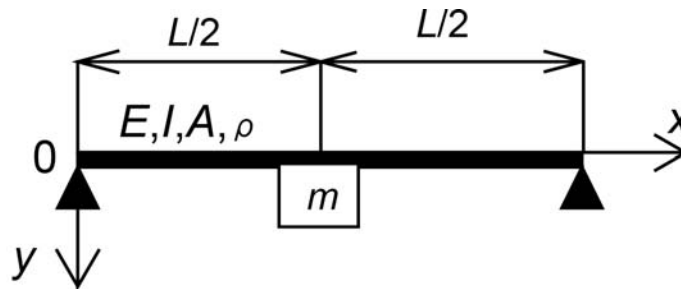


One-degree-of-freedom Vibration System (3)

[Example (1)]

Derive the natural frequency of a one DOF vibration system with a simply supported beam depicted in the figure by using Rayleigh's Method.

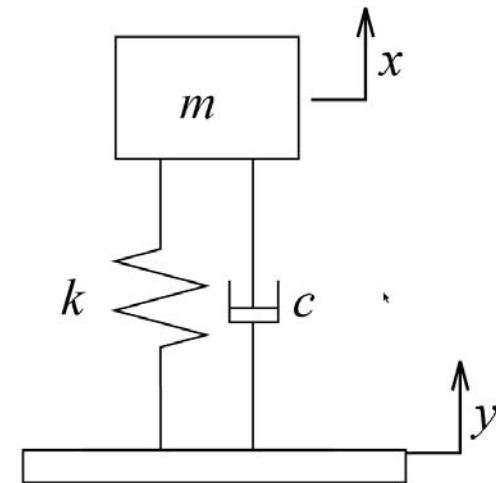
Length, section area, density, Young's modulus and geometrical moment of inertia of the beam are $L(\text{m})$, $A(\text{m}^2)$, $\rho \text{ (kg/m}^3\text{)}$, $E(\text{Pa})$ and $I(\text{m}^4)$, respectively. The mass is $m(\text{kg})$ and the mass of the beam $m_b(\text{kg})$ coincides with $LA\rho$.



[Example (2)]

The figure depicts an analytical model of a vibration isolator. Design physical parameters of this analytical model satisfying the following specifications.

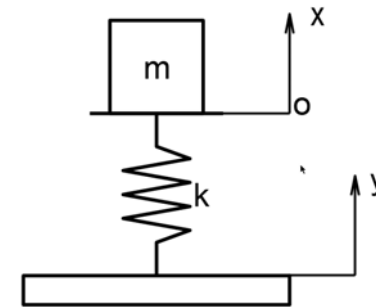
- A. Vibration transmissibility should not be greater than $\sqrt{2}$ at the natural frequency of the system.
- B. The lower limit angular frequency of vibration isolation should be 70(rad/s).
- C. Mass of the table, m , is 200kg.
- D. Stiffness of the spring should be as large as possible and damping should be as small as possible.



[Example (3)]

Consider an undamped one DOF vibration system shown in the figure. Derive the time response of the absolute displacement of the mass, $x(t)$, against a base displacement $y(t)$,

$$y(t) = \begin{cases} 0 & t < 0 \\ 0.5 & 0 \leq t \leq \alpha T_n \\ 1 & t > \alpha T_n \end{cases}$$



with the initial states $x(0)=0$ and $\dot{x}(0)=0$.

Here, $\alpha > 0$ and $T_n = 2\pi\sqrt{\frac{m}{k}}$ (s) is the natural period of the system.