

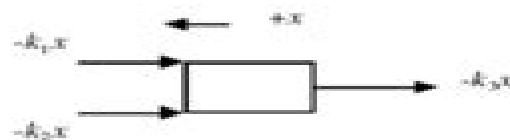
MCE 371 – Vibrations

Summer 2023

Homework #1

DUE: Sunday, June 04, 2023 (Submission to BlackBoard)

- 1- Derive the equation of motion and find the natural frequency of vibration of each of the systems shown in the figures.

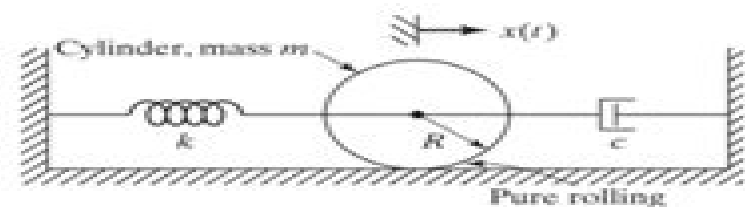


$$m\ddot{x} = -k_1x - k_2x - k_3x \Rightarrow$$

$$m\ddot{x} + k_1x + k_2x + k_3x = 0 \Rightarrow$$

$$m\ddot{x} + (k_1 + k_2 + k_3)x = 0 \Rightarrow \ddot{x} + \frac{(k_1 + k_2 + k_3)}{m}x = 0$$

$$\Rightarrow \omega_n = \sqrt{\frac{k_1 + k_2 + k_3}{m}}$$



$$T = \frac{1}{2}m\dot{x}^2 + \frac{1}{2}I\dot{\theta}^2$$

$$R = \frac{1}{2}c\dot{x}^2$$

$$U = \frac{1}{2}kx^2$$

$$x = R\theta$$

$$\frac{d}{dt} \left(\frac{\partial T}{\partial \dot{x}} \right) - \frac{\partial T}{\partial x} + \frac{\partial R}{\partial \dot{x}} + \frac{\partial U}{\partial x} = 0$$

$$\left(\frac{I}{R^2} + m \right) \ddot{x} + c\dot{x} + kx = 0$$

$$I = \frac{1}{2}mR^2$$

$$\omega_n = \sqrt{\frac{k}{m + \frac{I}{R^2}}}$$

Mechanical Vibrations Homework And Solutions

Judd E. Hollander



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