UCL Mechanical Engineering 2021/2022

MECH0023 Dynamics Tutorial

HD

21-10-19

Question 1

8 oscillations, initial displacement 6 cm, boundary condition: human hand.

$$L \approx 20\,\text{cm} \tag{1}$$
$$\delta = 16\pi\zeta \tag{2}$$
$$\ln 2 = 16\pi\zeta \tag{3}$$
$$\zeta = 0.0137 \tag{4}$$

Question 2

Brandon counting oscillations also yielded 8 periods to half the amplitude

Question 3

$$\text{Period} = \frac{4.85}{8} = 0.61\,\text{s} \tag{5}$$
$$\omega_n = \frac{2\pi}{0.61} = 10.36\,\text{rad}\,\text{s}^{-1} \tag{6}$$
$$\omega_d = \omega_n\sqrt{1-\zeta^2} = 10.27\,\text{rad}\,\text{s}^{-1} \tag{7}$$
$$x(t) = X_0 e^{-\zeta\omega_n t}\sin\left(\omega_d t + \varphi\right) \tag{8}$$
$$x(t) = 6e^{-0.0137\cdot 10.36t}\sin\left(10.27t + \varphi\right) \tag{9}$$

Source of damping is dependent on a variety of sources. We can see that the ruler is elastic and energy is lost when the ruler elastically snaps back to its original shape. We also see that the ruler may bounce on the table and energy may dissipate throughout the whole length of the ruler; essentially the ruler may start to act about a pivot and we could feel the ruler trying to push up against our hand. This dissipation of energy through the material is called Hysteretic damping. The ruler also displaces air and we can see that there is an element of drag against the motion of the ruler, so there is viscous damping in this case too.