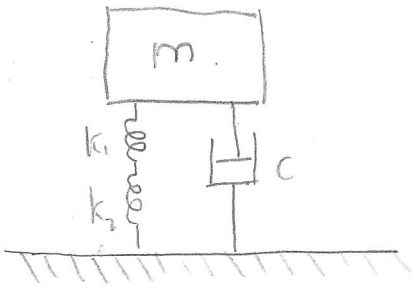
20-R-VIB-DY-31

A $m = 10\,kg$ box is supported in the air by springs in series and a damper in parallel. The springs have spring constants of $k = 50\ N/m$ & $25\ N/m$ and the damper has a damping constant of $c = 25.82\ Ns/m$. Find the equation of displacement of the box given an initial velocity $1\ m/s$ and displacement $0.05m$.



Solution: FBD

$$k = \frac{k_1 k_2}{k_1 + k_2} = 16.67 \qquad \omega_n = \sqrt{\frac{k}{m}} = 1.29$$

$$c_c = 2m\omega_n = 25.82 = c$$

critically damped

$$x(t) = [x_0 + (v_0 + x_0\omega_n)t]e^{-\omega_n t}$$

$$x(t) = (0.05 + 1.065t)e^{-1.29t}$$