

5.1.1: Spring/Mass Systems: Free Undamped Motion

Hooke's Law: $F = -kx$

x = distance the spring/mass is stretched from equilibrium.

k = spring constant

(-) = it's a restoring force.

Newton's 2nd Law: $F = ma$
 $= m x''$

so for a spring/mass: $m x'' = -kx$

$\Rightarrow x'' + \frac{k}{m} x = 0$

$\Rightarrow x'' + \omega^2 x = 0$ where $\omega^2 = \frac{k}{m}$

$\Rightarrow x = c_1 \cos \omega x + c_2 \sin \omega x$

Note: If the spring/mass is hanging, we consider

$x = 0$ equilibrium

$x > 0$ under equilibrium

$x < 0$ over equilibrium

ex1: A mass of 5kg, attached to a spring, stretches it 20cm. Initially, the mass is released from a point 15cm above the equilibrium position. Find the eq. of motion.

ex2: A mass weighing 64 lbs stretches a spring 0.32 ft.
The mass is initially released from a point 8 in.
above equilibrium w/a downward velocity of 5 ft/s.
Find the eqn. of motion.