

Summary: Vibrations - Free Undamped Response

EOM: For free response of undamped system:

$$m\ddot{x} + kx = 0$$

STANDARD FORM OF EOM: Divide EOM by “m” to get:

$$\ddot{x} + \omega_n^2 x = 0$$

where $\omega_n = \sqrt{\frac{k}{m}}$ = *natural frequency*

SOLUTION OF EOM:

$$x(t) = C \cos \omega_n t + S \sin \omega_n t$$

HOW TO FIND THE RESPONSE COEFFICIENTS, C AND S?

Enforce the initial conditions on the solution:

$$x(0) = x_0 = C \cos 0 + S \sin 0 \Rightarrow C = x_0$$

$$\dot{x}(0) = \dot{x}_0 = -C\omega_n \sin 0 + S\omega_n \cos 0 \Rightarrow S = \frac{\dot{x}_0}{\omega_n}$$