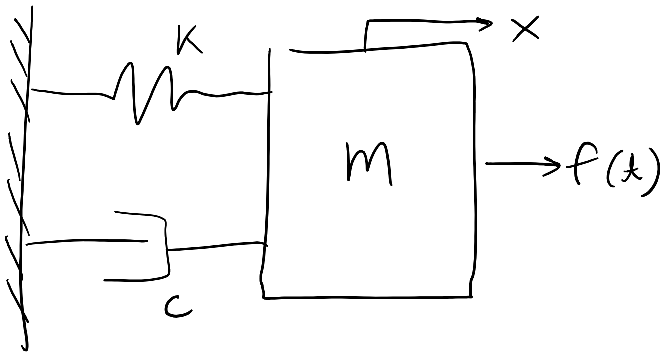
Lecture 3a - SDOF Forced Response Review

Monday, September 7, 2020 11:10 AM



$f(t) = Re(F_0 e^{i\omega t}) \longrightarrow$ (assume) $\longrightarrow x_{ss}(t) = x(t) = Re(X e^{i\omega t})$

$\dot{x}(t) = Re(i\omega X e^{i\omega t})$

$m\ddot{x} + c\dot{x} + kx = Re(F_0 e^{i\omega t})$

$Re\left[(-\omega^2 m X + i\omega c X + kX - F_0)e^{i\omega t}\right] = 0$

Complex #

$X = \dfrac{F_0 \;(1/m)}{k - \omega^2 m + i\omega c \;(1/m)} = \dfrac{F_0/m}{\omega_n^2 - \omega^2 + i\omega 2\zeta\omega_n}$

small

$\sqrt{k/m}$ System — Forcing Freq

Example: Find mag + phase of response @ $\omega = \omega_n$

$X = \dfrac{F_0/m}{i\omega_n 2\zeta\omega_n}$

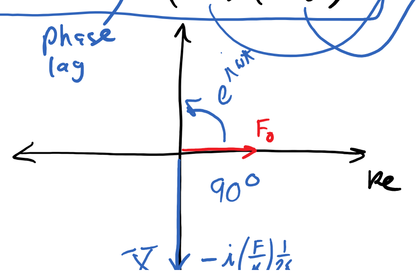
Matlab: abs(X), angle(X) ✓

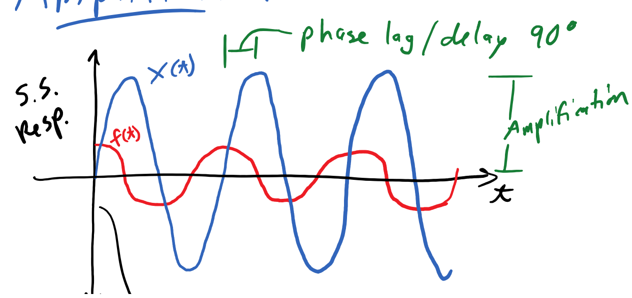
By hand

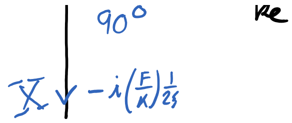
$X = -i\left(\dfrac{F_0/m}{2\zeta\omega_n^2}\right) = -i\dfrac{F_0}{2\zeta m\omega_n^2} = -i\dfrac{F_0}{2\zeta K}$

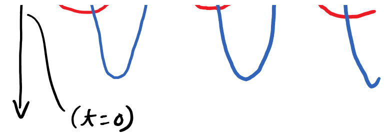
$$X = -i\left(\frac{F}{K}\right)\left(\frac{1}{2\zeta}\right)$$

phase lag — Quasi-static — Amplification









(If F_0 is real)