NYU Physics I — 2016-10-27

Agenda:- Reading: oscillators, quality factor, (resonance) — damped oscillator

- Exam 3 — 8/12
- Qs
- resonance.

$\vec{a} \cdot \vec{b}$

~~$\vec{p}$~~

$q\vec{E} + q\vec{v} \times \vec{B}$

vectors

$\vec{F}, \vec{p}, \vec{x}, \vec{v}, \vec{a} \ldots$

$\vec{E}$

pseudo-vectors

$\vec{\tau}, \vec{L}, \vec{\omega}, \vec{\alpha}$

$\vec{B}$

ma cv = damping

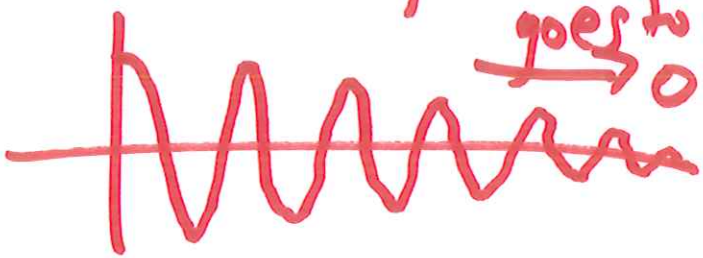
$$0 = m\frac{d^2x}{dt^2} + c\frac{dx}{dt} + kx$$ ← spring

define $\gamma \equiv \frac{c}{m}$ $\omega_0^2 \equiv \frac{k}{m}$

(A) $$0 = \underbrace{\frac{d^2x}{dt^2}}_{a_x} + \gamma \underbrace{\frac{dx}{dt}}_{v_x} + \omega_0^2 x$$

homogeneous

goes to 0



$$F(t) = m\frac{d^2x}{dt^2} + c\frac{dx}{dt} + kx$$

(B) $$\underbrace{\frac{F(t)}{m}}_{\text{external forcing}} = \frac{d^2x}{dt^2} + \gamma\frac{dx}{dt} + \omega_0^2 x$$ inhomogeneous.

(out of scope)

$$e^{i\theta} = \cos\theta + i\sin\theta$$

$$\frac{F}{m}(t) = \sum_{k=1}^{K}\left[a_k e^{i\omega_k t} + a_k^* e^{-i\omega_k t}\right]$$

$$i = \sqrt{-1}$$

$$ae^{i\omega t} = \frac{d^2x}{dt^2} + \gamma\frac{dx}{dt} + \omega_0^2 x$$

(*) - for one fourier component

complex #

guess: $x = Ae^{i\omega t}$

↑ complex # ? $A = A_{re} + iA_{im}$

$$\frac{dx}{dt} = i\omega Ae^{i\omega t} \qquad \frac{d^2x}{dt^2} = -\omega^2 Ae^{i\omega t}$$

$$ae^{i\omega t} = -\omega^2 Ae^{i\omega t} + i\omega\gamma Ae^{i\omega t} + \omega_0^2 Ae^{i\omega t}$$

yay! a solution if $a = -\omega^2 A + i\omega\gamma A + \omega_0^2 A$

God) a (choice

$$A = \frac{a}{(\omega_0^2 - \omega^2) + i\omega\gamma}$$

$$A = \frac{a}{(\omega_0^2 - \omega^2) + i\omega\gamma}$$

a: forcing fn

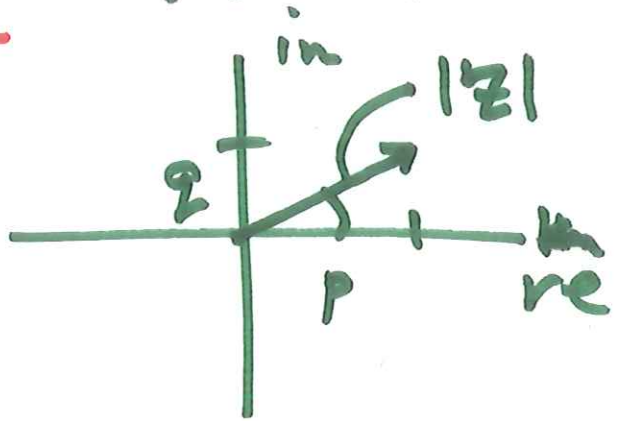
ω_0, γ: properties of the object

ω: ?

A: amplitude of response, complex!

$z = p + iq$

$|z| = \sqrt{p^2 + q^2}$



$$|A| = \frac{|a|}{\sqrt{(\omega_0^2 - \omega^2)^2 + \omega^2\gamma^2}}$$

$|a|$: accel $\frac{m}{s^2}$

$|A|$: position metres

λ: $\frac{1}{s^2}$

$|z|^2 = zz^*$