# EECS 16B  ## 2.13 LECTURE 8 ##

## PHASORS

Ubiquitous method for understanding response to sine inputs.
- Calculating the particular response given →

EX


$d V_o/dt = -1/RC\ V_o + 1/RC\ V_{in}$   $\lambda = -1/RC$

easier calc: $v_{in} = V_{in} e^{st} \rightarrow v_o = V_o e^{st}$

which led to $sV_o e^{st} = -\frac{1}{RC} e^{st}(V_o - V_{in})$  $V_o = \frac{V_{in}}{1+sRC}$

back to time response: $v_o = V_o e^{st} + A e^{st}$

So what's a phasor? $x(t) = A\cos(\omega t + \phi) = Re(\underline{Ae^{j\phi}} e^{j\omega t})$

A complex number w/amplitude & phase info →

Re(): take the real part

## PROPERTIES

Uniqueness: $x(t) = A\cos(\omega t + \phi) \longleftrightarrow A e^{j\phi}$

time waveform  phasor

consider $x_1(t) = Re(A_1 e^{j\omega t})$ & $x_2(t) = Re(A_2 e^{j\omega t})$

$x_1(t) = x_2(t) \Longleftrightarrow A_1 = A_2$

IF  $Re(A_1 e^{j\omega t}) = Re(A_2 e^{j\omega t})$ ✓

ONLY IF  $x_1(0) = Re(A_1)$  $x_2(0) = Re(A_2)$

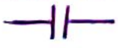
$x_1(\frac{\pi}{2}\frac{1}{\omega}) = Re(A_1 e^{j\pi/2})$  $x_2(\frac{\pi}{2}\frac{1}{\omega}) = Re(A_2 e^{j\pi/2})$

$e^{j\pi/2} = \cos\frac{\pi}{2} + j\sin\frac{\pi}{2} = j$   $Re(A_1 j) = Re(A_2 j)$ etc.

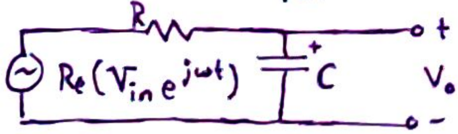
Linearity: $a_1 x_1(t) + a_2 x_2(t) \longleftrightarrow a_1 A_1 + a_2 A_2$

Differentiation: $d/dt\ x(t) = Re(j\omega A e^{j\omega t})$   $d/dt\ x(t) \longleftrightarrow j\omega A$

## APPLICATION

 $i = C\, dv/dt \longleftrightarrow I = j\omega C V$

 $v = L\, di/dt \longleftrightarrow V = j\omega L I$

EX



$V_o = \frac{1}{1+j\omega CR} V_{in}$

$v_o(t) = Re(V_o e^{j\omega t})$