EECS 16B ## 2.18 LECTURE 9 ##

PHASOR SUMMARY

- analysis of one frequency $\omega = 2\pi f$ $T = 1/f =$ period
- $d/dt\ \vec{x}(t) = A\vec{x}(t) + \vec{b}\,u(t)$ for phasors, $u(t) = U\cos\omega t$
- Euler's Formula $e^{j\omega t} = \cos\omega t + j\sin\omega t$ $\left\{\begin{array}{l}\cos\omega t = Re[e^{j\omega t}] \\ \sin\omega t = Im[e^{j\omega t}]\end{array}\right.$
  $\cos\omega t = \frac{1}{2}(e^{j\omega t} + e^{-j\omega t})$ $\sin\omega t = \frac{1}{2j}(e^{j\omega t} - e^{-j\omega t})$
- uniqueness $x(t) = A\cos(\omega t + \phi) \longleftrightarrow Ae^{j\phi}$ time $\longleftrightarrow$ phasor
- linearity $a_1 x_1(t) + a_2 x_2(t) \longleftrightarrow a_1 A_1 e^{j\phi_1} + a_2 A_2 e^{j\phi_2}$ $\forall a_1, a_2 \in \mathbb{R}$
- differentiation $d/dt\ x(t) \longleftrightarrow j\omega A e^{j\phi}$
- application: KVL - linear on branch/phasor voltages $V = RI$
  $V = \underline{j\omega L}\,I$ KCL - linear on branch/phasor currents $I = \underline{j\omega C}\,V$
  impedance, which functions like resistor 1/impedance

$v_{in} = V_{in}\cos(\omega t)$
$= Re[V_{in}e^{j\omega t}]$

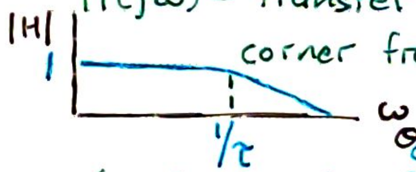
voltage divider w/impedances! $V_o = \dfrac{1/j\omega C}{1/j\omega C + R} V_{in}$

$V_o/V_{in} = 1/(1 + j\omega RC)$ $\longleftarrow$ transfer function: algebraic w/parameter ω

FREQUENCY RESPONSE

Presentation of algebraic function vs. frequency parameter ω
log scaling: Bode plots $H(j\omega) =$ transfer function

- $|H(j\omega)|$ vs ω log-log scale



- phase of H vs ω log scale
  angle of H $\theta = \tan^{-1}\left(\frac{Im(H)}{Re(H)}\right) = \tan^{-1}(-\omega t) = -\tan^{-1}(\omega t)$