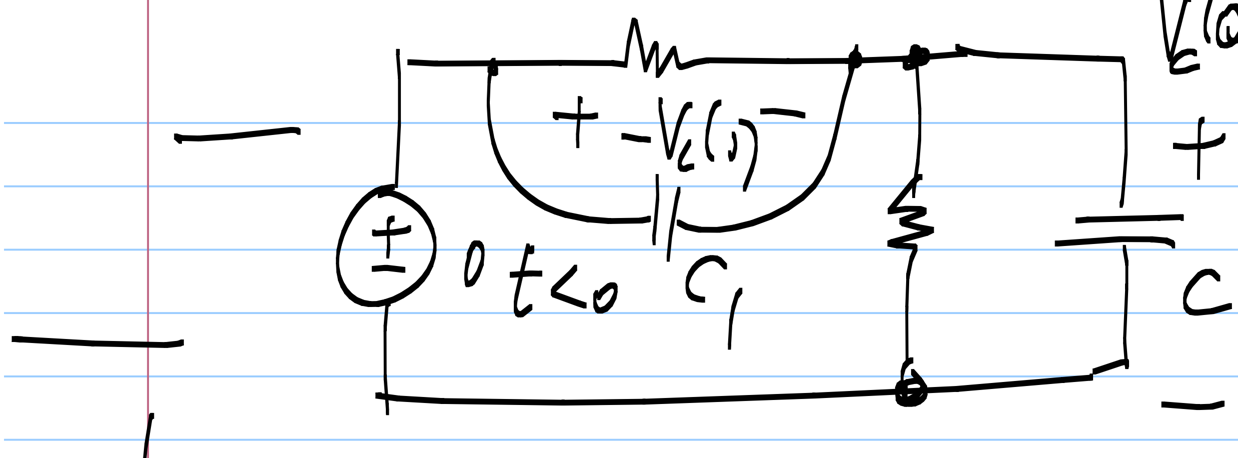
Lecture 25

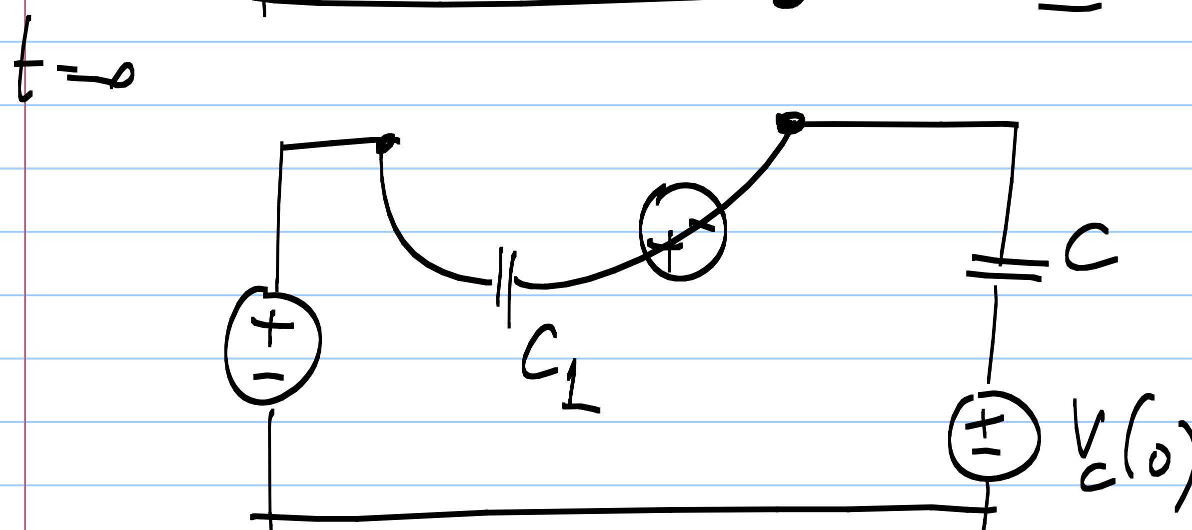
First order circuit : Single "effective" capacitor
OR
Single "effective" inductor] Nulled circuit

Step response :

* Discontinuity at the instant of step
* Exponential with a time constant τ
* Steady state



$V_c(0)$ Replace capacitor w/ a voltage source equal to the initial condition



Step response:

* Discontinuity at the instant of step
* Exponential with a time constant τ
* Steady state

* capacitors replaced by voltage sources (initial cond.)
* Capacitor - voltage source loop

Eq. resistance

Capacitors open.

$$V(0+)\exp\left(-t/\tau\right) + V(\infty)\left(1-\exp\left(-t/\tau\right)\right)$$

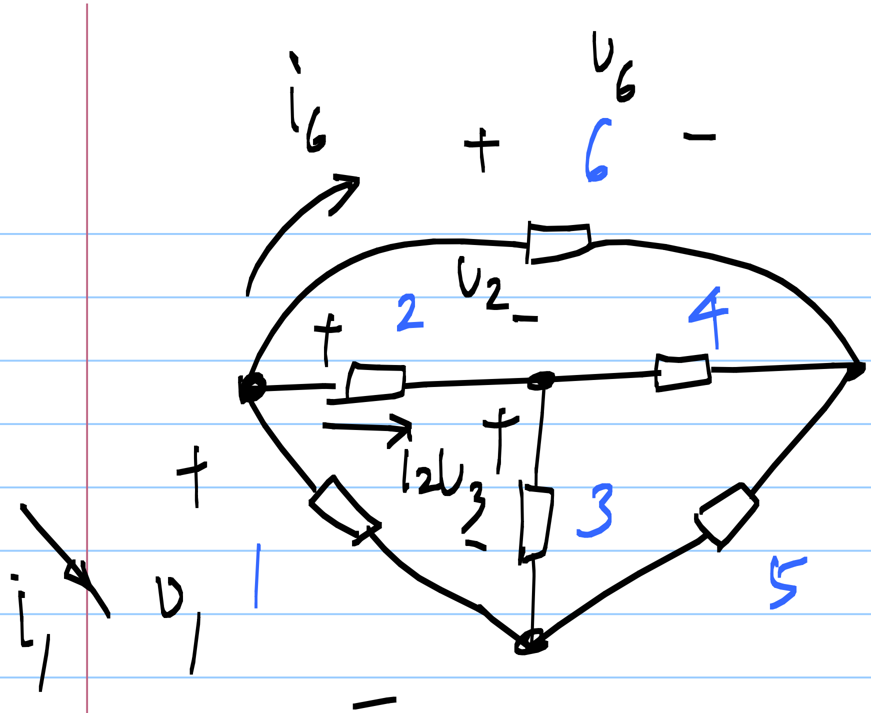
Response to $\exp(j\omega t)$ = (Transient) + $\exp(j\omega t)\cdot$ [frequency, circuit]

Transient: die out with time

$\exp(j\omega t)\cdot$ [frequency, circuit]: steady state response

Sinusoidal steady state analysis

$$v_c(t) = (\quad\quad) + \exp(j\omega t)\cdot\frac{1}{1+j\omega CR}$$



$\exp(j\omega t)$:

Every branch voltage & current will have a steady state part

$\exp(j\omega t) \cdot [\quad]$

$$v_1 = \bar{V}_1 \exp(j\omega t)$$

$$v_2 = \bar{V}_2 \cdot \exp(j\omega t)$$

$$v_3 = \bar{V}_3 \cdot \exp(j\omega t)$$

$$\bar{V}_1 - \bar{V}_2 - \bar{V}_3 = 0$$

phasors

$$\bar{I}_1 + \bar{I}_2 + \bar{I}_6 = 0$$

$$\bar{V}_1 = 1 + j2$$

$$v_1 \Big|_{\text{steady state}} = Re\left[(1 + j2)\exp(j\omega t)\right]$$

$$v_s = v_p \cos(\omega t + \phi)$$

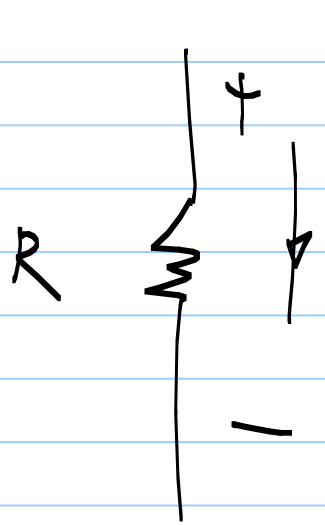
$$= Re\left[V_p \cdot \exp(j\phi)\exp(j\omega t)\right]$$

$V_p \cos(\omega t + \phi)$ $\qquad$ $I_p \cos(\omega t + \theta)$

All sources should be at the same freq. ω

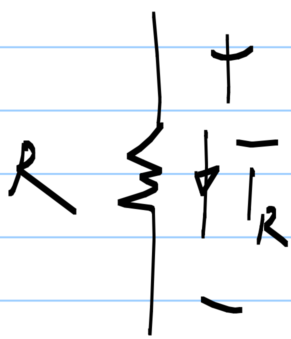
$V_p \exp(j\phi)$ ~~$\exp(j\omega t)$~~ $\qquad$ $I_p \exp(j\theta) \cdot$ ~~$\exp(j\omega t)$~~

Implicit



$$V_p \cos(\omega t + \phi) \qquad V_p \exp(j\phi)\exp(j\omega t)$$

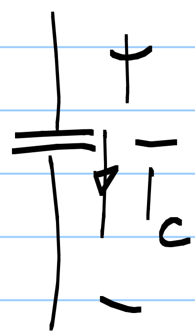
$$\frac{V_p}{R}\cos(\omega t + \phi) \qquad \frac{V_p \exp(j\phi)}{R}\exp(j\omega t)$$



$$\bar{V}_R \qquad \frac{\bar{V}_R}{\bar{I}_R} = R$$

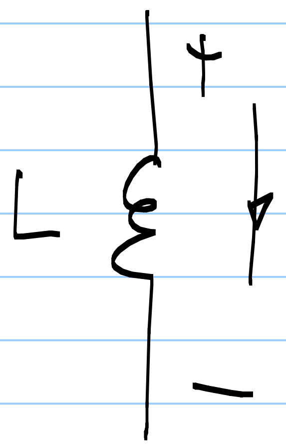
$V_p \cos(\omega t + \phi)$ $\qquad$ $V_p \exp(j\phi)\exp(j\omega t)$

$-\omega C V_p \sin(\omega t + \phi)$ $\qquad$ $j \cdot \omega C V_p \exp(j\phi)\exp(j\omega t)$



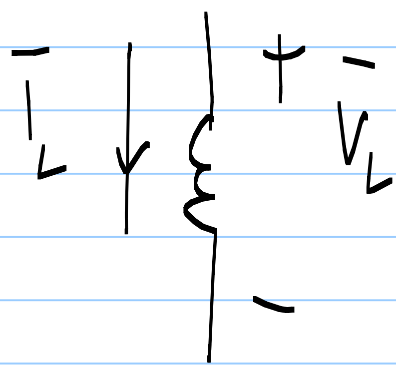
$\bar{V}_c$ $\quad$ $\bar{I}_c$

$$\frac{\bar{V}_c}{\bar{I}_c} = \frac{1}{j\omega C}$$



$$V_p \cos(\omega t + \phi) \qquad V_p \exp(j\phi)\exp(j\omega t)$$

$$\frac{V_p}{\omega L}\sin(\omega t + \phi) \qquad -j\frac{V_p}{\omega L}\exp(j\phi)\exp(j\omega t)$$



$$\frac{\bar{V}_L}{\bar{I}_L} = j\omega L$$