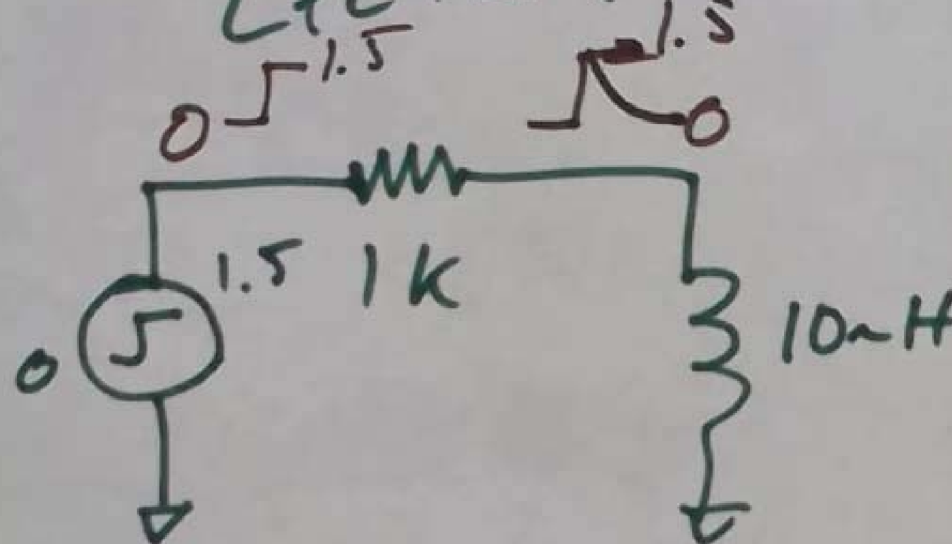
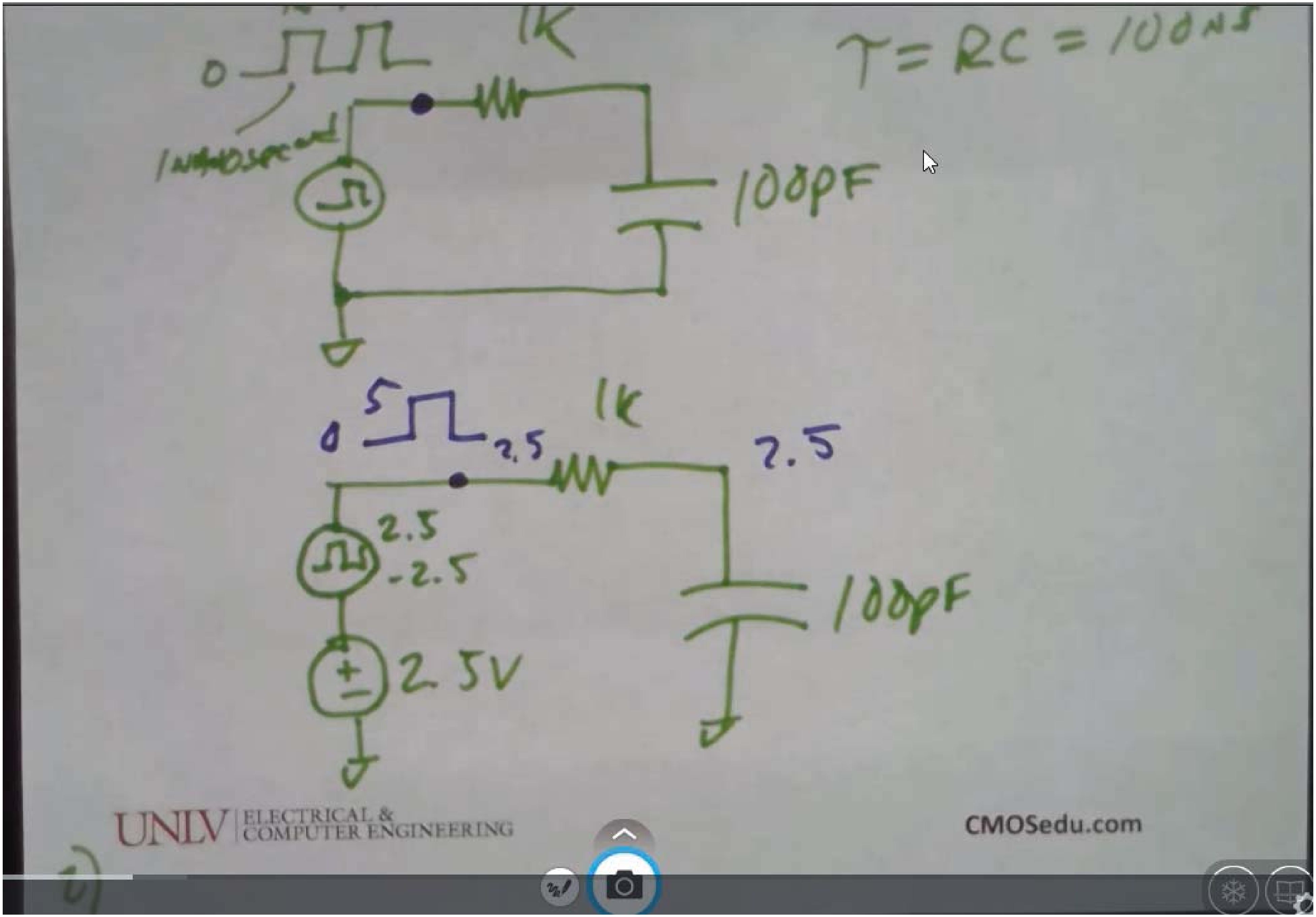
EE 220 Circuits II

April 3, 2019

Lecture 17




1k
τ = RC = 100nS
0
1 nanosecond
100pF
5
0
2.5
1k
2.5
2.5
-2.5
2.5V
100pF
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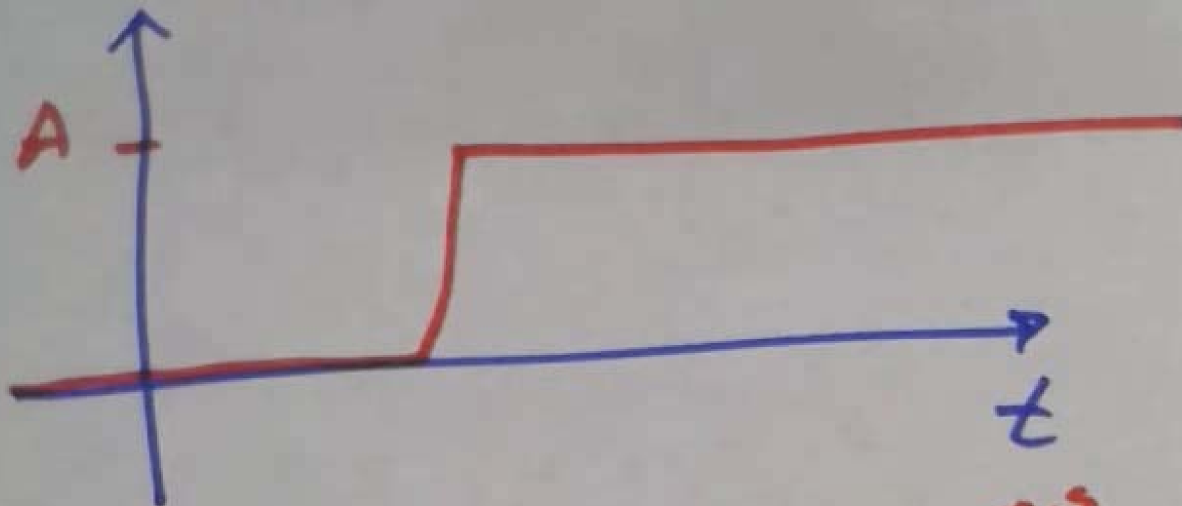
$Au(t-t_0)$ $\qquad \int_{0^-}$



$$= A\cdot\frac{e^{-st_0}}{s}$$

$$\int_{t_0}^{\infty} Ae^{-st}\cdot dt = A\int_{-st_0}^{-\infty\cdot s}\frac{1}{-s}e^{u}\cdot du$$

let $u = -st$ $\qquad = \frac{A}{-s}e^{u}\Big|_{-st_0}^{-\infty}$

$$\frac{du}{dt} = -s \qquad = \frac{A}{s}\left(0 - e^{-st_0}\right)$$

$$e^{-st_0} \rightarrow e^{-j\omega t_0}$$

$$s = \sigma + j\omega$$

for sinusoids only

$$s = j\omega$$

$$e^{-j\omega t_0} = \cos(\omega t_0) + j\sin(-\omega t_0)$$

$$\left|e^{-j\omega t_0}\right| = \sqrt{\cos^2(-\omega t_0) + \sin^2(\omega t_0)} = 1$$

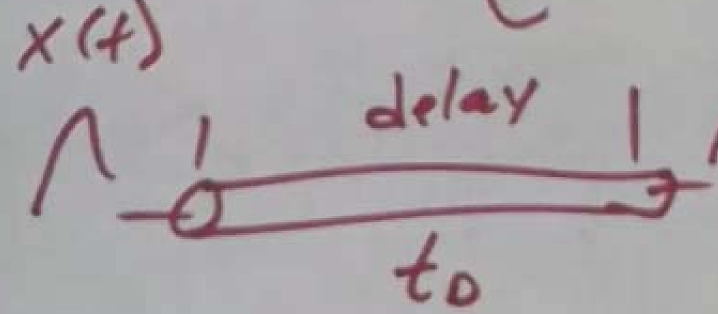
$$\angle \tan^{-1}\frac{\sin(-\omega t_0)}{\cos(\omega t_0)} = \tan^{-1}\tan(-\omega t_0)$$

$$\angle = -\omega t_0$$

$$\theta = \frac{t_d}{T} \cdot 2\pi = t_d \cdot 2\pi f$$

$$\theta = -\omega \underline{t_0} = 2\pi f \cdot \underline{t_d}$$

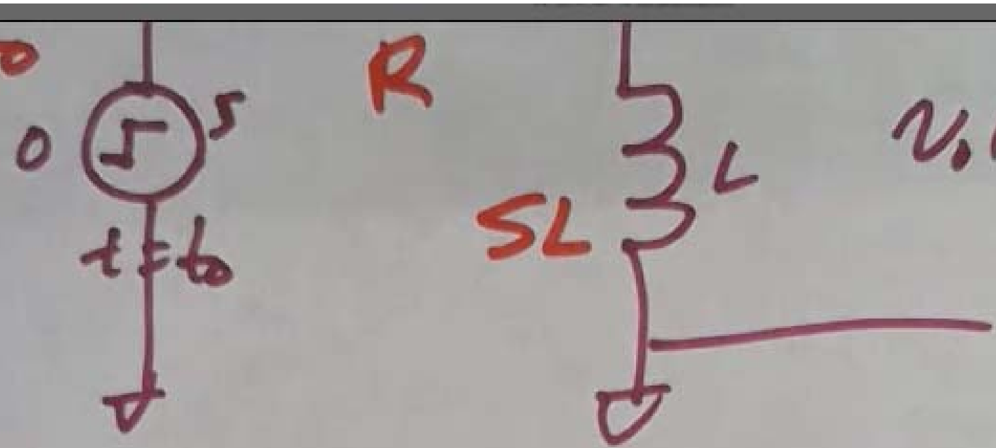
$$e^{-j\omega t_0} \longrightarrow \frac{1\text{ns}}{\text{ft}}$$



$$y(t) = x(t)\, e^{-s \cdot t_0}$$

$$x(t) = e^{-j\omega t_0}$$

$\frac{5}{s} e^{-st_0}$



$v_o(t) = 5e^{-\frac{(t-t_0)}{L/R}}$

$t \geq t_0$

$$V_o(s) = \frac{\cancel{s}L}{sL + R} \cdot \frac{5}{\cancel{s}} e^{-st_0}$$

$$= \frac{5}{s + \frac{R}{L}} \cdot e^{-st_0}$$

$$= 5e^{-\frac{R}{L}(t-t_0)} \cdot u(t-t_0)$$

$$= 5e^{-\frac{(t-t_0)}{L/R}} \cdot u(t-t_0)$$

IPEVO Visualizer

$\mathcal{L}\{e^{-at} \cdot u(t)\}$

$$= \int_{0^-}^{\infty} e^{-at} \cdot e^{-st} \cdot dt$$

$$= \int_{0}^{\infty} e^{-t(s+a)} \cdot dt$$

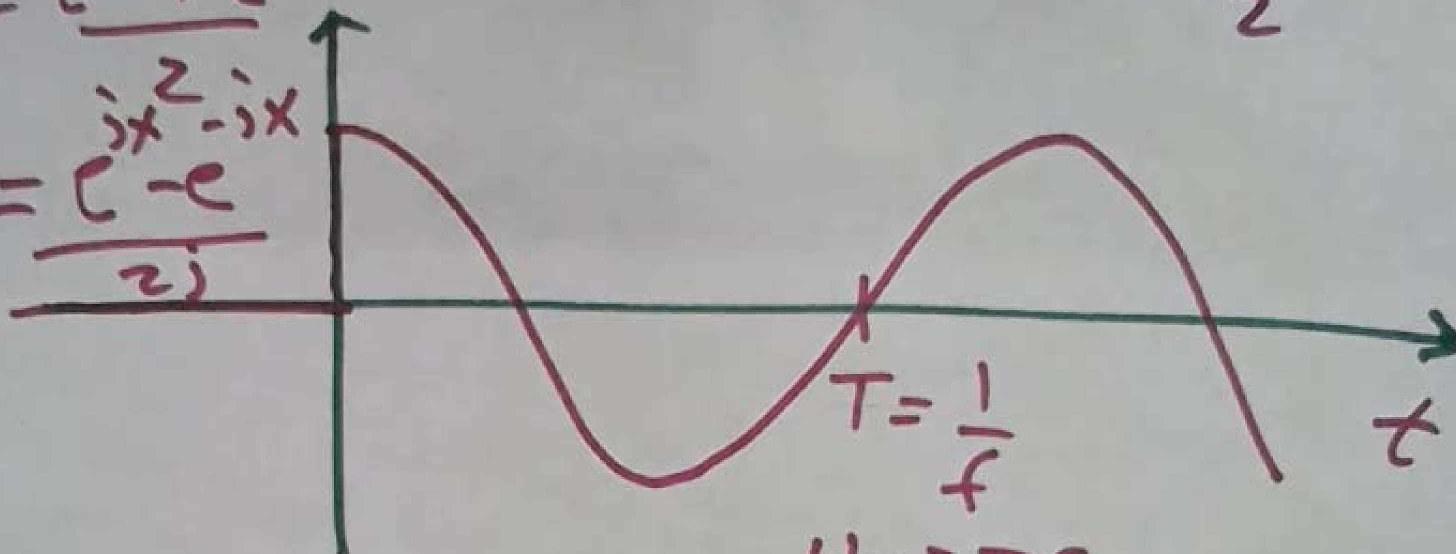
$$= \frac{1}{-(s+a)} e^{-t(s+a)} \Big|_0^{\infty}$$

$$= \frac{1}{s+a}$$

$$\cos \omega t \cdot u(t) = \frac{e^{j\omega t} + e^{-j\omega t}}{2}$$

$$\cos x = \frac{e^{jx} + e^{-jx}}{2}$$

$$\sin x = \frac{e^{jx} - e^{-jx}}{2j}$$



$$\omega = 2\pi f$$

$$\mathcal{L}\{\cos \omega t \cdot u(t)\} = \frac{1}{2}\int_0^\infty \left(e^{j\omega t} + e^{-j\omega t}\right) e^{-st} \cdot dt$$

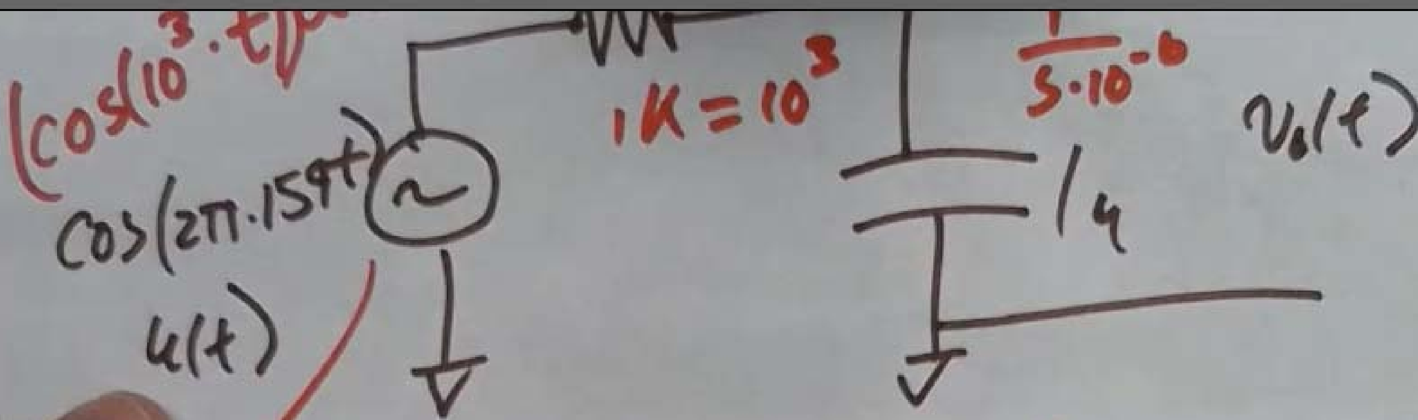
$$= \frac{1}{2}\int_0^\infty \left(e^{(j\omega - s)t} + e^{-(j\omega + s)t}\right) \cdot dt$$

$$= \frac{1}{2}\left[\frac{1}{j\omega - s} e^{j\omega t} \cdot e^{-st}\Big|_0^{\infty} + \frac{1}{j\omega + s}\right]$$

$$\frac{s}{s^2+\omega^2} = \frac{1}{2}\left[\frac{s+j\omega}{(s-j\omega)\cdot(s+j\omega)} + \frac{1}{s+j\omega}\cdot\frac{s-j\omega}{(s-j\omega)}\right]$$

$$= \frac{1}{2}\left[\frac{s+j\omega}{s^2+\omega^2} + \frac{s-j\omega}{s^2+\omega^2}\right]$$

IPEVO Visualizer



$$\frac{s}{\ldots 10^6}$$

$$V_o(s) = \frac{\frac{1}{s\cdot 10^{-6}}}{10^3 + \frac{1}{s\cdot 10^{-6}}} \cdot \frac{s}{s^2+10^6}$$

$$= \frac{1}{s\cdot 10^{-3}+1} \cdot \frac{s}{s^2+10^6}$$

$$= \frac{1}{s+10^3} \cdot \frac{s}{s^2+(10^3)^2}$$

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$$V_0(s) = \frac{10^3 \cdot (s+10^3)}{\cancel{s+10^3}} \cdot \frac{s}{s^2+(10^3)^2} = \frac{A \cdot (s+10^3)}{\cancel{s+10^3}} + \frac{B(s \ldots}{s^2+(10^3)^2}$$

$$0$$

$$s = -10^3$$

$$A = \frac{10^3 \cdot (-10^3)}{10^6 + 10^6} = \frac{-10^6}{2 \cdot 10^6}$$

$$\boxed{A = -\frac{1}{2}}$$