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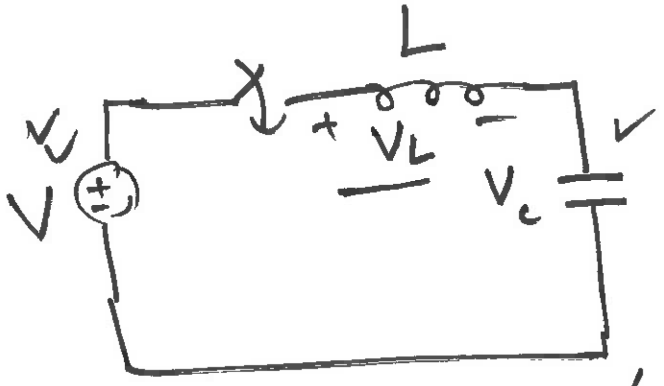
LECTURE 2



$$V_L(0) = V(0) - \cancel{V_c(0)}$$

0

$$\underbrace{V_L(0)} = V(0)$$

$$L\frac{di(0)}{dt} = \underbrace{V(0)}$$

$$i'(0) = \boxed{\frac{di(0)}{dt} = \frac{V}{L}}$$

$$s^2 i(s) - s i(0) - \underbrace{i'(0)} + \frac{i(s)}{LC} = 0$$

$$s^2 i(s) - 0 \qquad \underbrace{-\frac{V}{L}} + \frac{i(s)}{LC} = 0$$

$$s^2 i(s) + \frac{i(s)}{LC} = \frac{V}{L}$$

$$i(s)\left[s^2+\frac{1}{LC}\right) = \frac{V}{L}$$

$$i(s) = \frac{V}{L\left(s^2+\frac{1}{LC}\right)}$$

$$= \frac{V}{L\left(s^2+\left(\sqrt{1/LC}\right)^2\right)} * \frac{\sqrt{C}}{\sqrt{C}}$$

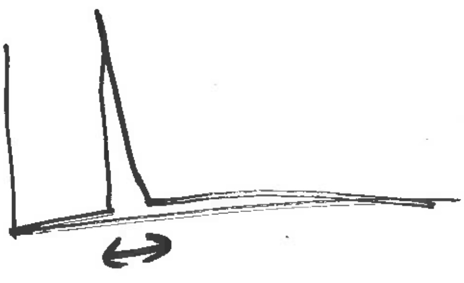
$(\sqrt{L} * \sqrt{L})$

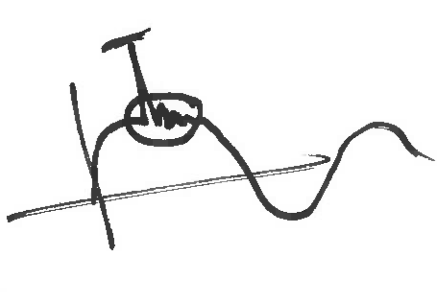
$$\boxed{\sin \omega t = \frac{\omega}{s^2+\omega^2}}$$

$$i(s) = \frac{V}{\sqrt{L/C}} \; \frac{1/\sqrt{LC}}{s^2+\left(\frac{1}{\sqrt{LC}}\right)^2}$$

↓ time domain

$$i(t) = \frac{V}{\sqrt{L/C}} \; \sin\left(1/\sqrt{LC}\right)t$$





Equation (c)

$$V = L\frac{di}{dt} + V_c$$

$$i = c\frac{dv_c}{dt} \text{ ——— } D$$

$$\frac{di}{dt} = c\frac{d^2 v_c}{dt^2} \text{ — } E$$

$$\rightarrow L\frac{di}{dt} = V - V_c$$

$$\frac{di}{dt} = \frac{V}{L} - \frac{V_c}{L}$$

$$c\frac{d^2 v_c}{dt} = \frac{V}{L} - \frac{V_c}{L}$$

$$\underline{\omega_0} = \sqrt{\frac{1}{Lc}} \implies \omega_0^2 = \frac{1}{\sqrt{Lc}}$$

$$\rightarrow \frac{d^2 v_c}{dt} = \frac{V}{Lc} - \frac{V_c}{Lc}$$

$$\frac{d^2 v_c}{dt} = \omega_0^2 v - \omega_0^2 v_c$$

EXERCISE PAGE 11 – SLIDES

ⓐ Peak voltage across Capacitor

$200kV = 2 * V_{input}$

$V_p = V_{rms} * \sqrt{2}$

$V_{input} = \frac{\cancel{200}^{100}kV}{\cancel{2}} = 100kV$

$V_{input\,(rms)} = \frac{100k}{\sqrt{2}} = 70.7kV$

ⓑ

$S = P + iQ$

Apparent Power VA = Active Power Watt + iQ VAr

$X_s = 0.2\,\Omega = 2\pi f L$

$L = \frac{0.2}{2*\pi*f} = \frac{0.2}{2*\pi*50} =$

$\Rightarrow L = 6.4 * 10^{-4} H$

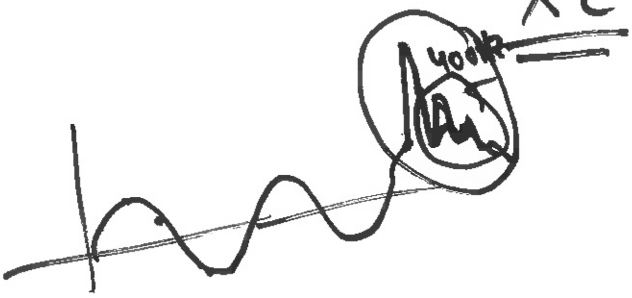
$f_0 = 400 HZ$

$\downarrow$

$$\frac{1}{2\pi\sqrt{LC}} = 400 HZ$$

$$C = \frac{1}{4 * \pi^2 * \underbrace{400^2}_{f} * \underbrace{6.4 * 10^{-4}}_{L}} = 2.5 * 10^{-4} F$$

$$S_c = \frac{V^2}{X_c} = (70.7 * 1000)^2 * 2\pi f * C$$

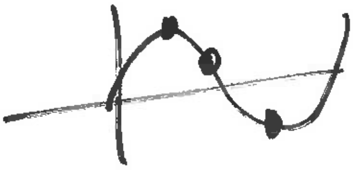


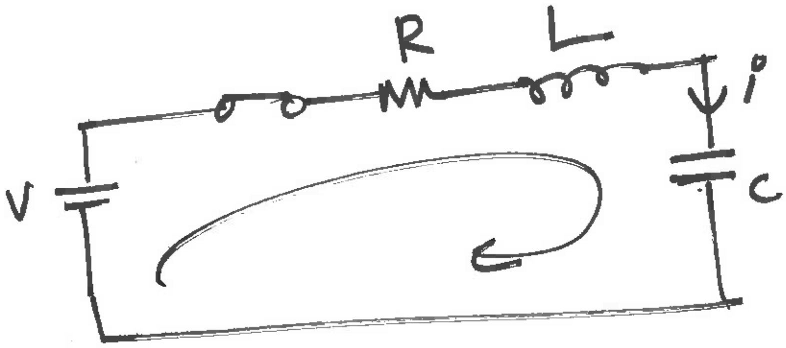
$$= (70.7 * 1000)^2 * 2 * \pi * 50 * 2.5 * 10^{-4}$$

$$S_c = 392.6 MVAr$$

$$\text{Surge Impedance} = \sqrt{\frac{L}{C}} = \sqrt{\frac{6.4 * 10^{-4}}{2.5 * 10^{-4}}}$$

$$= 1.6 \Omega$$





$$V = Ri + L\frac{di}{dt} + V_c \quad \text{—— I}$$

$$i = C\frac{dv}{dt} \quad \text{—— J}$$

differentiating J

$$\frac{di}{dt} = C\frac{d^2v}{dt} \quad \text{—— k}$$

$$L\frac{di}{dt} = V - Ri - V_c$$

$$\frac{di}{dt} = \frac{V}{L} - \frac{Ri}{L} - \frac{V_c}{L}$$

FROM k

$$\frac{\cancel{C}\,d^2v}{\cancel{C}\,dt} = \frac{V}{LC} - \frac{Ri}{LC} - \frac{V_c}{LC}$$

Star delta

3ϕ 415 - V 50 Hz

$\downarrow$

V_{L-L}

V_{LL}

$\downarrow$ peak or rms

$$V_{phase} = \frac{415}{\sqrt{3}} = 239 \; V_{rms}$$

$$V_{phase} = 239 * \sqrt{2} \; V_{peak}$$