EE 582 - LECTURE 4

Mar 15, 2000

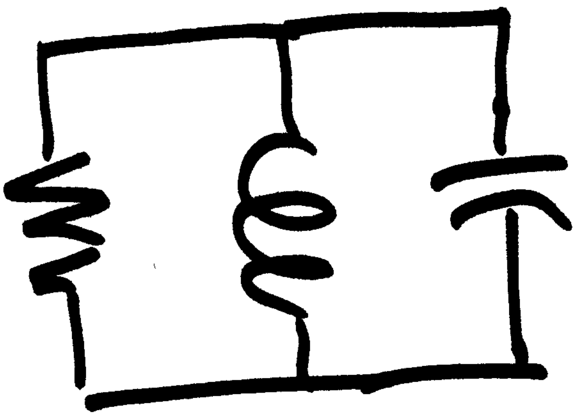
Reminder - Friday Homework

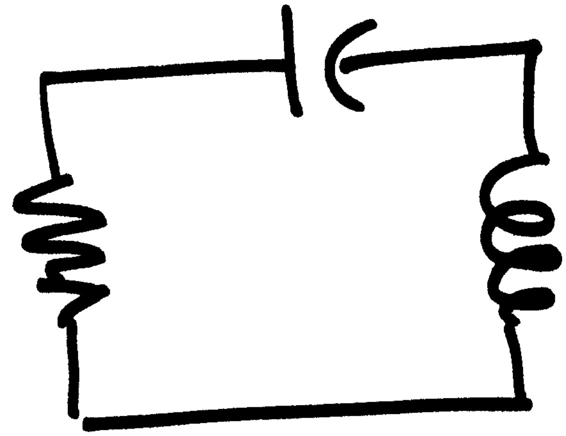
3.2
3.3
3.4
3.6
3.12

Next Topic: Cap Bank Switching
Print out paper
for Friday's Lecture!

Today: - RLC Circuits
- Practical Approach
- ATP Simulations
(10am Thurs - Edison)

PARALLEL RLC - SERIES RLC





Resonant freq:

$$\omega_0 = \frac{1}{\sqrt{LC}} \qquad \omega_0 = \frac{1}{\sqrt{LC}}$$

Exponential Damping Coefficient (or Neper freq)

$$\alpha = \frac{1}{2RC} \qquad \boxed{\alpha = \frac{R}{2L}}$$

Damped or "Natural" Resonant freq

$$\omega_d = \sqrt{\omega_0^2 - \alpha^2}$$

Damping:

Critical Damping: $\alpha = \omega_0$

$$\omega_d = \sqrt{\omega_0^2 - \alpha^2} = 0$$

Overdamped:

$$\alpha > \omega_0$$

Underdamped:

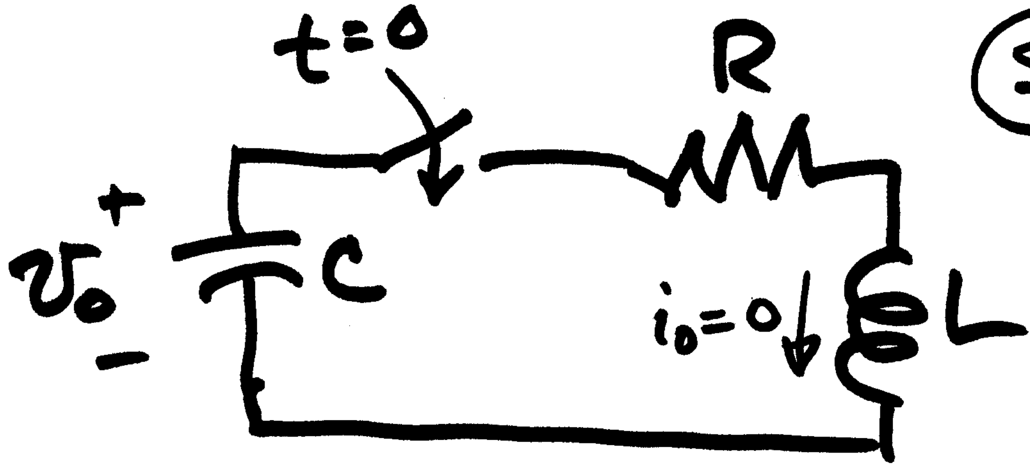
$$\omega_0 > \alpha$$

Undamped: $\alpha = 0$

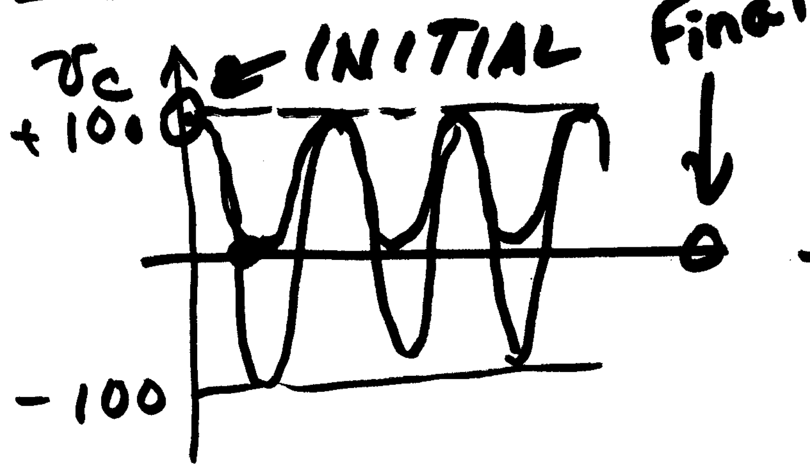
$$\omega_d = \omega_0$$

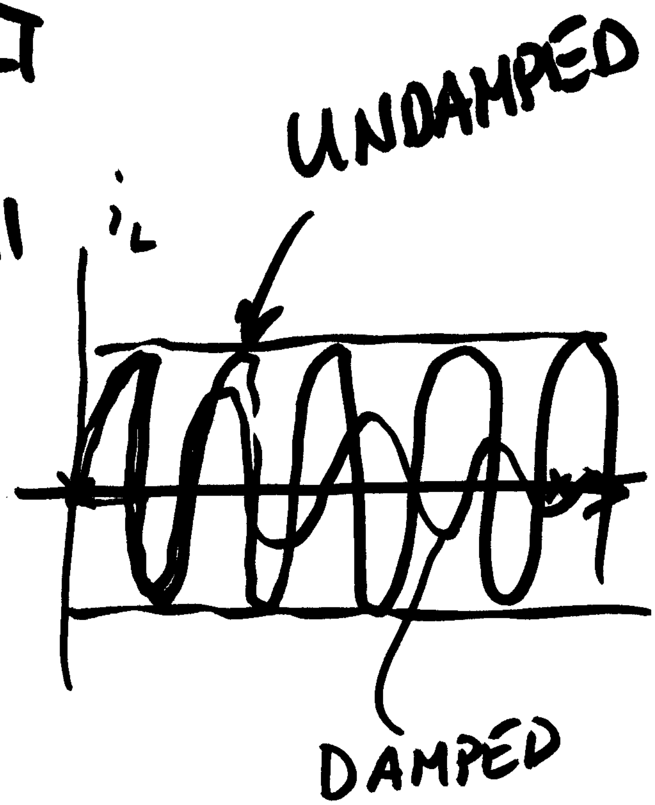
Look at series RLC

SER_RLC.adp



UNDAMPED $R = 0$





Ex:

$L = 10\,mH$

$C = 1\,\mu F$

$R \cong 0$

① $Z_0 = \sqrt{\frac{L}{C}} = \sqrt{\frac{.01}{10^{-6}}} = 100\,\Omega$

$I_p = \frac{\Delta V}{Z_0}$

② $\omega_0 = 10{,}000\ s^{-1}$

$f = 1591\ Hz$

$T = 0.63\ ms$

$\Delta t \cong 20\,\mu s$

$T_{END} =$

Read Ch. 4 – § 4.3 – Damping

Make transition from

$\alpha, \omega_0, \omega_d$

to $\boxed{s = \sigma + j\omega}$

~~int~~ in terms of Z_0, R, λ, η

More on simulation:

Critically damped:

$$\alpha = \omega_0 = \frac{R}{2L}$$

Check: decrease R

$$\alpha = 10{,}000 = \frac{R}{(2)(.01)}$$

$$\Rightarrow \underline{R = 200\,\Omega}$$

$R = 190\,\Omega \Rightarrow \alpha = \frac{R}{2L}$

$= \frac{190}{(2)(.01)}$

$= 9500$

$\omega_d = \sqrt{\omega_0^2 - \alpha^2}$

$= \sqrt{10{,}000^2 - 9500^2} = 3122\ s^{-1}$

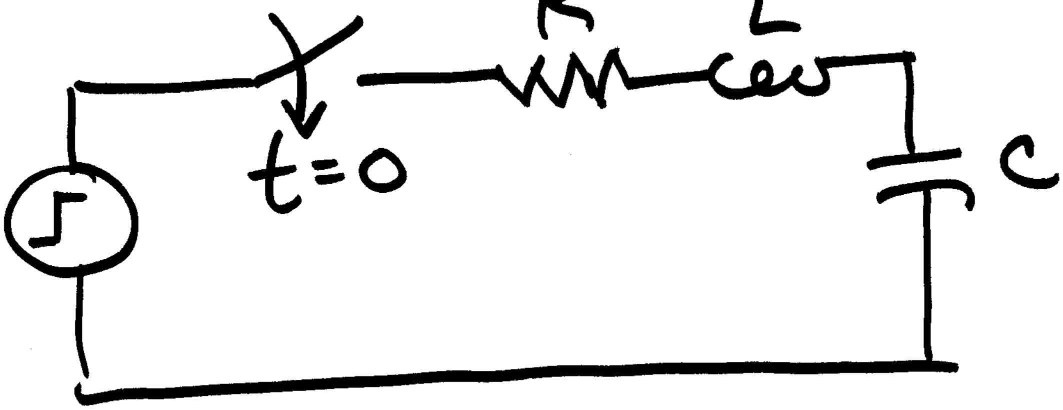
$= 497\ Hz$

$T = 2\ ms$

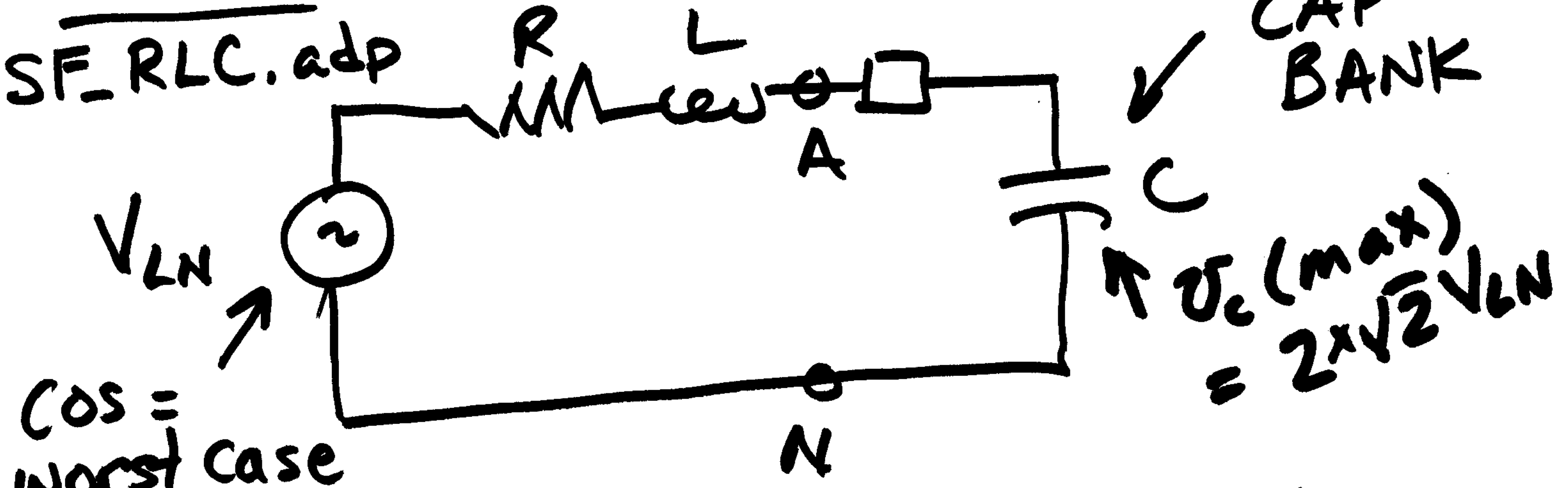
$R = 10{,}000 \rightarrow$ overdamped

Forced RLC Responses

(F_RLC)



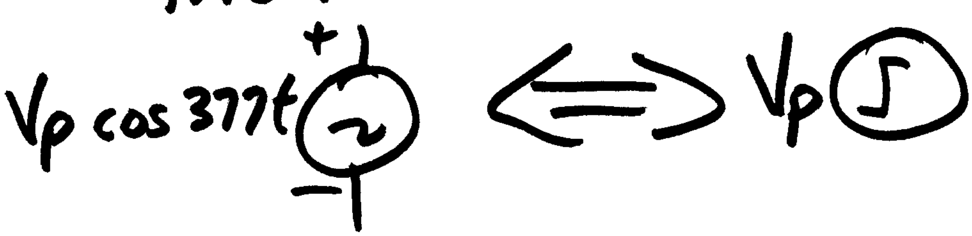
Note: Very similar to

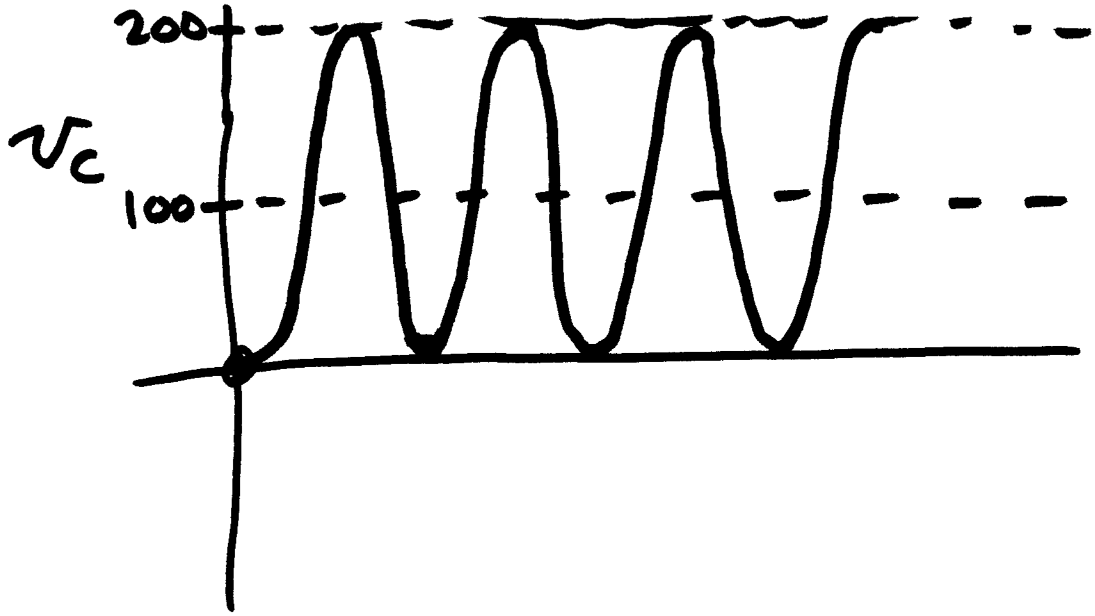


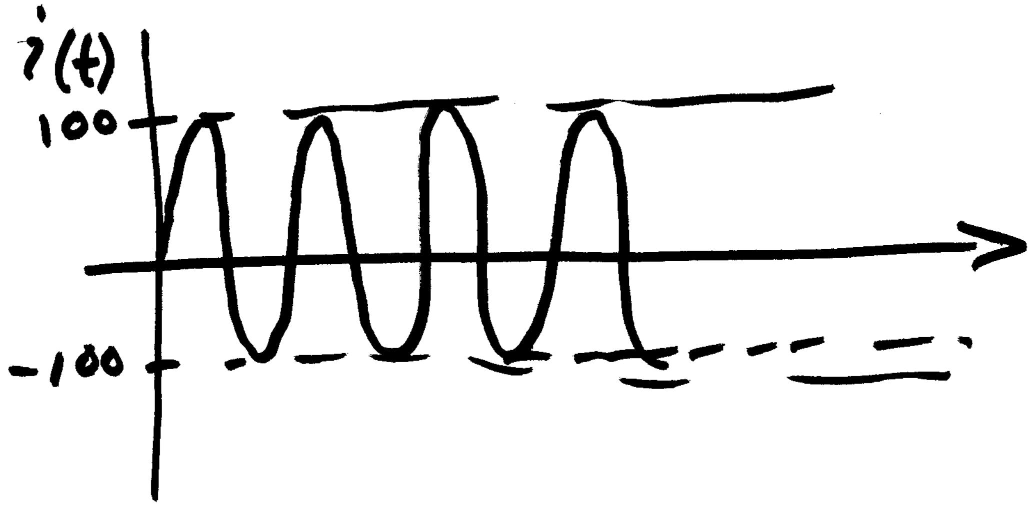
since L is very small and C is sizeable

Then $\boxed{\omega_0 \gg 377}$

Then we can assume that







<u>If</u> $\frac{X}{R}$ ratio is 10, then

$$R = \frac{X}{10} = \frac{377L}{10} = \underline{0.377\,\Omega}$$