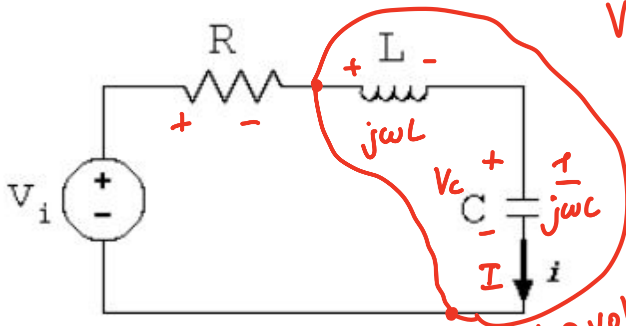
- Resonance-cont
  - What if we add a resistor too?




net 0 voltage

series resonance

$$V_c = V_i \frac{\frac{1}{j\omega C}}{\left(\frac{1}{j\omega C} + j\omega L + R\right)} = \frac{V_i}{\underbrace{1-\omega^2 LC}_{0}+j\omega RC}$$

if $\omega = \frac{1}{\sqrt{LC}}$

$$V_c = \frac{V_i}{j\omega RC} = -j\sqrt{\frac{L}{C}}\frac{1}{R}V_i$$

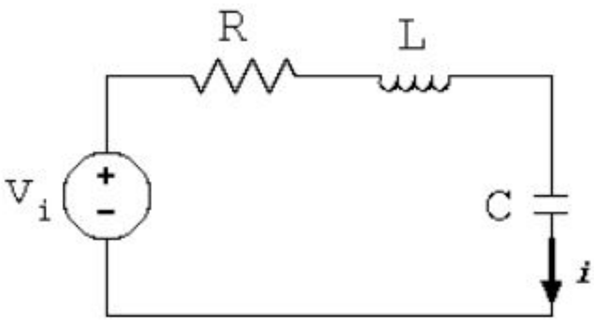
$$V_L = \frac{j\omega L V_i}{\frac{1}{j\omega C} + R + j\omega L} = j\sqrt{\frac{L}{C}}\frac{1}{R}V_i = -V_c$$

$$V_c + V_L = V_c - V_c = 0$$

$$Z_s = R + \underbrace{j\omega L - \frac{j}{\omega C}}_{=0 \text{ If } \omega = \frac{1}{\sqrt{LC}}}$$

L and C act like a short, but they still have voltage, just opposite in signs to each other
⇒ max current achieved!

- Example #10
    - Determine the current and voltage in each element if $v_i(t) = \cos(\omega_0 t)$, where $\omega_0 = \frac{1}{\sqrt{LC}}$

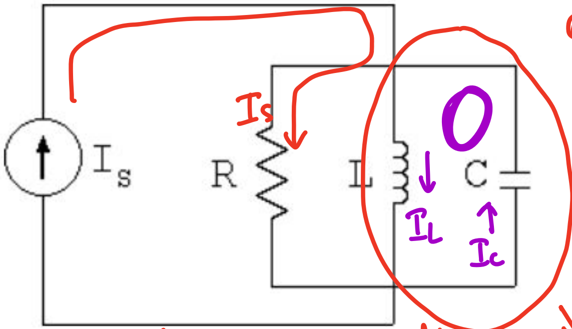



$V_R = V_i$

$I = \frac{V_i}{R}$

- Resonance-cont
  - What if elements are in parallel? Parallel resonance

@ $\omega = \frac{1}{\sqrt{LC}}$




$\Downarrow$ max V achieved!

$\downarrow$ now, they act as open circuit, but they still have current. It goes around just between L and C

$$Z_p = \frac{1}{\frac{1}{R} + j\left(\omega C - \frac{1}{\omega L}\right)} = R$$

# Chapter objectives

- Understand the representation of co-sinusoids as phasors
- Understand and apply the principles of superposition and derivative in phasors
- Understand the representation of resistors, inductors and capacitors as impedances
- Carry out co-sinusoidal steady-state analysis of dissipative LTI systems through differential equations and directly through circuits
- Calculate the average absorbed power of basic circuit elements
  - For inductors and capacitors P = 0W
- Understand the meaning of available power and matched impedance, as well as how to calculate them
- Understand the concept of resonance