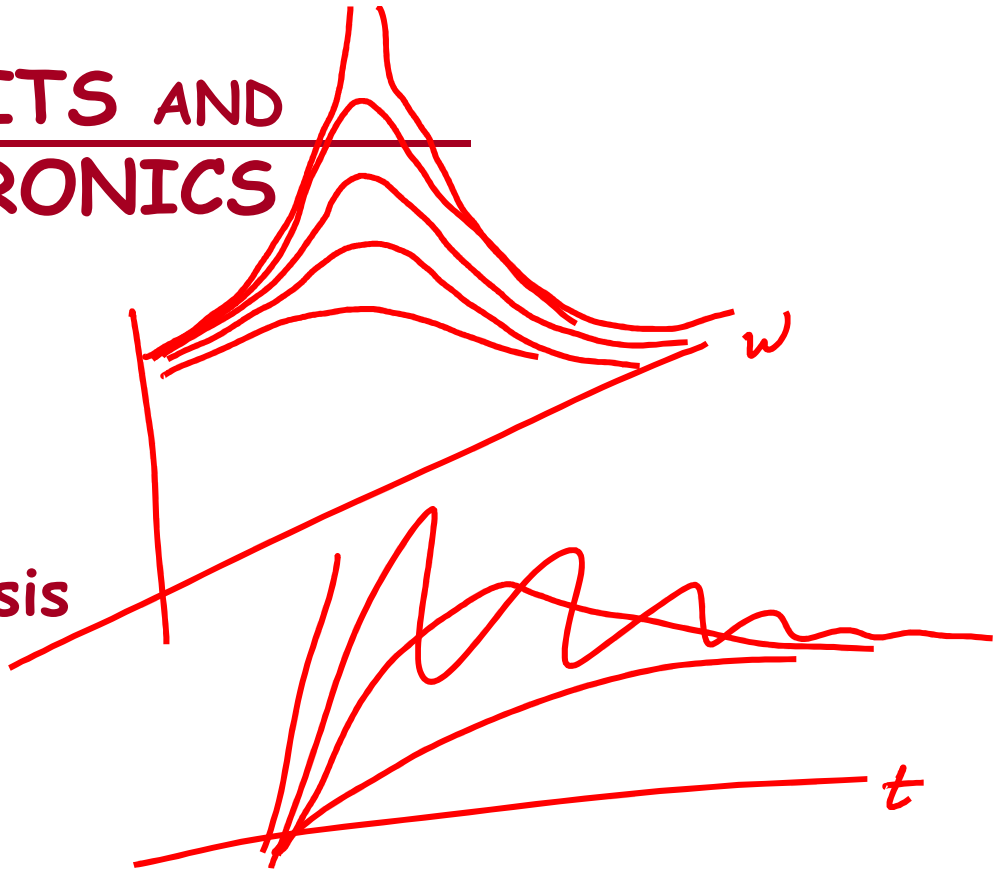
6.002x CIRCUITS AND ELECTRONICS

Time Domain versus Frequency Domain Analysis

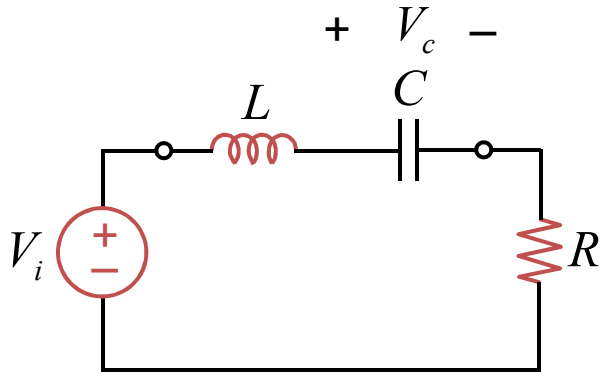


Reading: Section 13.6.3 and Pages 819 – 823 of A & L.

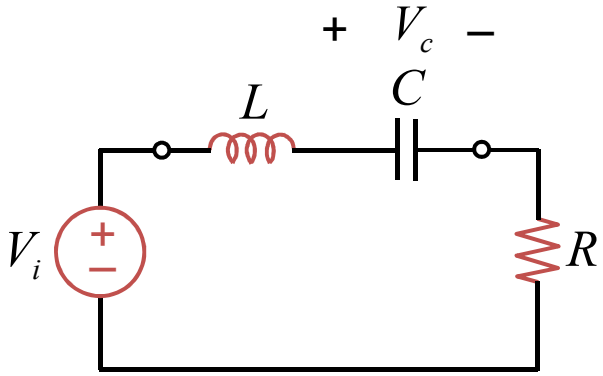
Review

Review

One Circuit, Different Filters

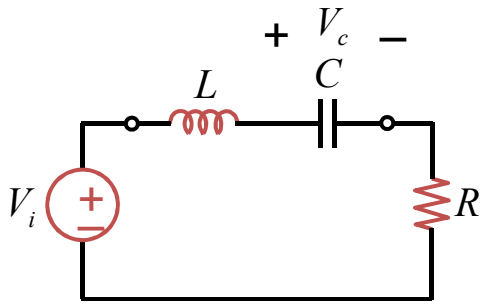


Review Q indicates peakiness





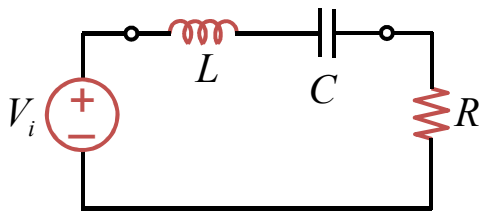
Mapping back to time domain is easy



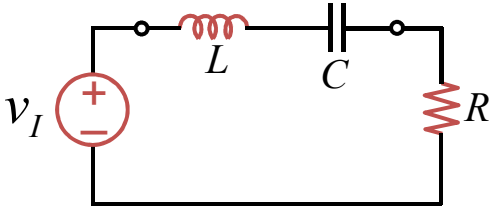
$$\frac{V_c}{V_i} = \frac{\omega_o^{\,2}}{s^2 + 2\alpha s + \omega_o^{\,2}}$$

Let's use Q to compare time domain and frequency domain

Frequency domain

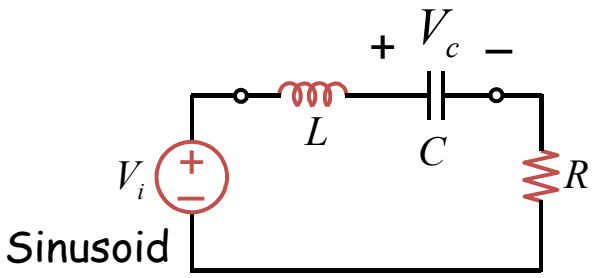


Time domain



Overdamped case: $\alpha > \omega_o$ Or $Q = \frac{\omega_o}{2\alpha} < \frac{1}{2}$

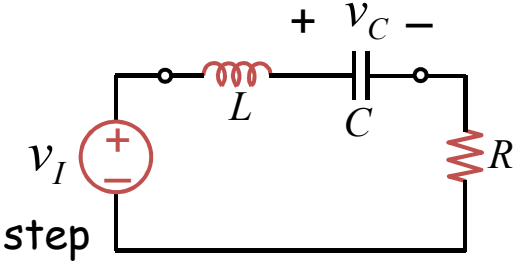
Frequency domain



Sinusoid

$v_I = V_i \cos \omega t$

Time domain



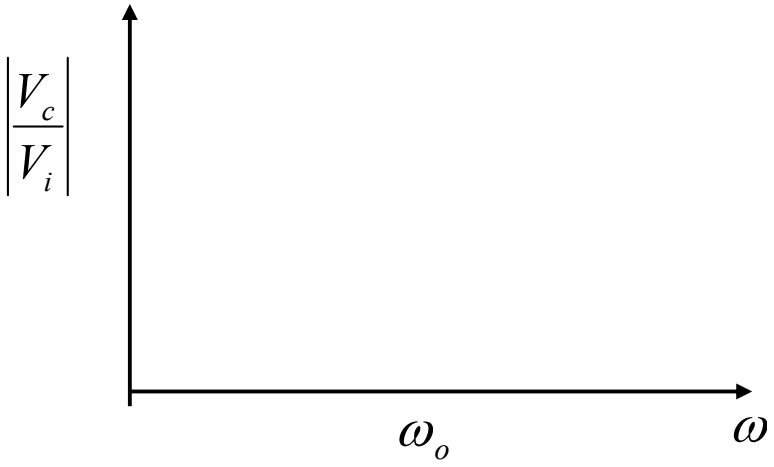
Unit step

$v_I = u(t)$

$$Q = \frac{\omega_o}{2\alpha}$$

$$\omega_o = \frac{1}{\sqrt{LC}}$$

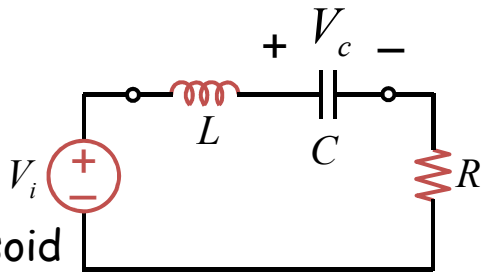
$$2\alpha = \frac{R}{L}$$





Underdamped case: $\alpha < \omega_o$ Or $Q = \frac{\omega_o}{2\alpha} > \frac{1}{2}$

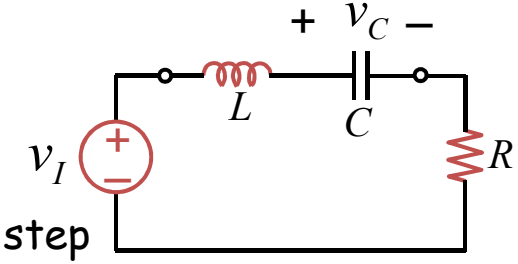
Frequency domain



Sinusoid

$v_I = V_i \cos \omega t$

Time domain



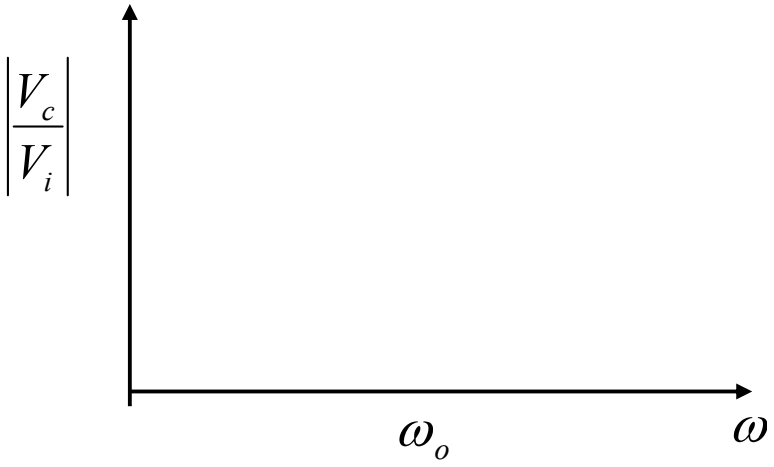
Unit step

$v_I = u(t)$

$$Q = \frac{\omega_o}{2\alpha}$$

$$\omega_o = \frac{1}{\sqrt{LC}}$$

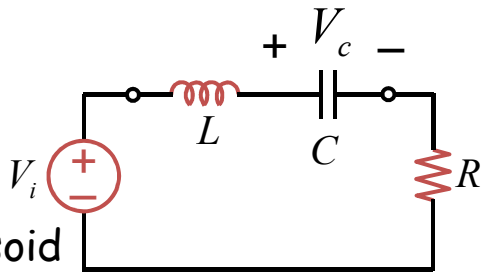
$$2\alpha = \frac{R}{L}$$





Critically damped case: $\alpha = \omega_o$ Or $Q = \frac{\omega_o}{2\alpha} = \frac{1}{2}$

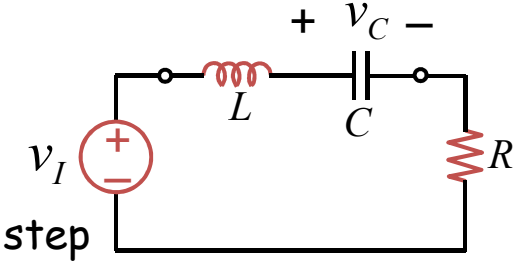
Frequency domain



Sinusoid

$v_I = V_i \cos \omega t$

Time domain



Unit step

$v_I = u(t)$

$$Q = \frac{\omega_o}{2\alpha}$$

$$\omega_o = \frac{1}{\sqrt{LC}}$$

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

