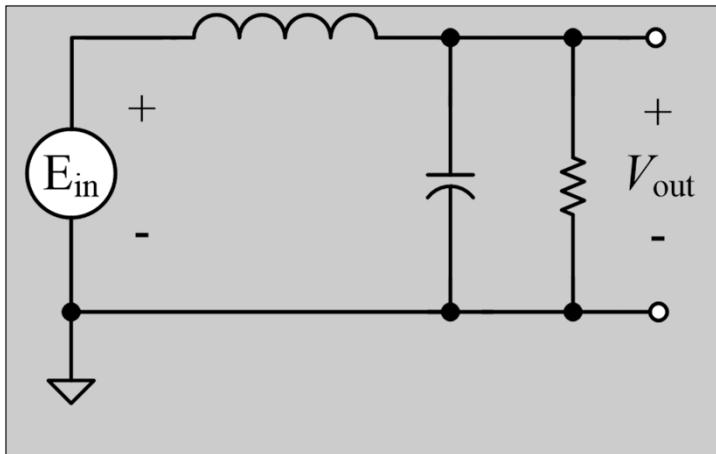


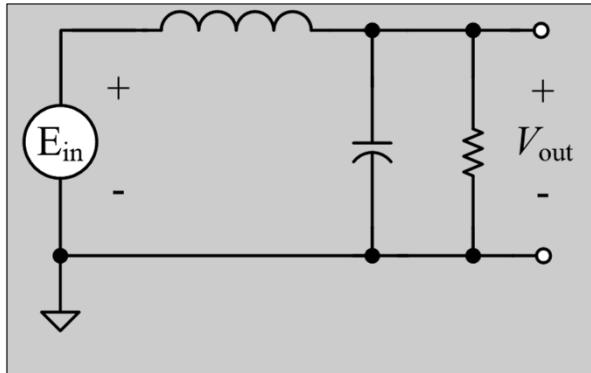
# Laplace LC Low Pass Filter



1. Add the Laplace impedances.
2. Find the transfer function.

$$\frac{V_{out}}{E_{in}} = \frac{1}{s^2 + \frac{1}{LC} s + \frac{R^2}{LC}}$$

\_\_\_\_\_ sets frequency      \_\_\_\_\_ sets damping

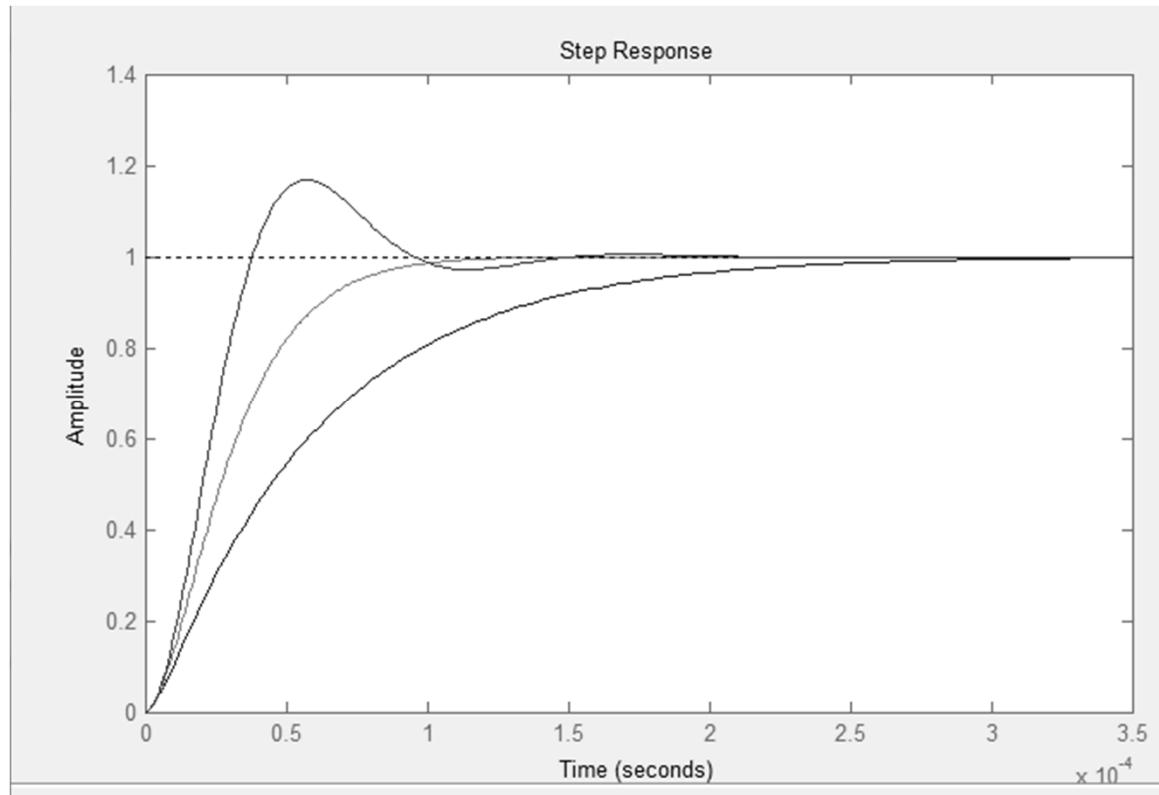


Write the transfer function with numeric values

- a.  $R = 8 \Omega$     $L = 500 \mu\text{H}$     $C = 0.5 \mu\text{F}$
- b.  $R = 8 \Omega$     $L = 257 \mu\text{H}$     $C = 1.0 \mu\text{F}$
- c.  $R = 8 \Omega$     $L = 125 \mu\text{H}$     $C = 2.0 \mu\text{F}$

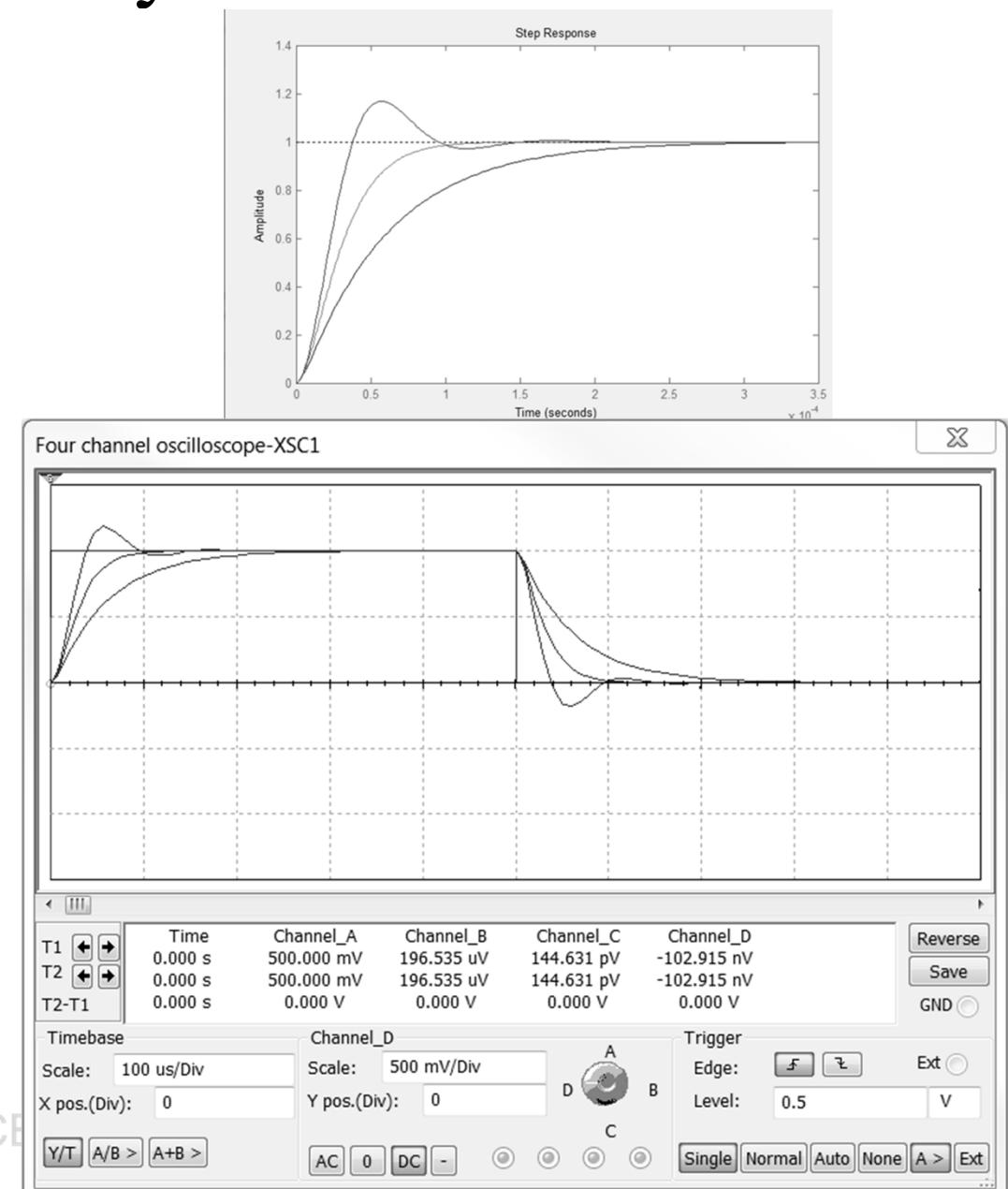
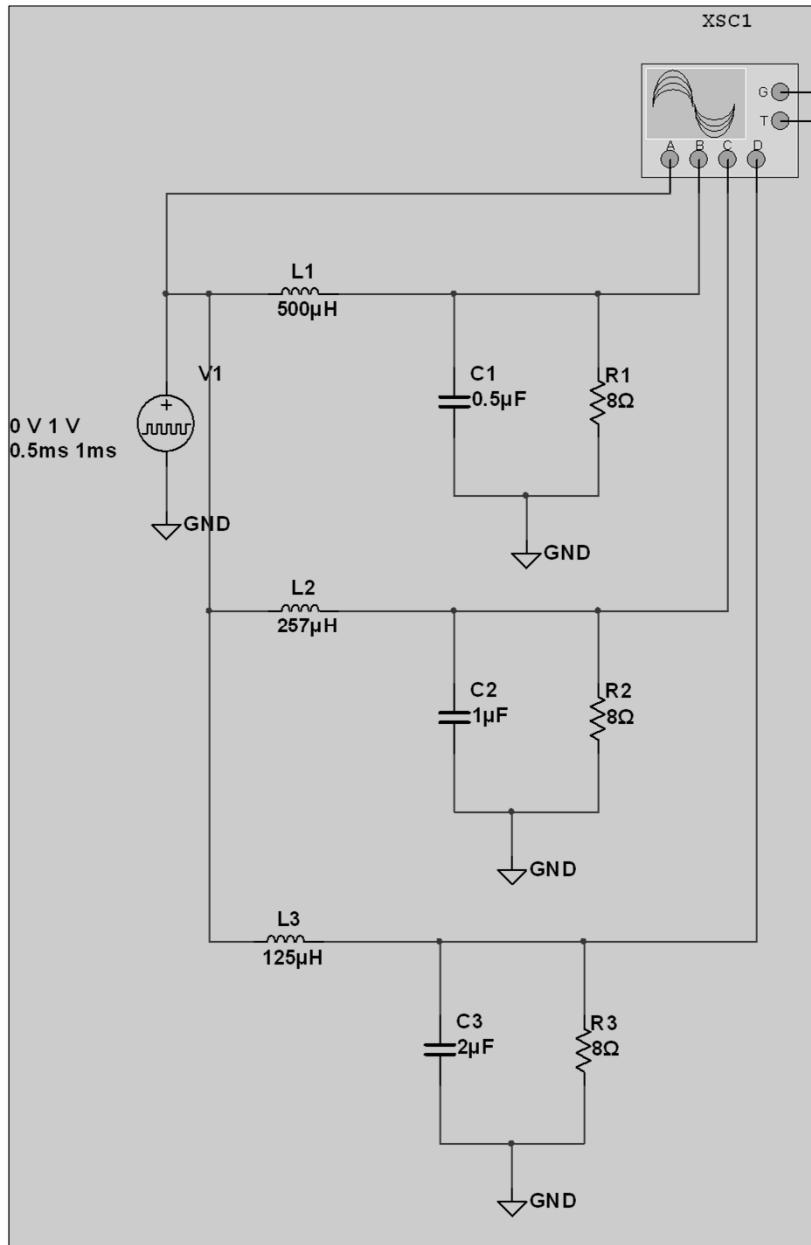
# MATLAB Analysis

```
clc  
clear  
s=tf('s')  
R=8;  
L1=500e-6;  
C1=0.5e-6;  
  
L2=257e-6;  
C2=1e-6;  
  
L3=125e-6;  
C3=2e-6;
```

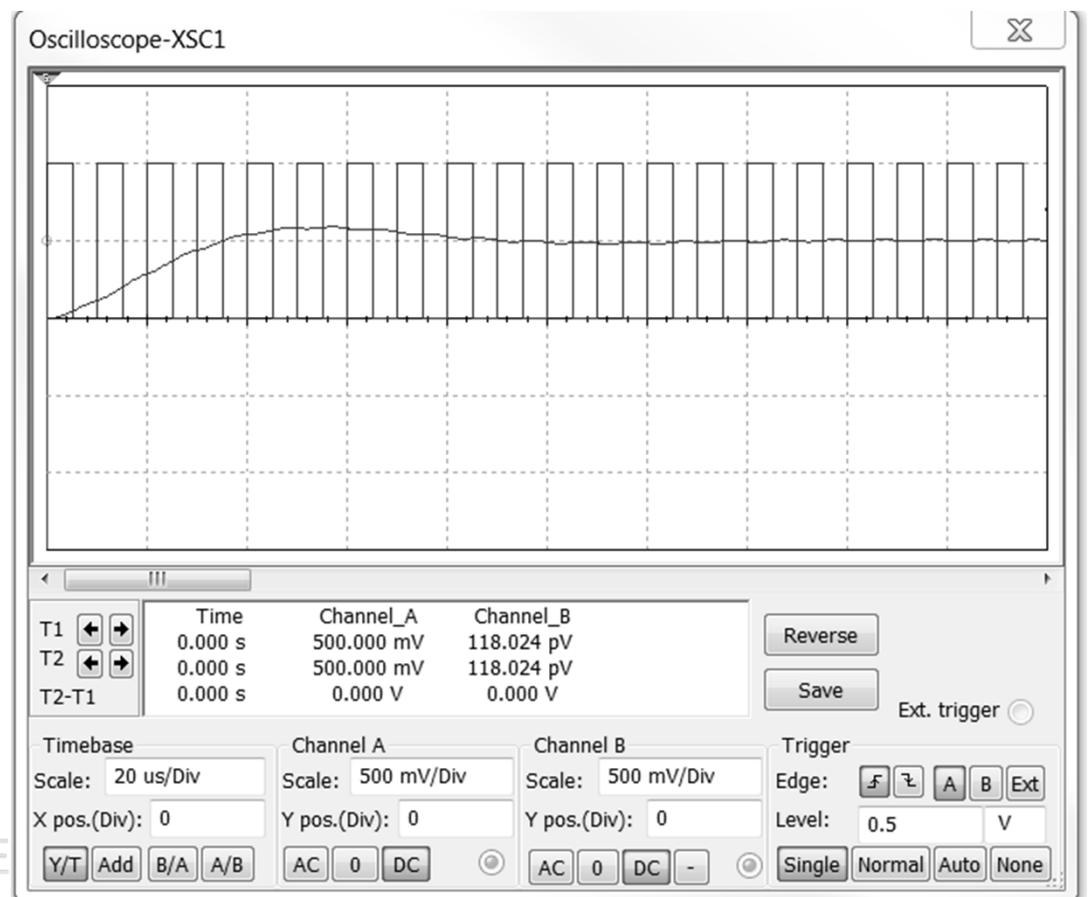
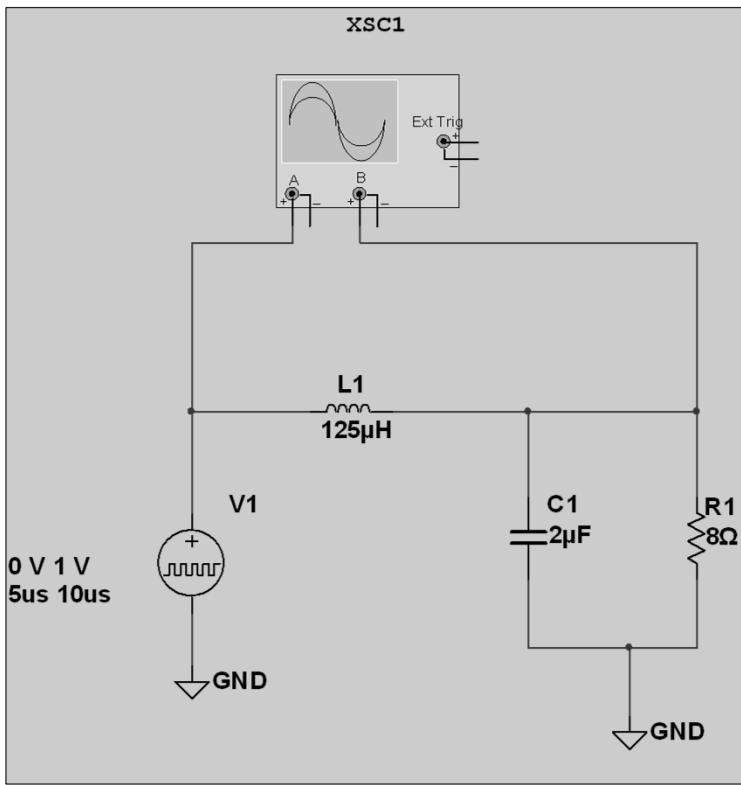


```
G1=(1/(L1*C1))/(s^2+s/(R*C1)+1/(L1*C1))  
G2=(1/(L2*C2))/(s^2+s/(R*C2)+1/(L2*C2))  
G3=(1/(L3*C3))/(s^2+s/(R*C3)+1/(L3*C3))  
ltiview(G1,G2,G3)
```

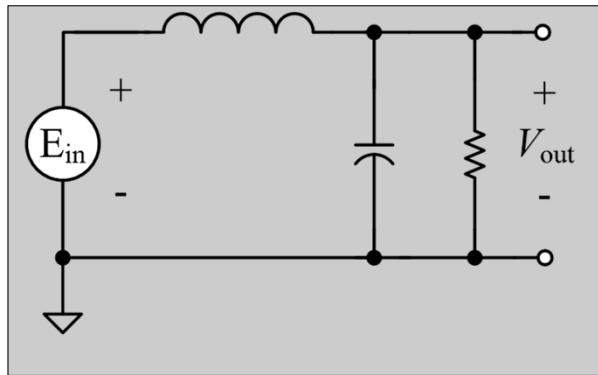
# Multisim Analysis – 1 kHz



# Multisim Analysis – 100 kHz



- Effect of changing  $\omega$  ?
  - How?
- Effect of changing  $\zeta$  ?
  - How?



Design an LC Low Pass filter with

$$R = 4 \Omega, \quad f_n = 10 \text{ kHz}, \quad \xi = 0.7$$

$$\omega_n = 2\pi f_n$$

$$\frac{V_{\text{out}}}{E_{\text{in}}} = \frac{\frac{1}{LC}}{s^2 + \frac{1}{RC}s + \frac{1}{LC}}$$

$$\frac{V_{\text{out}}}{E_{\text{in}}} = \frac{\omega_n^2}{s^2 + 2\xi\omega_n s + \omega_n^2}$$

$$2\xi\omega_n = \frac{1}{RC} \quad \omega_n = \frac{1}{\sqrt{LC}}$$