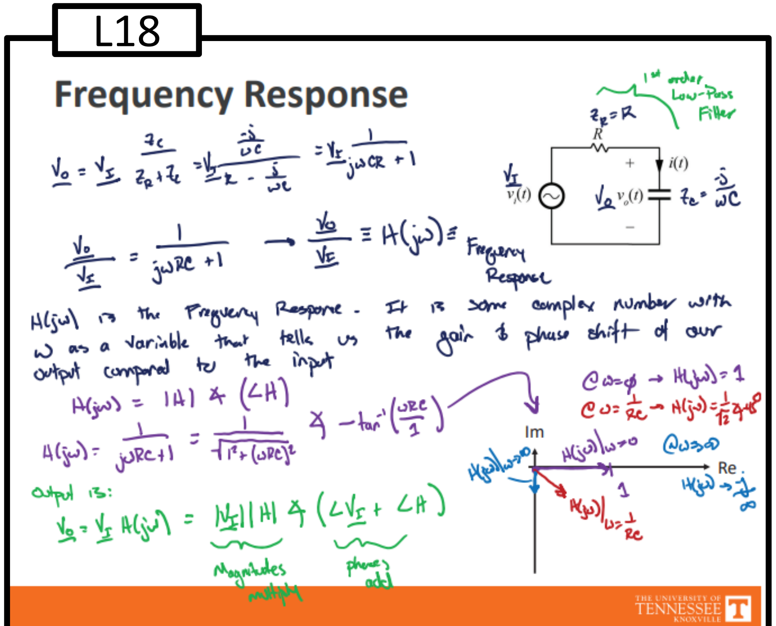
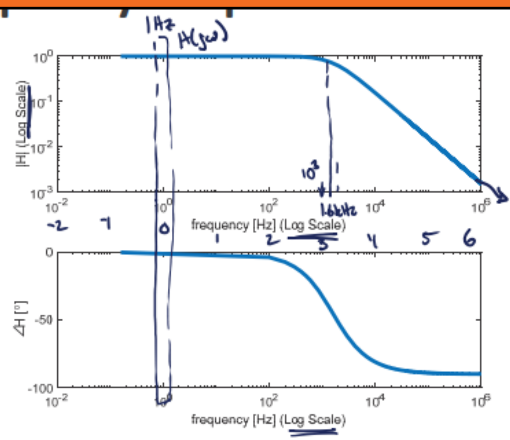
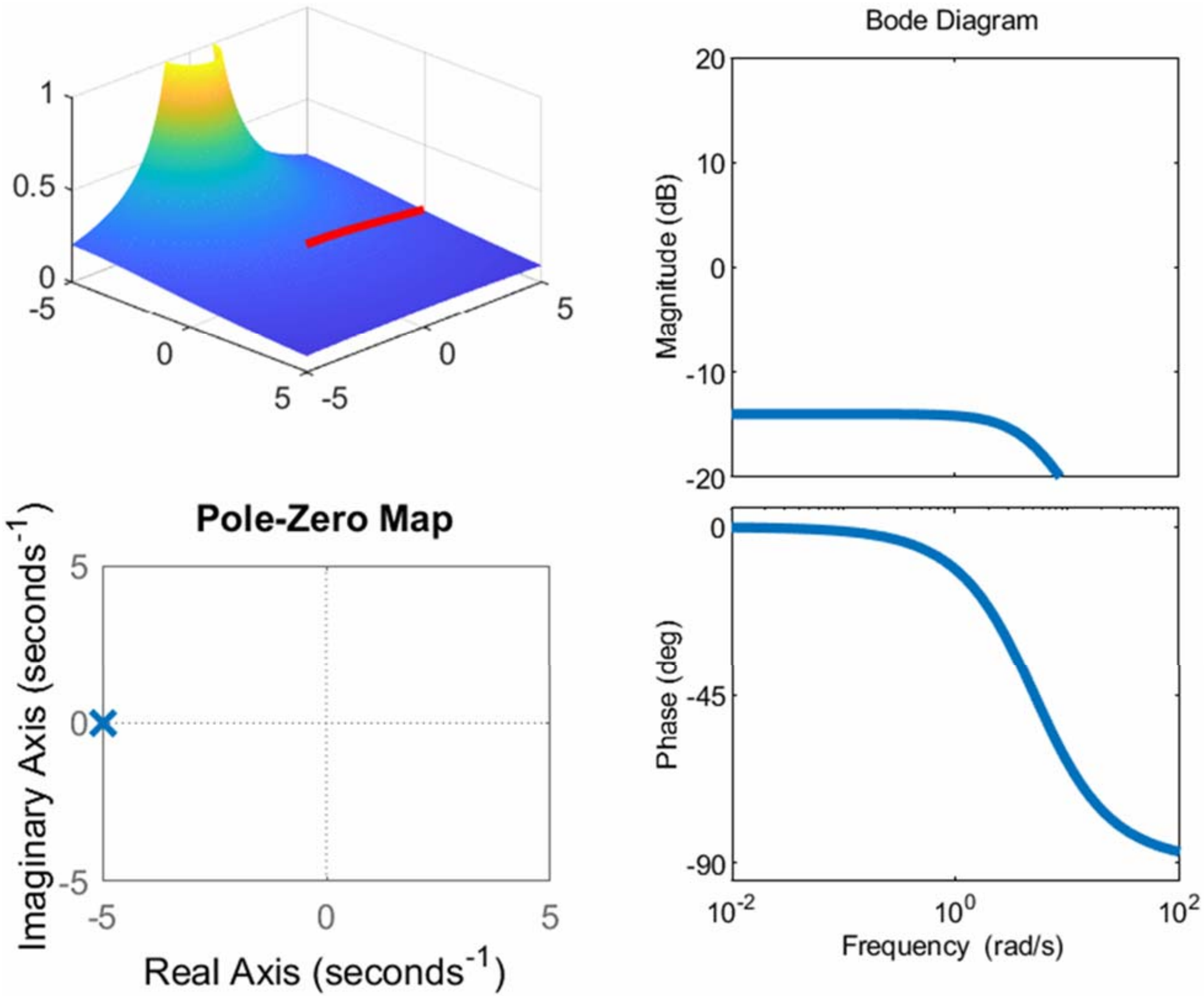
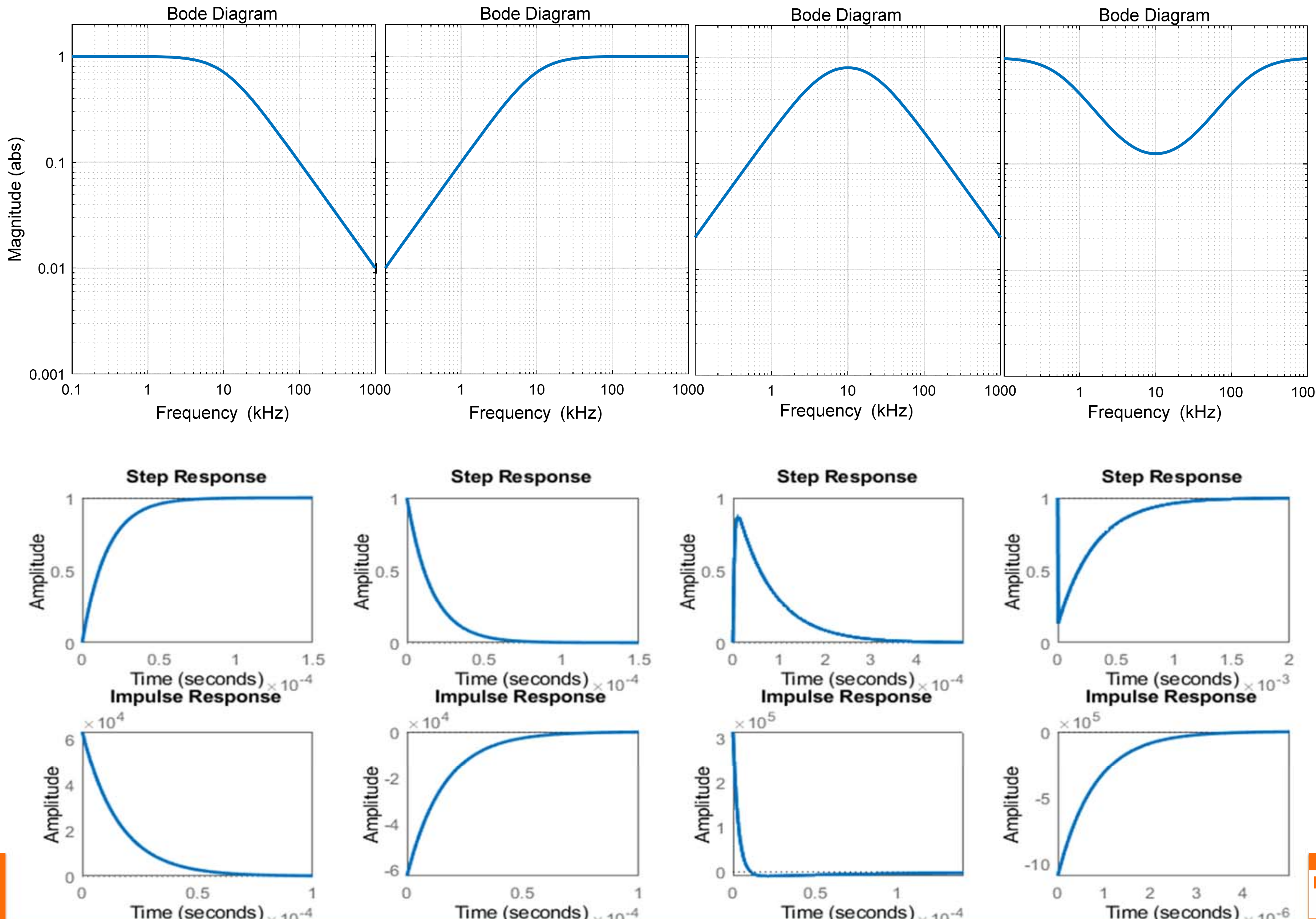
Frequency Response



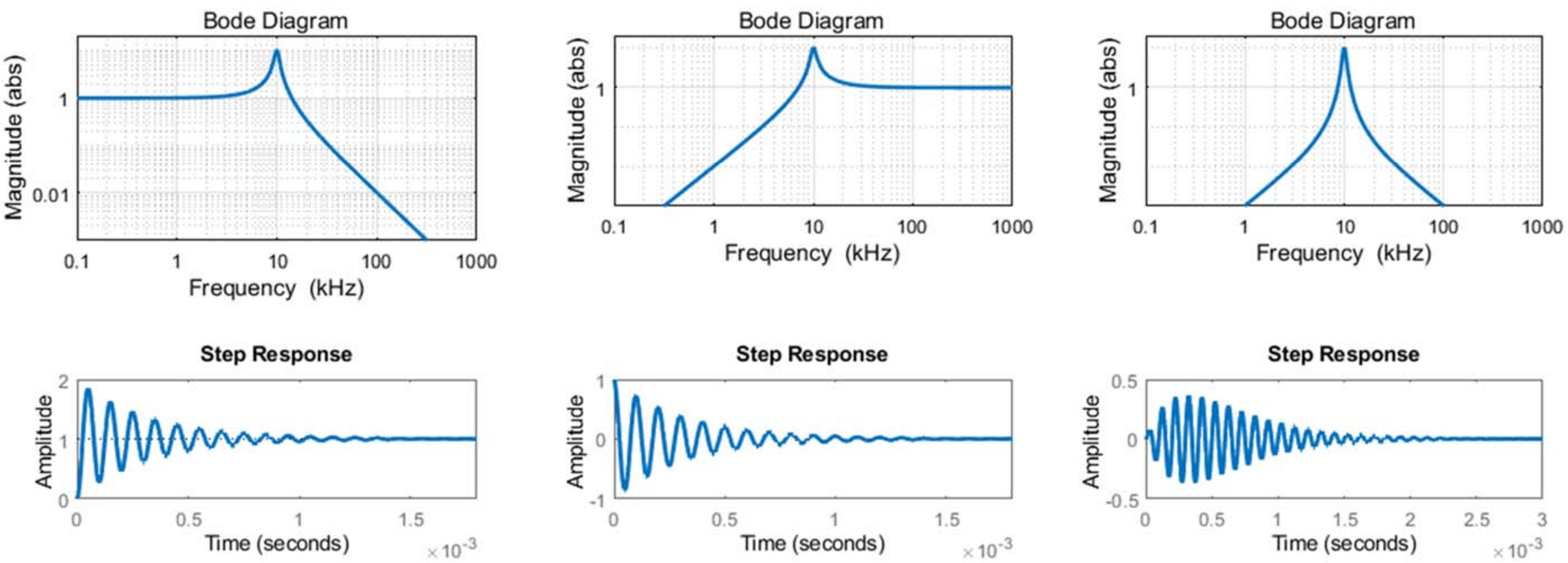



1
0.5
0
-5
0
5
-5
0
5
Bode Diagram
Magnitude (dB)
20
10
0
-10
-20
Phase (deg)
0
-45
-90
10-2
100
102
Frequency (rad/s)
Pole-Zero Map
Imaginary Axis (seconds-1)
5
0
-5
-5
0
5
Real Axis (seconds-1)

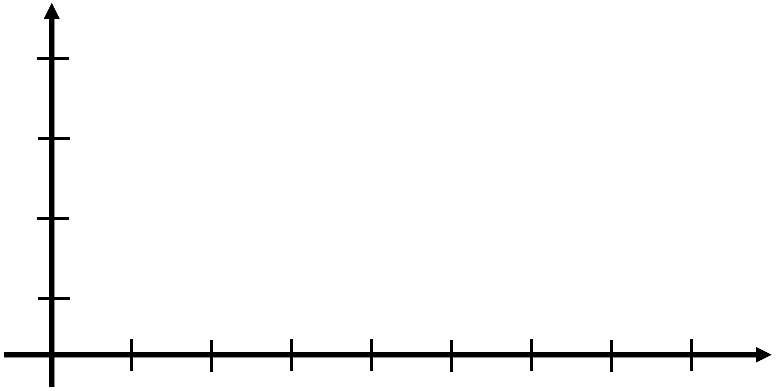
Frequency Response and Circuit Behavior

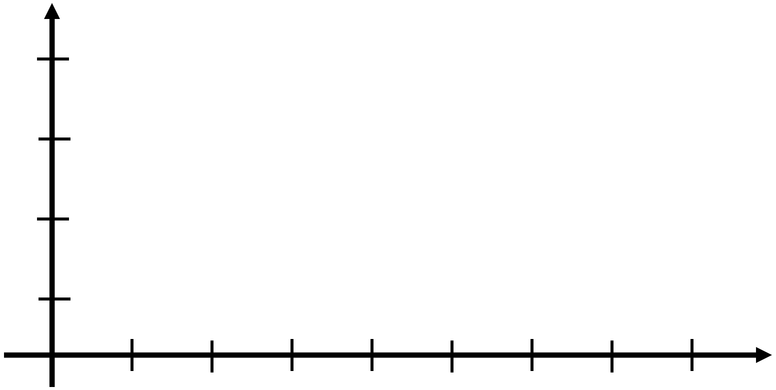


Complex Poles



Bode Plots





dB Scale

Decibels

$$\| G \|_{\mathrm{dB}} = 20 \log_{10}\left(\| G \| \right)$$

Decibels of quantities having units (impedance example): normalize before taking log

$$\| Z \|_{\mathrm{dB}} = 20 \log_{10}\left(\frac{\| Z \|}{R_{base}} \right)$$

Table 8.1. Expressing magnitudes in decibels

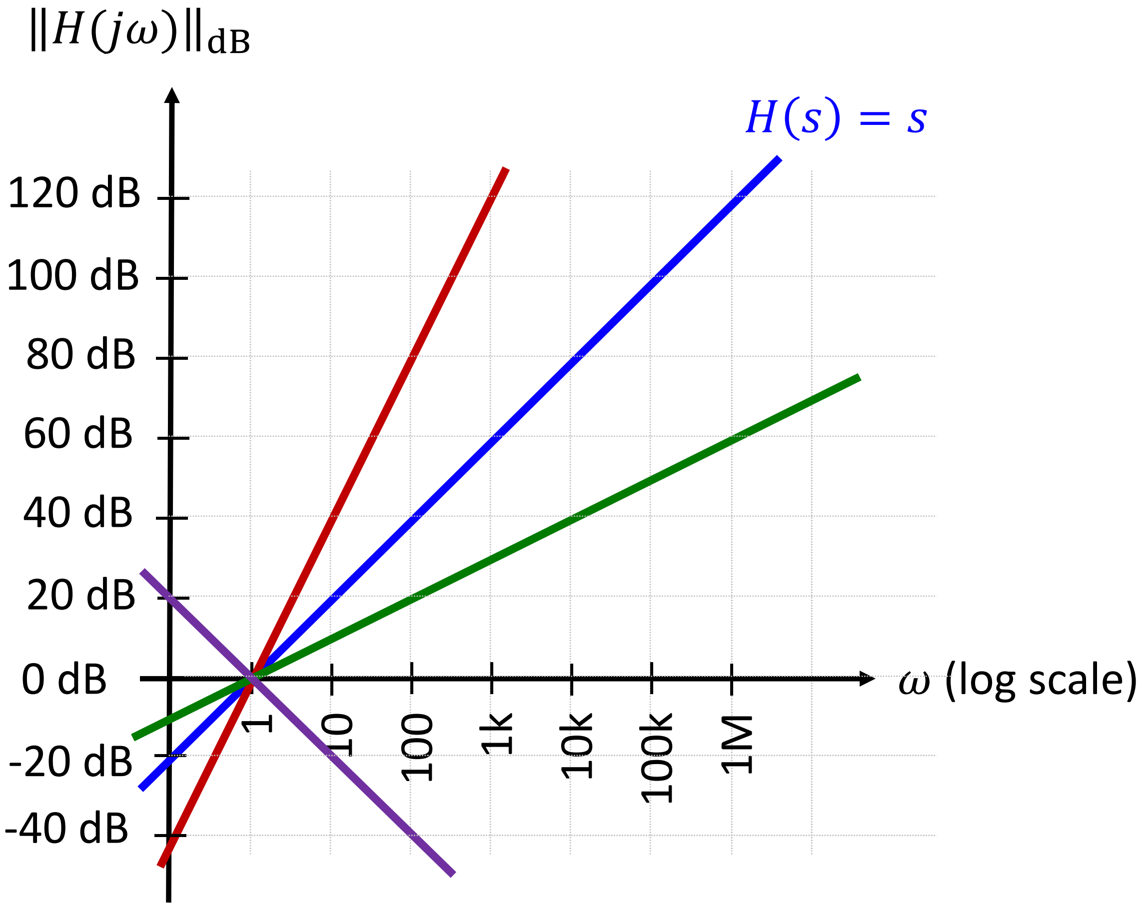
Actual magnitude	*Magnitude in dB*
1/2	– 6dB
1	0 dB
2	6 dB
5 = 10/2	20 dB – 6 dB = 14 dB
10	20dB
$1000 = 10^3$	$3 \cdot 20$dB = 60 dB

5Ω is equivalent to 14dB with respect to a base impedance of R_{base} = 1Ω, also known as 14dBΩ.

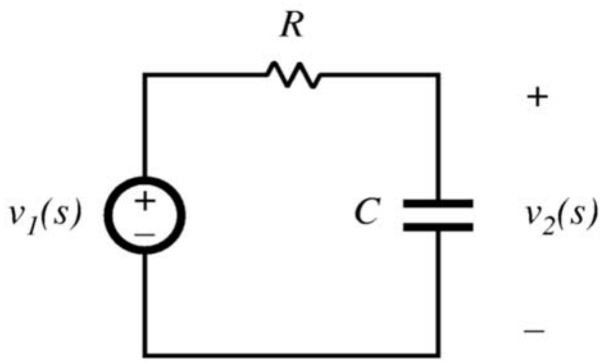
60dBμA is a current 60dB greater than a base current of 1μA, or 1mA.

Logarithm Review

Plotting on Logarithmic Axes



Single Pole Response



Magnitude of Single Pole Response

Asymptotic Behavior