Georgia Institute of Technology

Introduction to Electronics

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An introduction to electronic components and a study of circuits containing such devices.

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Review of Frequency Response Plots (Bode)

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Review of linear plots and Bode plots to show the frequency characteristics of signals and circuits

Previous Lesson

- Review of Transfer Functions

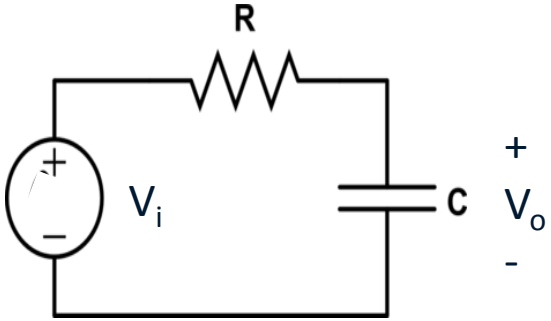
Lesson Objectives

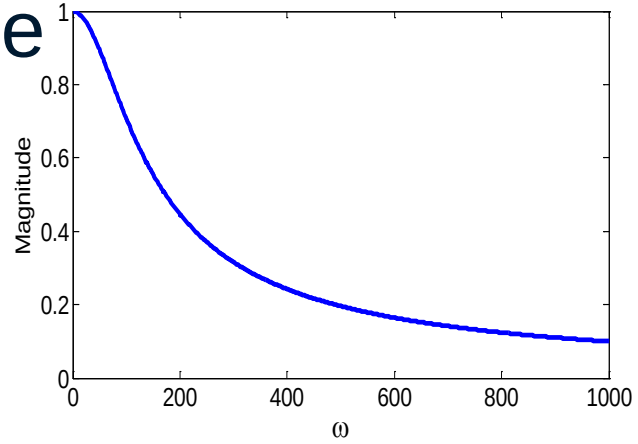
- Define the frequency response for a transfer function $H(\omega)$

  Magnitude Plot: $|H(\omega)|$ vs ω
  Angle Plot: $\angle H(\omega)$ vs ω

- Show linear plots and Bode plots

Frequency Response



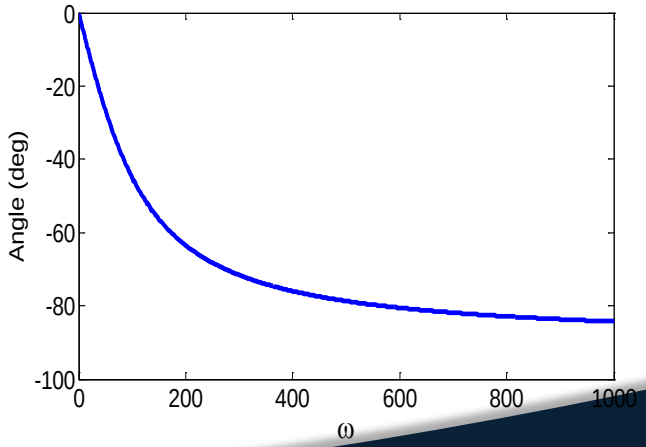


Transfer Function

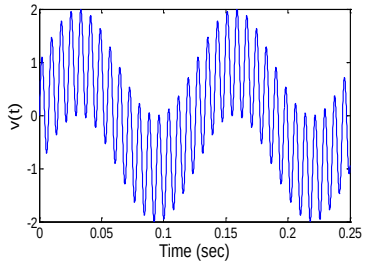
$$H(\omega) = \frac{1}{1 + RC\omega j}$$

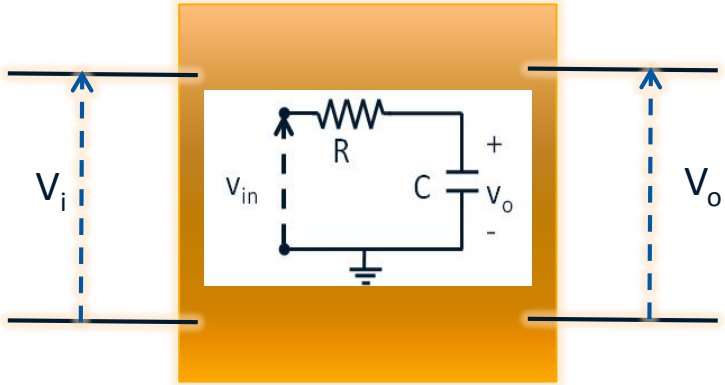
$$|H(\omega)| = \frac{1}{\sqrt{1 + (RC\omega)^2}}$$

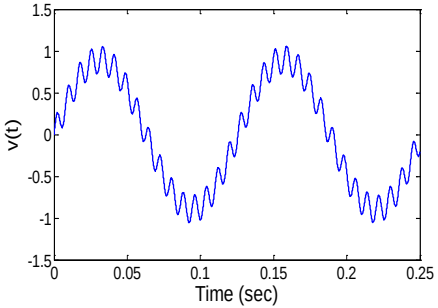
$$\angle H(\omega) = -\mathrm{atan}(RC\omega)$$



Circuit Response

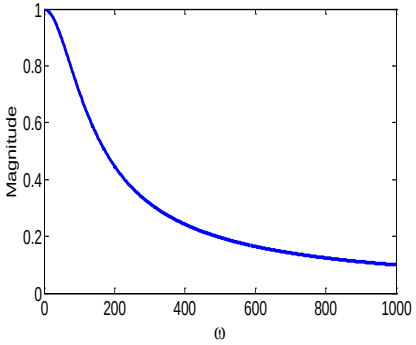


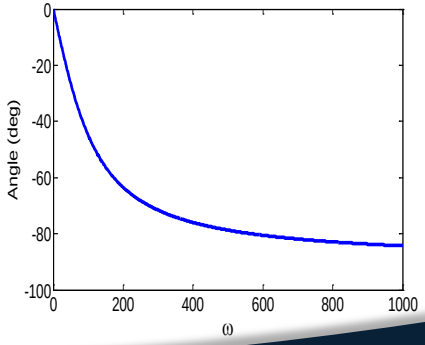




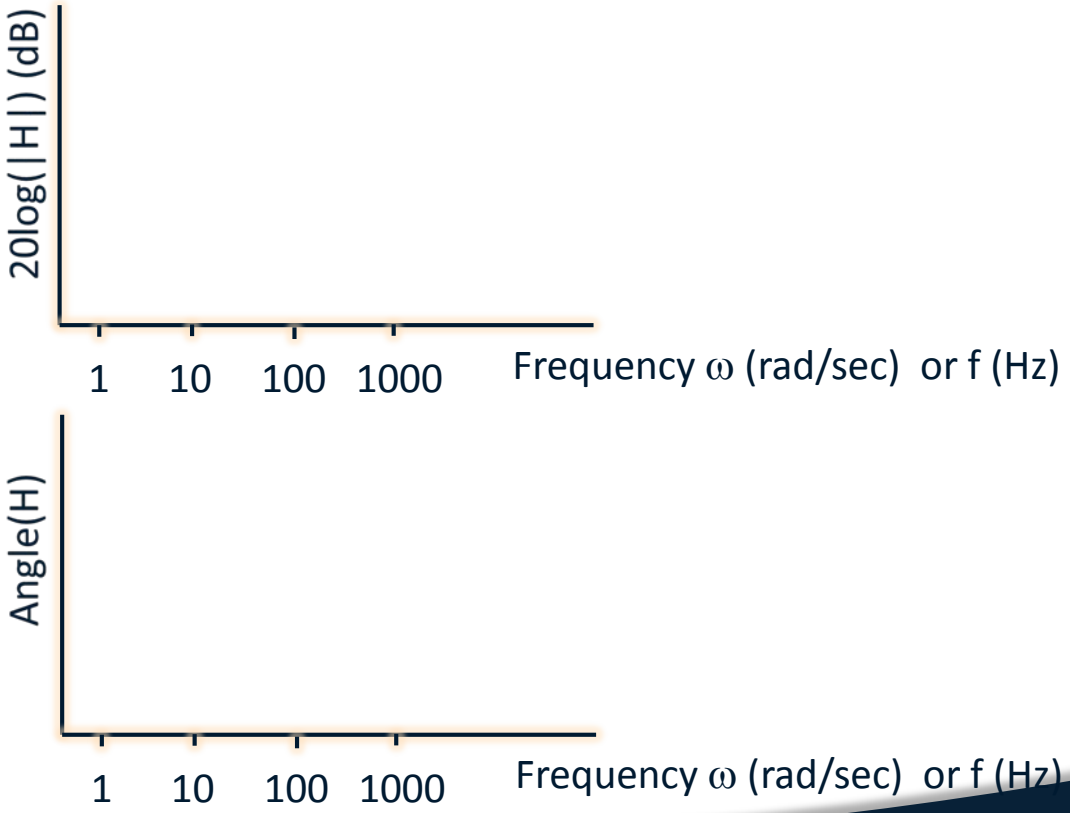
$V_i = \cos(50t) + \cos(800t)$

$V_o = 0.95\cos(50t-20^o) + 0.13\cos(800t-85^o)$

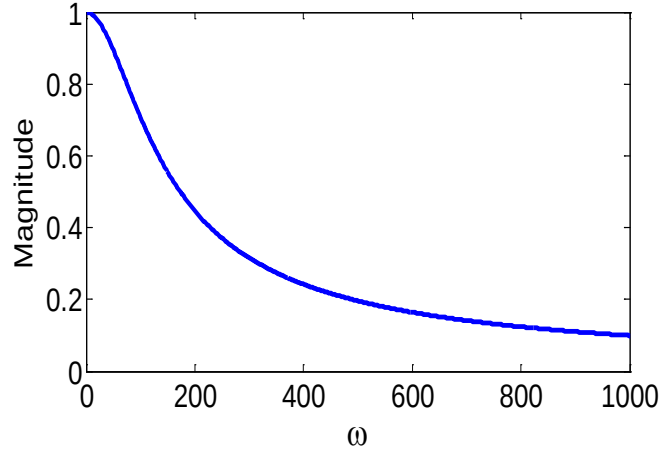


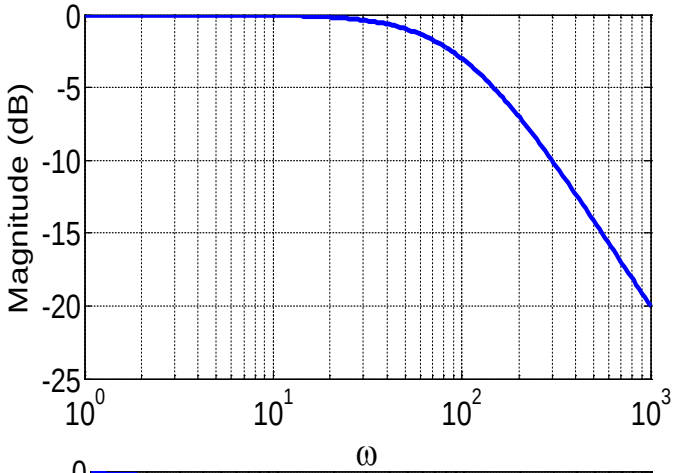


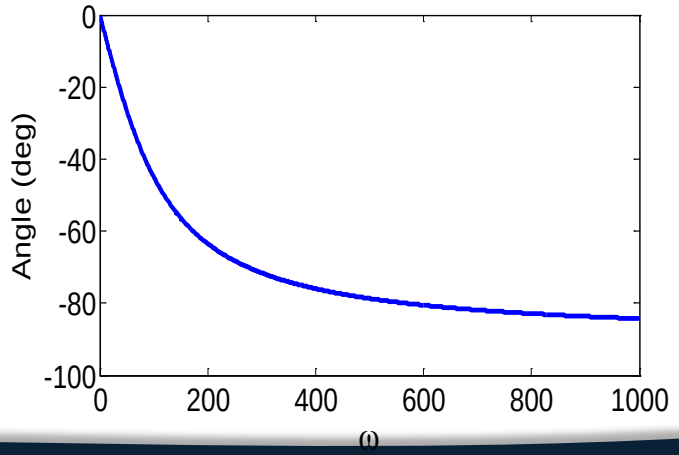
Bode Plots

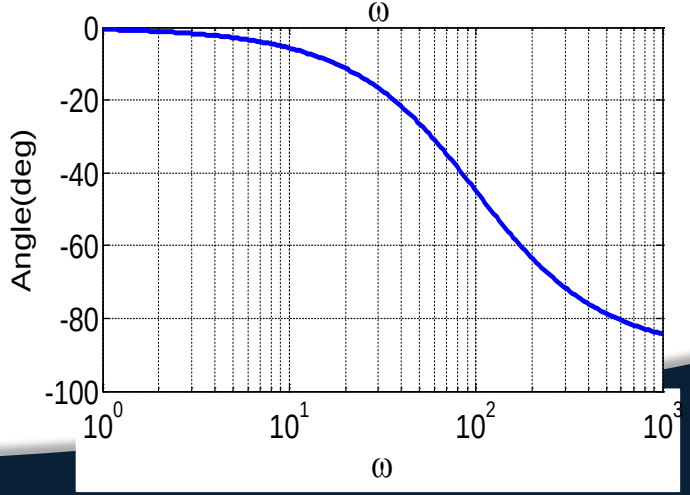

20log(|H|) (dB)
1
10
100
1000
Frequency ω (rad/sec) or f (Hz)
Angle(H)
1
10
100
1000
Frequency ω (rad/sec) or f (Hz)

Linear Plot and Bode Plot

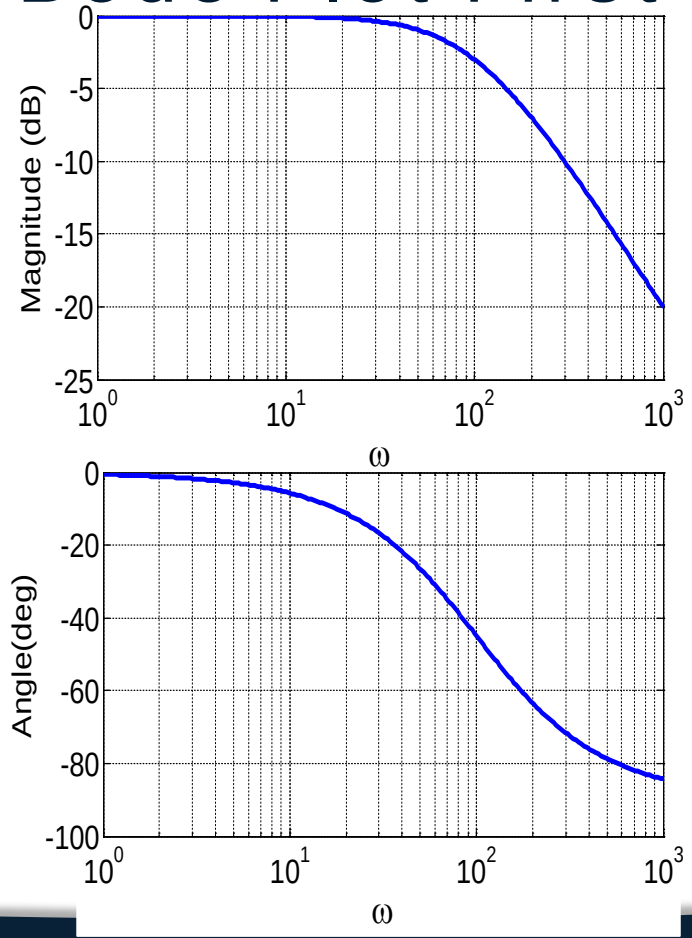








Bode Plot First-Order Characteristics

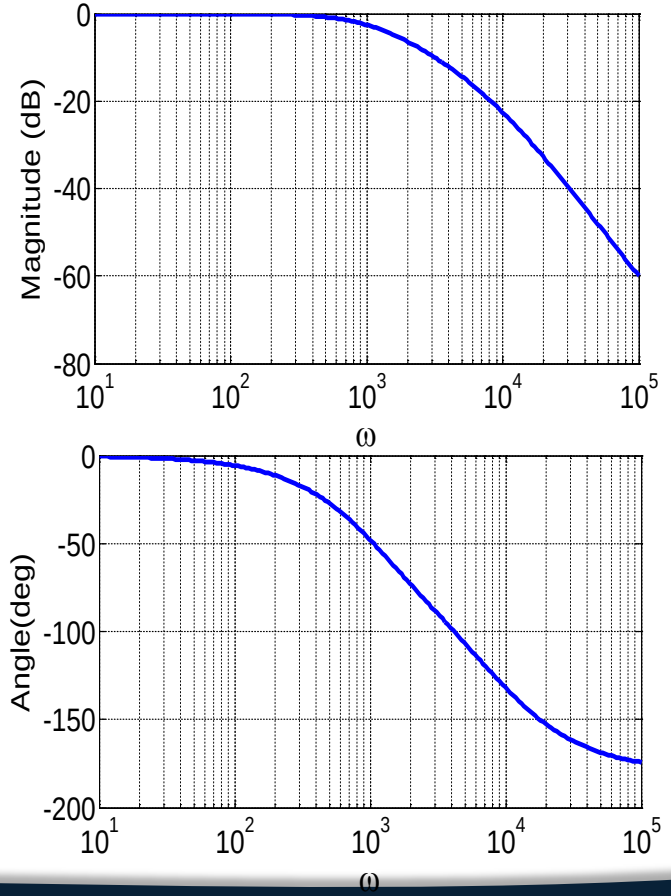


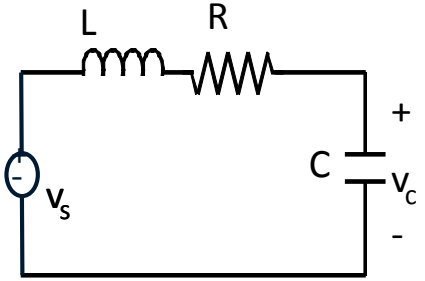
$$H(\omega) = \frac{1}{1 + j\omega RC}$$

$$\left|H(\omega)\right| = \frac{1}{\sqrt{1 + (\omega RC)^2}}$$

$$\angle H(\omega) = -a\tan(\omega RC)$$

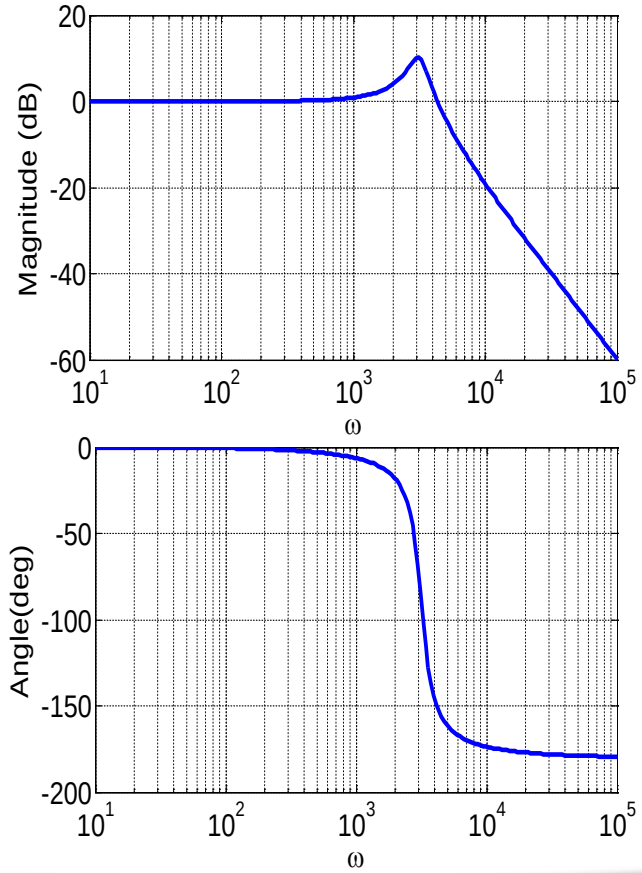
Bode Plot of RLC Circuit, Overdamped





$$H(\omega) = \frac{1}{(1 - LC\omega^2) + RCj\omega}$$

Bode Plot of RLC Circuit, Underdamped



Summary

- A **frequency response** is a plot of the transfer function versus frequency
- The frequency response can be used to determine the steady-state sinusoidal response of a circuit at different frequencies