Announcements

• HW10 posted, includes Quiz problem
  – Bode plots should be created by hand unless otherwise stated
• Experiment 2 discussion
• TNvoice evaluations
  – 5 points EC on final if we get 100% participation

Resonance
Filtering

Scaling and Bandwidth

Scaling (Impedances)

- Frequency scaling: $f \rightarrow kf$
- Magnitude scaling: $Z \rightarrow kZ$

Bandwidth = width of a frequency range

-$3\times$B bandwidth

\[ BW = \frac{\omega_0}{Q} \rightarrow \text{Higher } Q = \text{smaller bandwidth} \]

"Frequency selective"
The Sallen-Key Amplifier

2nd order LPF

2nd order HPF

\[ \frac{V_o}{V_i} = \frac{G}{R_A + R_B} \]

\[ s^2 + \frac{1}{R_1 C_1} + \frac{1}{R_2 C_1} + \frac{1}{R_2 C_2} + \frac{1}{R_1 R_2 C_1 C_2} \]

2nd order

Canonical 2nd Order Filter Designs

Butterworth

\[ |H(j\omega)| = \frac{K}{\sqrt{1 + (\omega/\omega_c)^{2n}}} \quad n = 1, 2, 3, \ldots \]

Chebyshev

\[ |H(j\omega)| = \frac{K}{\sqrt{1 + \beta^2 C_n^2 (\omega/\omega_c)}} \quad n = 1, 2, 3, \ldots \]

Matlab: butter()

Cheby(): cheby()