DSP HW 3

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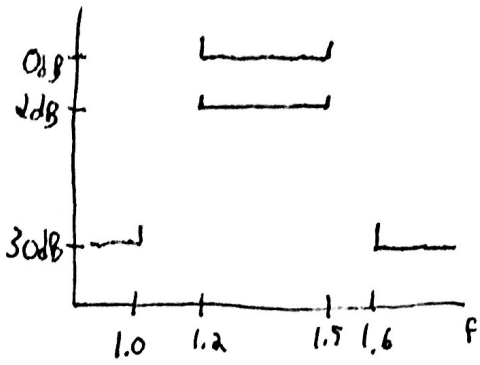
1a)



$B = \omega_{Hi} - \omega_{Lo} = 1.5MHz - 1.2MHz = .3MHz$

$= 300KHz$

$= 6\pi \cdot 10^5 \frac{rad}{s}$

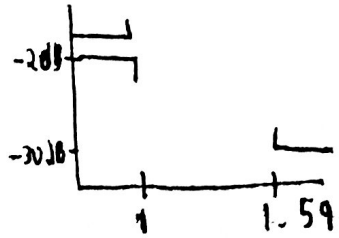
$\omega_0 = \sqrt{\omega_{Hi} \cdot \omega_{Lo}} = \sqrt{(1.5)(1.2)} = \sqrt{1.8} = 1.34MHz$

$= 2.68\pi \cdot 10^6 \frac{rad}{s}$

1) $\omega_p = \left| \frac{\omega_{BP}^2 - \omega_0^2}{B \cdot \omega_{BP}} \right| = \left| \frac{(1.6MHz)^2 - (1.34MHz)^2}{(.3MHz)(1.6MHz)} \right| = 1.59$

2) $\omega_p = \left| \frac{1^2 - 1.34^2}{(.3)(1)} \right| = 2.65$

Use the lower frequency



1b) Butterworth

$$n \geq .5 \frac{\log_{10}(\delta(r_s)/\delta(r_p))}{\log_{10}(\omega_s/\omega_p)}$$

$r_p = 2dB$
$r_s = 30dB$
$\omega_p = 1.59$
$\omega_s = 1$

$$\geq .5 \frac{\log_{10}((10^{30/10}-1)/(10^{2/10}-1))}{\log_{10}(1/1.59)}$$

$$\geq 6.87$$

$$n = 7$$

1c) Chebyshev

$$n \geq \frac{\cosh^{-1}\left(\sqrt{\delta(r_s)/\delta(r_p)}\right)}{\cosh^{-1}(w_s/w_p)}$$

$r_s = 30$
$r_p = 2$
$w_s = 1$
$w_p = 1.59$

$$n \geq \frac{\cosh^{-1}\left(\sqrt{(10^{30/10}-1)/(10^{2/10}-1)}\right)}{\cosh^{-1}(1/1.59)}$$

$n \geq 4.9567$

$n = 5$

Butterworth = 14

Chebyshev = 10