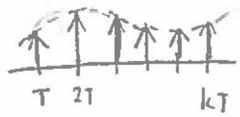
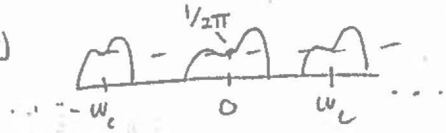
Kyle Flores

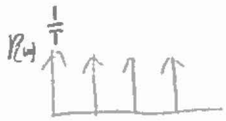
1] a]



c]

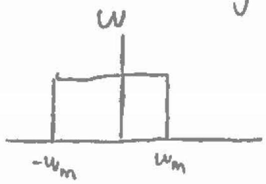


b]



d] T_s corresponds to a frequency at least $2 \cdot w_m$.

e] Convolve $x_p(t)$ against



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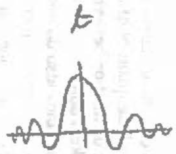
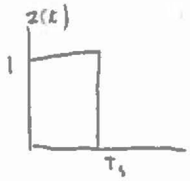


f]

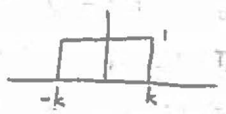


g]

h. $X_z(w) = X_p(w) \cdot Z(w)$

find $Z(w)$.

know that ~~coefficients~~ transform of



will be $\frac{2}{w} \sin\left(\frac{T_s}{2} \cdot w\right)$

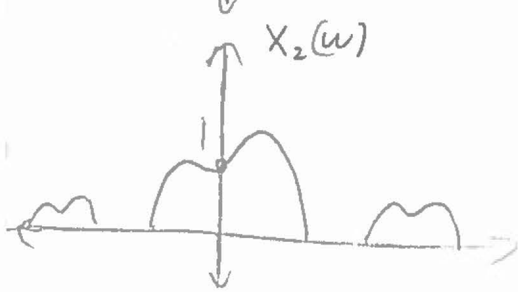
$$X(w) = \int_{-\frac{T}{2}}^{\frac{T}{2}} \overset{1}{\cancel{x(t)}}\, e^{-jwt}\,dt$$

$$X(w) = \frac{-1}{wj} e^{-jwt}\Big|_{-\frac{T}{2}}^{\frac{T}{2}}$$

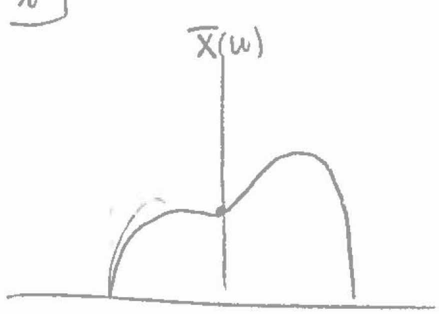
$$= \frac{-1}{wj}\left(e^{-jw\frac{T}{2}} - e^{jw\frac{T}{2}}\right)$$

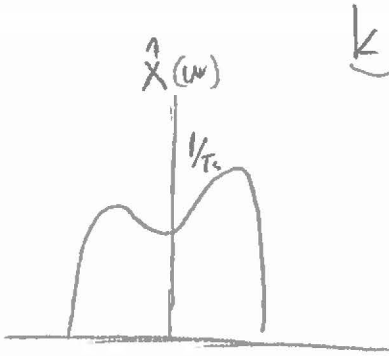
$$\frac{2}{w} \sin\left(\frac{T_s}{2} \cdot w\right)$$

↓



i]





j] $\bar{X}$'s frequencies decay according to the sinc-like shape as $|w|$ increases. $\hat{X}$ does not. $\hat{X}$ has more high freq content.

k] $\hat{X} = \overbrace{\frac{1}{2\pi} X(w)}^{x_p} \cdot H(w)$

$\bar{X} = \frac{2}{w}\sin\left(\frac{T_s}{2} w\right) \cdot X_p(w) \cdot H(w)$

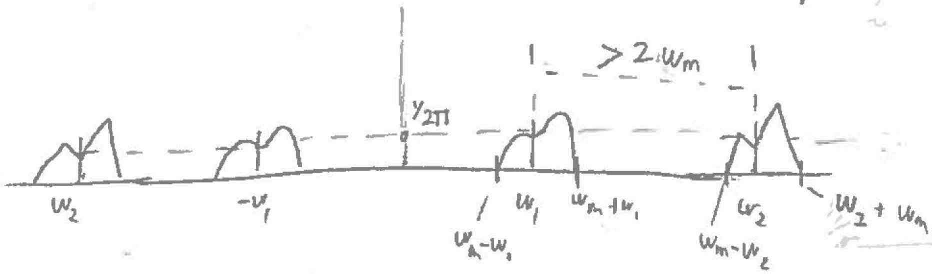
ratio is $\frac{2}{w} \sin\left(\frac{T_s}{2} w\right)$

$w = \frac{\pi}{T_s}$

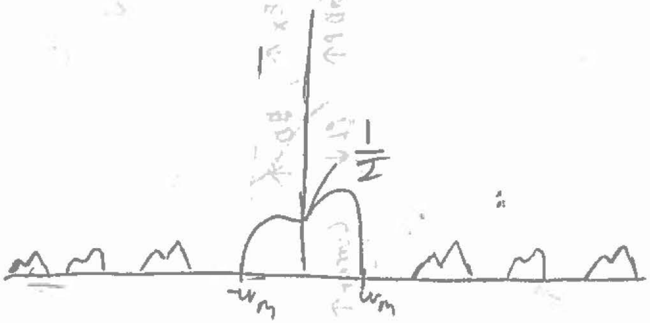
$= \frac{T_s}{2\pi}$

2. $y(t) = x_1(t)\cos(w_1 t) + x_2(t)\cos(w_2 t))$

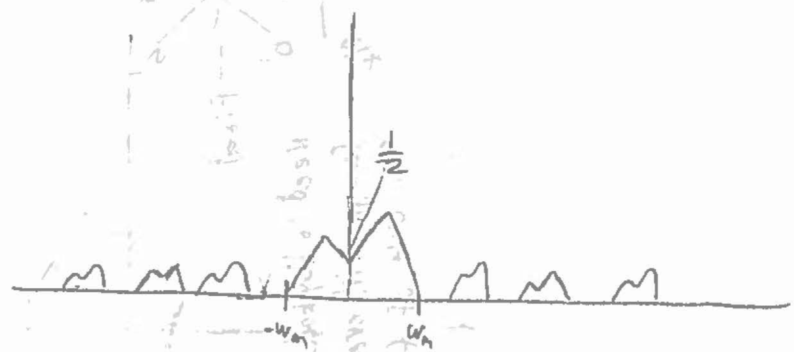
a) $Y(w) = \frac{1}{2\pi}\left(X_1(w) * \cos(w_1 t) + X_2(w) * \cos(w_2 t)\right)$



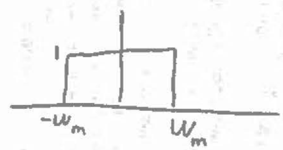
b) $y(t)\cos(w_1 t)$



$y(t)\cos(w_2 t)$



c) To recover the original signal within a scalar multiple, after receiving $X_k(t)$, modulate $x_k(t)$ by w_k to return X_k to be within the band $-w_c < w < w_c$. Then, filter the spectra in b) with



to remove all the copies of smaller spectra illustrated in b)

3) a) $V_{in}(t) = V_R + V_c + V_L$

$V_{in}(t) = RC\frac{dV_{out}}{dt} + CL\frac{d^2V_{out}}{dt^2} + V_{out}$

b) $V_{in}(\omega) = RCj\omega V_{out}(\omega) + CL\cancel{j}^{-1}\omega^2 V_{out}(\omega) + V_{out}(\omega)$

$V_{in}(\omega) = V_{out}(\omega)\left[j\omega RC - \omega^2 CL + 1\right]$

$\frac{V_{out}(\omega)}{V_{in}(\omega)} = \frac{1}{j\omega RC - \omega^2 CL + 1} = H(\omega)$

c) $H(\omega) = \frac{1}{|j\omega RC - \omega^2 CL + 1|} = \frac{1}{|(1-\omega^2 CL) + \omega RC j|}$

$= \frac{1}{\sqrt{1 - 2\omega^2 CL + \omega^4 C^2 L^2 + \omega^2 R^2 C^2}}$

d) $H(\omega) = \left(1 - 2\omega^2 CL + \omega^4 C^2 L^2 + \omega^2 R^2 C^2\right)^{-\frac{1}{2}}$

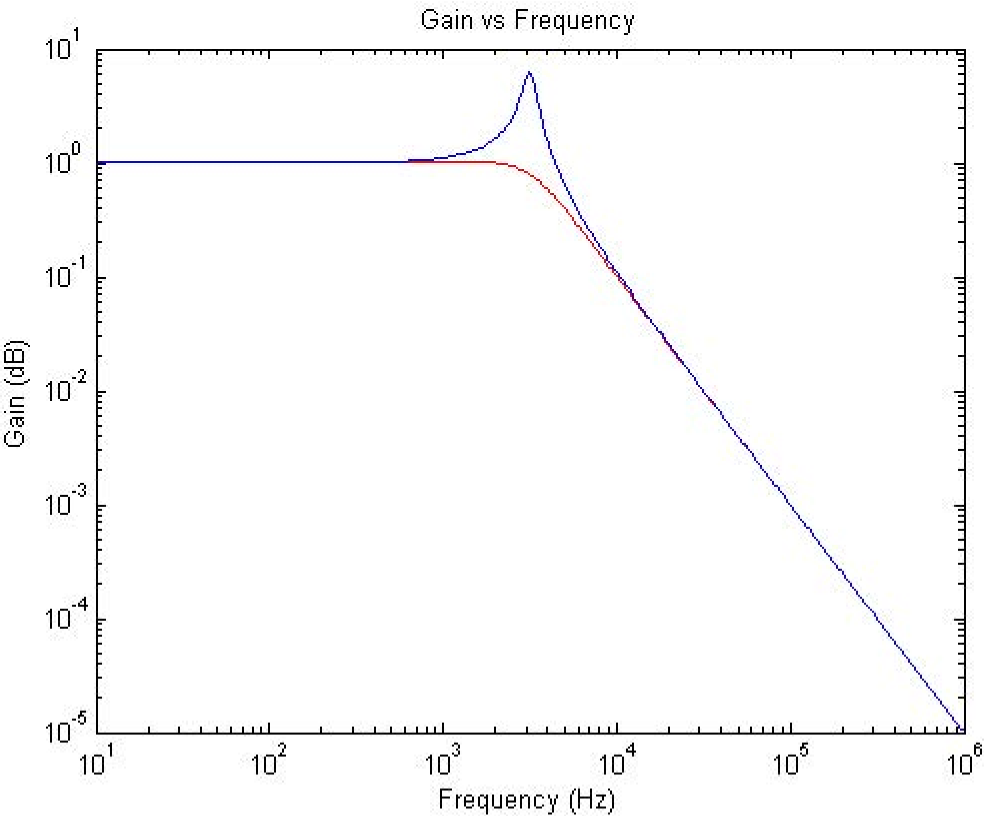
$\frac{dH(\omega)}{d\omega} = \left(\frac{1}{(1 - 2\omega^2 CL + \omega^4 C^2 L^2 + \omega^2 R^2 C^2)^{\frac{3}{2}}}\right) \cdot \left(-4CL\omega + 4C^2L^2\omega^3 + 2R^2C^2\omega\right)$

$0 = -4CL + 4C^2L^2\omega^2 + 2R^2C^2$

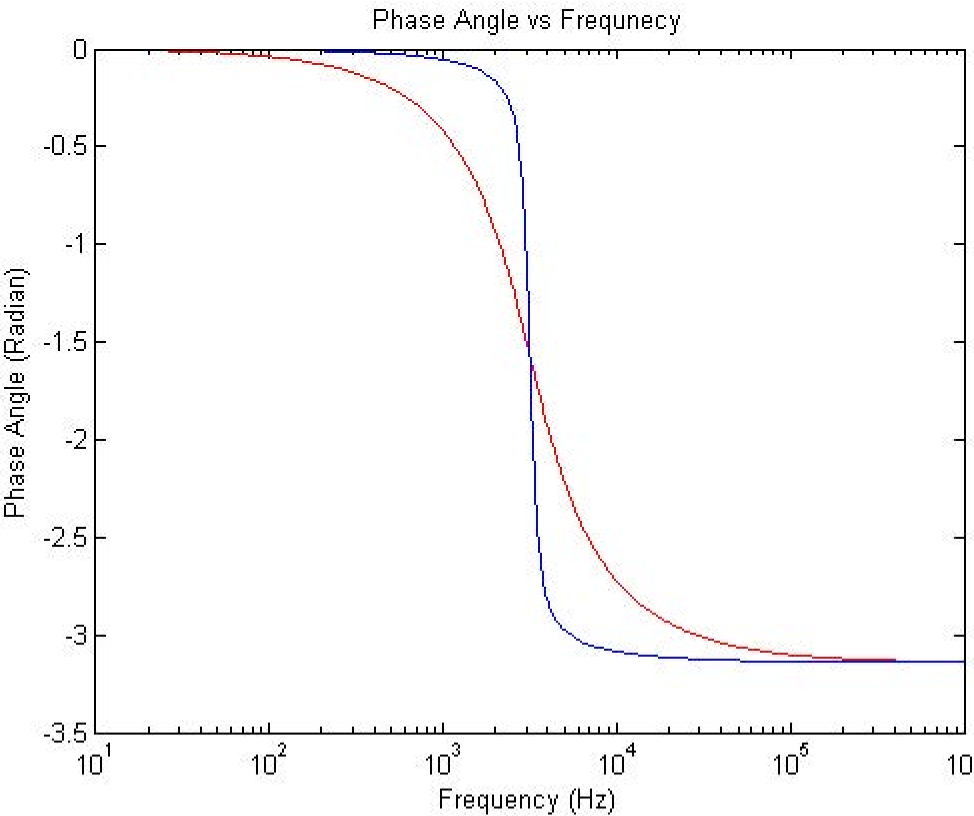
$0 = -2CL + 2C^2L^2\omega^2 + R^2C^2$

$\sqrt{\frac{2CL - R^2C^2}{2C^2L^2}} = \omega$

$\sqrt{\frac{1}{CL} - \frac{R^2}{2L^2}} = \omega$



Gain vs Frequency
Gain (dB)
Frequency (Hz)
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
10^1
10^2
10^3
10^4
10^5
10^6


Phase Angle vs Frequnecy
Phase Angle (Radian)
Frequency (Hz)
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
10^1
10^2
10^3
10^4
10^5
10^6