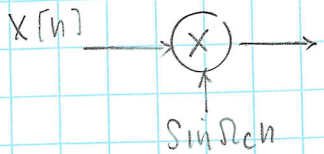
6.02 Recitation R17 (10, 11 am) 11/08/12

- mistake from last recitation on Quadrature Demodulation

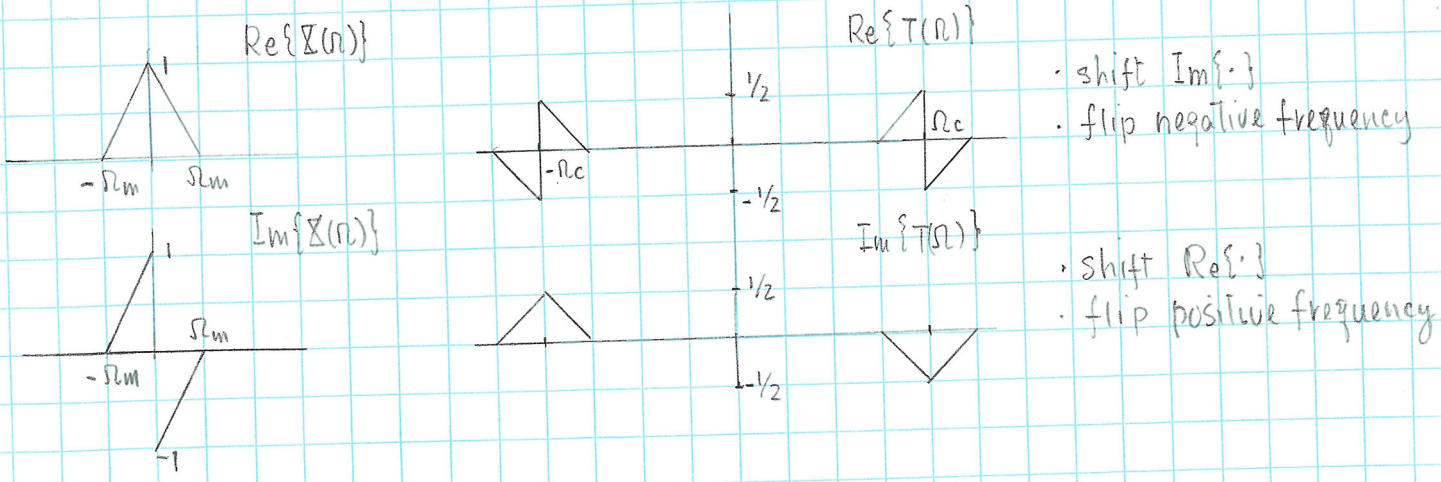
  let $W[n] = I[n] + Q[n]$ should be $W[n] = I[n] + jQ[n]$

  it has been corrected in the online posting

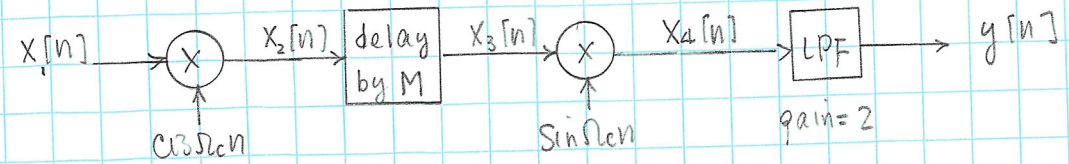
- recall from last time:



$$T(\Omega) = \frac{1}{2}\left(Im\{X(\Omega-\Omega_c)\} - Im\{X(\Omega+\Omega_c)\}\right) + j\cdot\frac{1}{2}\left(Re\{X(\Omega+\Omega_c)\} - Re\{X(\Omega-\Omega_c)\}\right)$$



[Example]: Working out some details about channel delay



$$X_2(\Omega) = \frac{1}{2}\{X_1(\Omega+\Omega_c) + X_1(\Omega-\Omega_c)\}$$

$$X_3(\Omega) = e^{-j\Omega M} X_2(\Omega) = \frac{1}{2} e^{-j\Omega M}\{X_1(\Omega+\Omega_c) + X_1(\Omega-\Omega_c)\}$$

$$x[n] \leftrightarrow X(\Omega) \Rightarrow x[n-n_0] \leftrightarrow e^{-j\Omega n_0} X(\Omega)$$

$$X_4(\Omega) = \frac{1}{2j}\{X_3(\Omega-\Omega_c) - X_3(\Omega+\Omega_c)\}$$

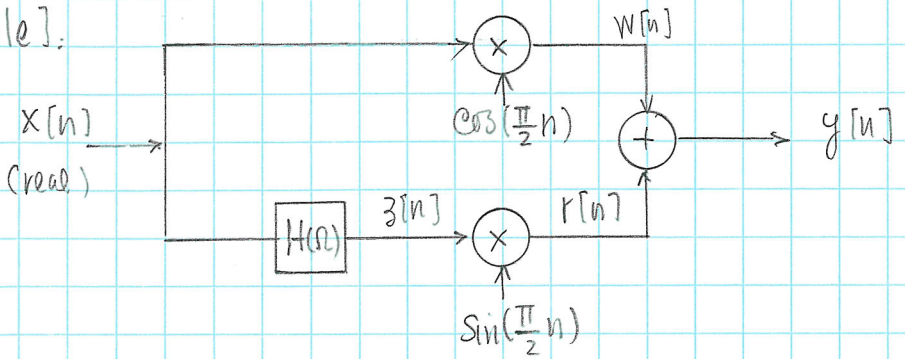
$$= \frac{1}{2j}\cdot\frac{1}{2}\left\{e^{-j(\Omega-\Omega_c)M}[X_1(\Omega)+X_1(\Omega-2\Omega_c)] - e^{-j(\Omega+\Omega_c)M}[X_1(\Omega+2\Omega_c)+X_1(\Omega)]\right\}$$

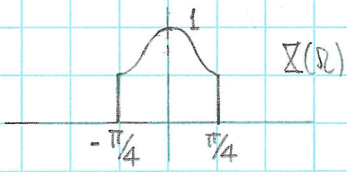
$$= \frac{1}{2}\cdot e^{-j\Omega M}\cdot\underbrace{\frac{1}{2j}\left(e^{+j\Omega_c M} - e^{-j\Omega_c M}\right)}_{\sin\Omega_c M} X_1(\Omega) + (\text{high freq. Terms})$$

$$\Rightarrow \quad Y(\Omega) = e^{-j\Omega M} X_1(\Omega)\sin\Omega_c M$$

$$y[n] = x[n-M]\sin\Omega_c M \qquad \text{(lower branch of Quadrature Demodulation}$$

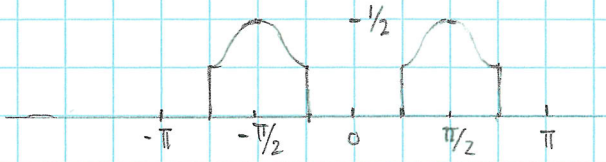
[Example].



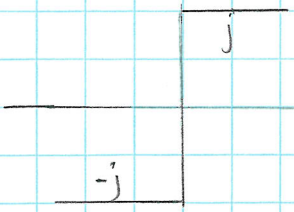


$X(\Omega)$ real. even

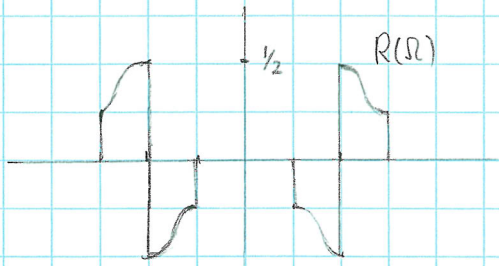
$W(\Omega)$



$H(\Omega)$ (90° phase shifter)



$$H(\Omega) = \begin{cases} j & \Omega > 0 \\ -j & \Omega < 0 \end{cases}$$



$$Z(\Omega) = \begin{cases} j\,\mathrm{Re}\{X(\Omega)\} & \Omega > 0 \\ -j\,\mathrm{Re}\{X(\Omega)\} & \Omega < 0 \end{cases}$$

$\mathrm{Im}\{Z(\Omega)\}$

$Y(\Omega)$

SSB Modulation

[Example] Image rejection mixer (Prob 14.5)