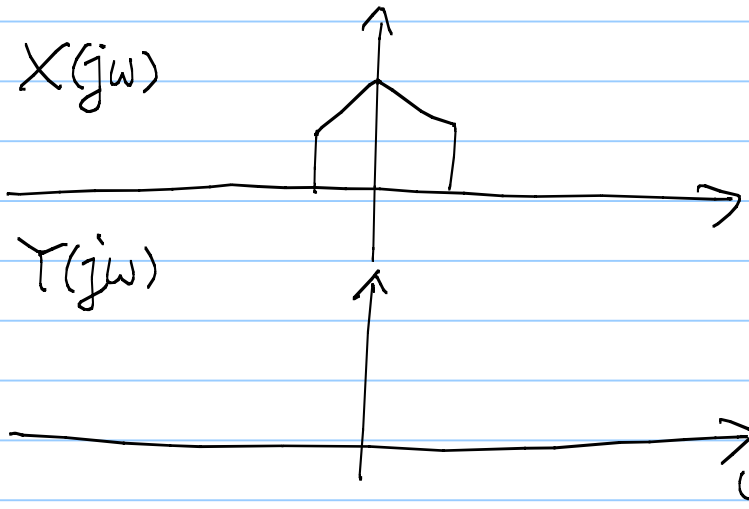
Sections 8.1 – 8.4 Amplitude Modulation

We will start from basic discussion of AM to some practical considerations

Amplitude Modulation (AM)

Type 1: $c(t) = e^{j\omega_c t}$

$Y(j\omega)$ is the shifted version of $X(j\omega)$



Note: any real-valued signal $x(t)$, its $X(j\omega)$ is always (conjugate) symmetric.

$Y(jw)$ is no longer symmetric

$\equiv$ $y(t)$ is no longer real

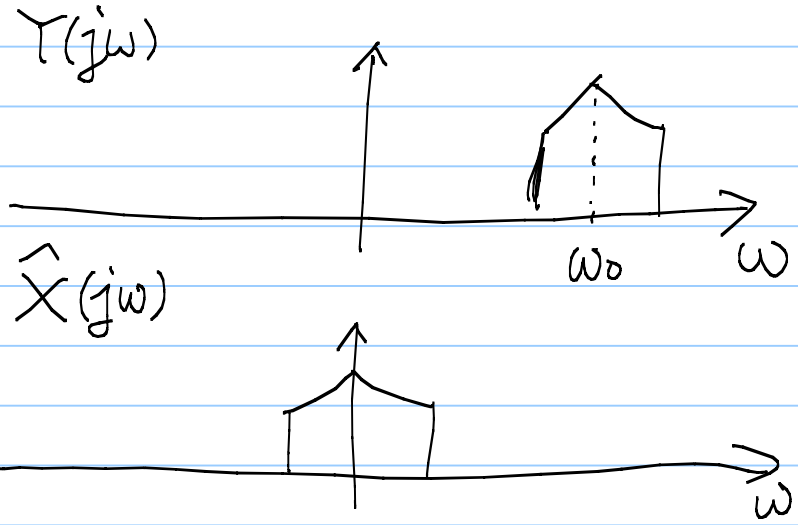
(since we multiply $x(t)$ by $e^{jw_c t}$)

Drawback: We cannot send imaginary-valued signals $y(t)$.

Demodulation $\hat{x}(t) = y(t)\, e^{-jw_c t}$

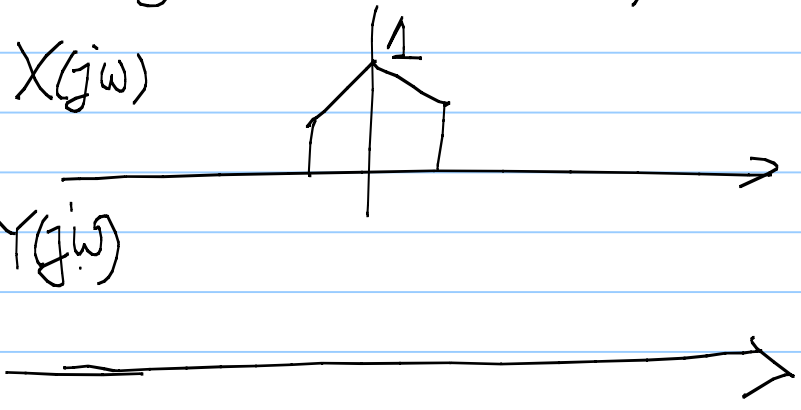
multiply $e^{-jw_c t}$ in time

$\equiv$ shift it back in freq



Type 2

$y(t) = x(t)\cos(w_c t)$

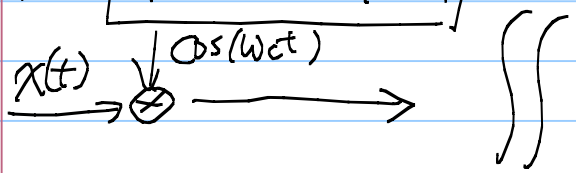


145 * How to demodulate (from $y(t)$ back to $x(t)$)?

Try 1:

Try 2

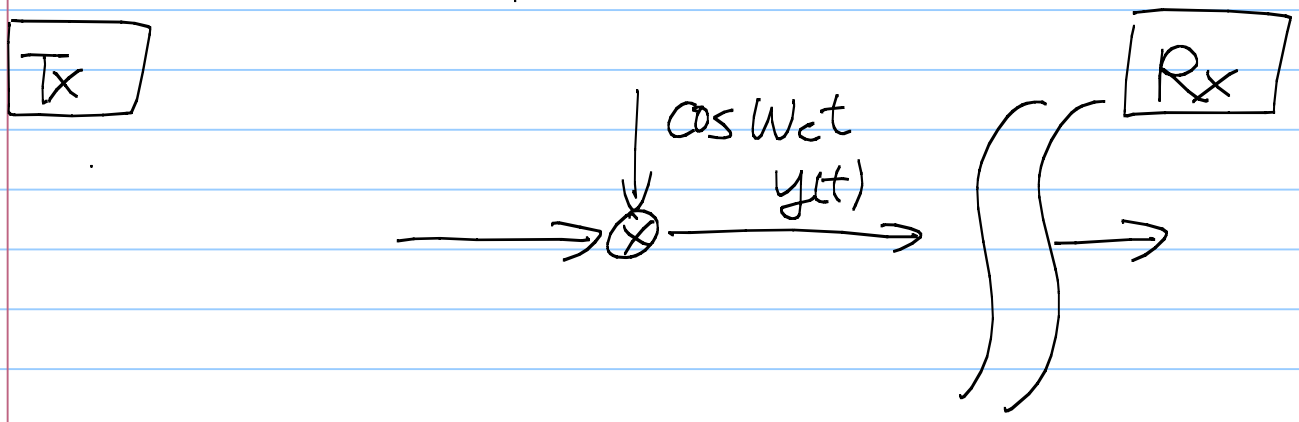
* **Demodulation**



Drawback: ① What if $X(jw) = e^{-|w|}$

We do not have identical copies any more due to the undesired "frequency overlap" after multiplying $\cos(w_c t)$. The original signal is unrecoverable even before demodulation

Solution to drawback #1:
Make the input $x(t)$ band-limited



Slightly worse quality since we lose some high-freq components. However, we avoid the undesired freq overlay in the "center" of the freq band.

We have three frequency parameters to choose in this AM system.

① W_M :

② ω_c :

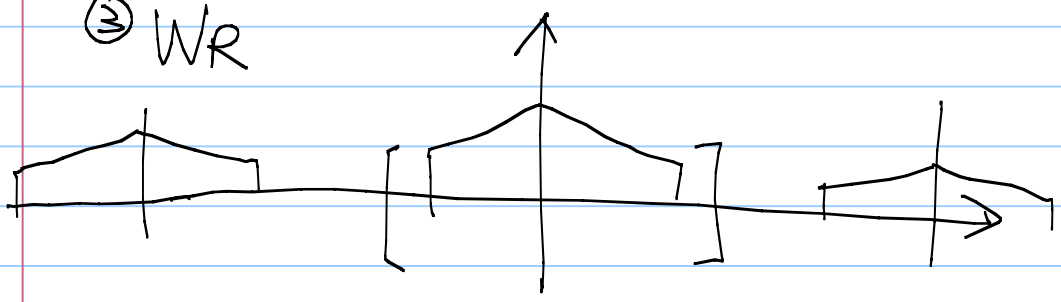
③ W_R :

How to choose them?

① W_C: Usually given by the government (FCC). Need to purchase "licence" to use certain frequency-band. Different frequency bands will have different price, depending on the transmission range, bandwidth, channel quality, etc.

② W_M: To avoid overlap in freq

③ W_R



W_R: Choose it to be equal to or sightly larger than W_M