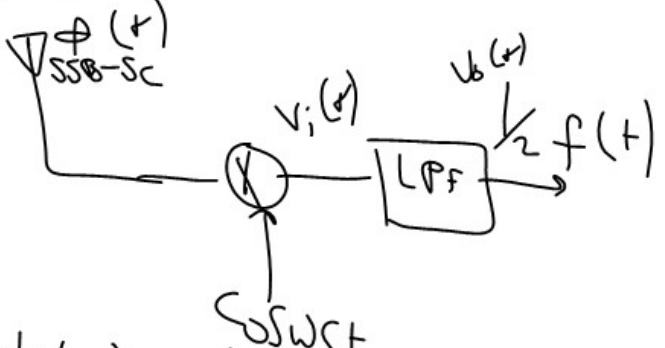
5.4.3 Demodulation of SSB signals

* SSB-SC signal can be demodulated by the synchronous detector as shown below

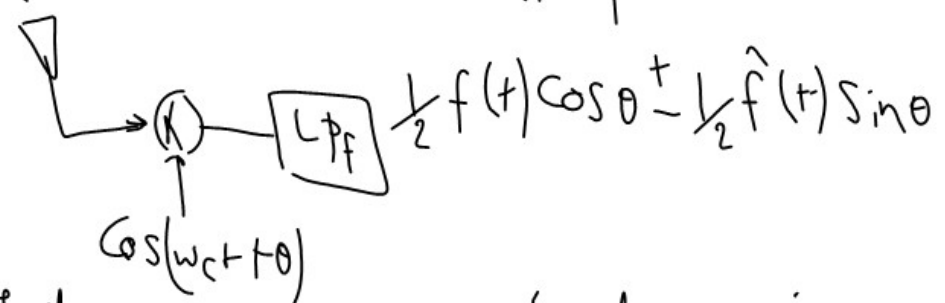


$$V_i(t) = \phi_{SSB-SC}(t)\cos\omega_c t$$
$$= \left[f(t)\cos\omega_c t \pm \hat{f}(t)\sin\omega_c t\right]\cos\omega_c t$$
$$= \frac{1}{2}f(t) + \frac{1}{2}f(t)\cos 2\omega_c t \pm \frac{1}{2}\hat{f}(t)\sin 2\omega_c t$$

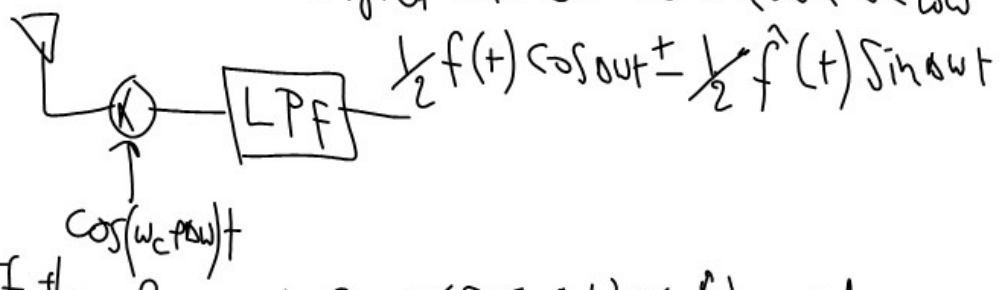
* The signal detected at the LPF is

$$V_o(t) = \frac{1}{2}f(t)$$

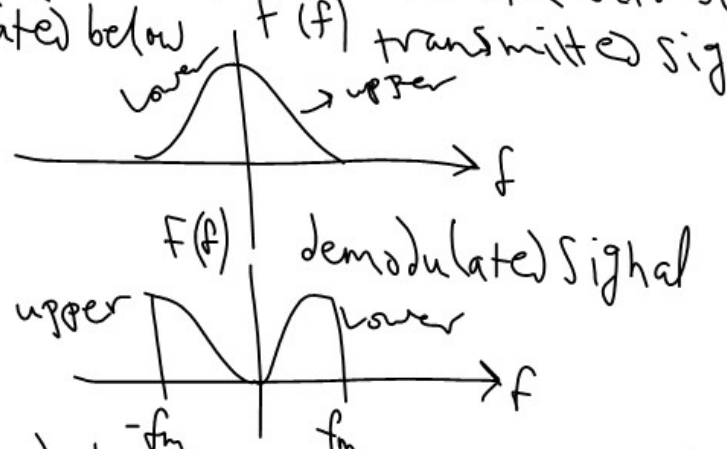
* If there is a phase between the carriers in the transmitter and the receiver, (i.e the receiver is as shown below)



* If there is a frequency in the receiver, then the demodulated signal will be as shown below



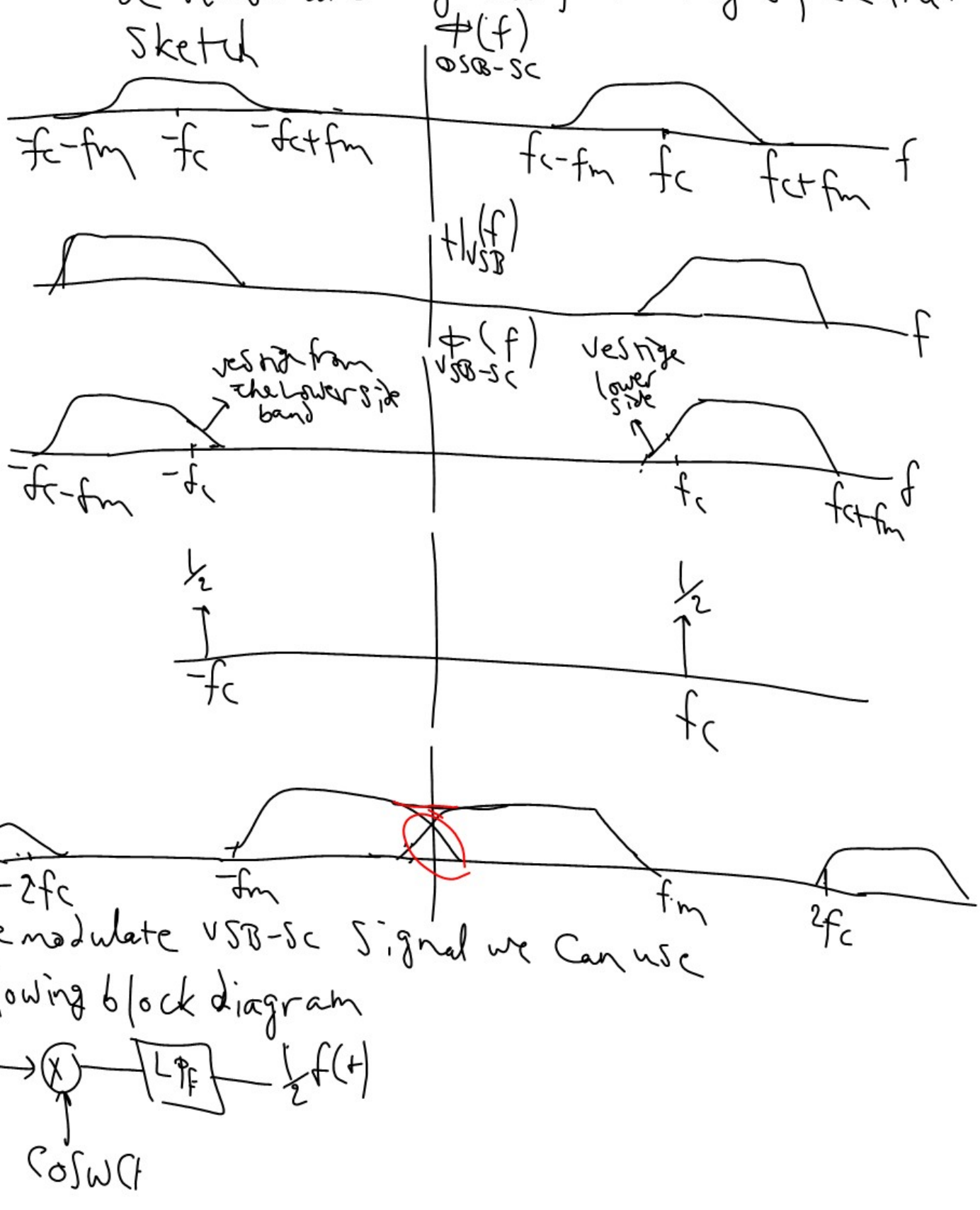
* If the frequency error $\Delta\omega \simeq \omega_m$, then an effect known as Scrambling will be noticed
* Scrambling means that the upper side band became lower and the lower side band became upper as illustrated below



* Single side band large carrier signal can be demodulated by using an envelope detector.

5.5 Vestigial side band modulation

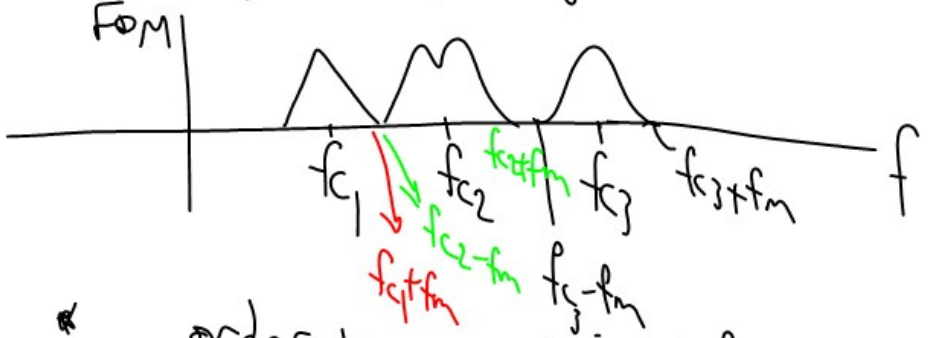
* Vestigial side band modulation is used when the bandwidth of the information signal $f(t)$ is very large and contains frequency down to zero as in vedio signals
* If the bandwidth is very large, then there is no practical circuit, that will give 90° phase shift over large frequency band
  ∴ Hilbert transform will not work
* If the signal contains frequency down to zero, then the side band filter will take the upper side band plus vestige from the lower side band
* This kind of modulation is called vestigial side band modulation
* vestigial side band modulation can be illustrated by the following spectrum sketch



* To demodulate VSB-SC signal we can use the following block diagram

5.3 Frequency division multiplexing

* In Frequency division multiplexing (FDM), the frequency axis is divided between different users (channels) so that all of them can transmitt at the same time
* The concept of FDM is best illustrated by the following diagram



* order to prevent interference between adjacent channels it is required that

$$f_{c_1}+f_m \geq f_{c_2}-f_m$$

$$f_{c_2}-f_{c_1} \geq 2f_m$$

* In comercial AM Stations, we have $f_m = 4kHz$, therefore

$$f_{c_2}-f_{c_1} \geq 8kHz$$

However the Fedral Communication Committy adds another 2kHz as a guard frequency,

$\therefore f_{c_2}-f_{c_1} = 10kHz$

* In commercial AM Station the frequency bands allocated are 540kHz–1600kHz, with a bandwidth for each channel

$$BW = 10kHz$$

* FDM can be implemented by using the following block diagram