PRINCIPLES OF COMMUNICATIONS

UNIT-3

LECTURE-2

Single Side Band (SSB) Modulation

- In DSB-SC it is observed that there is symmetry in the bandstructure. So, even if one half is transmitted, the other half can be recovered at the received. By doing so, the bandwidth and power of transmission is reduced by half.

  Depending on which half of DSB-SC signal is transmitted, there are two types of SSB modulation

  1. Lower Side Band (LSB) Modulation
  2. Upper Side Band (USB) Modulation

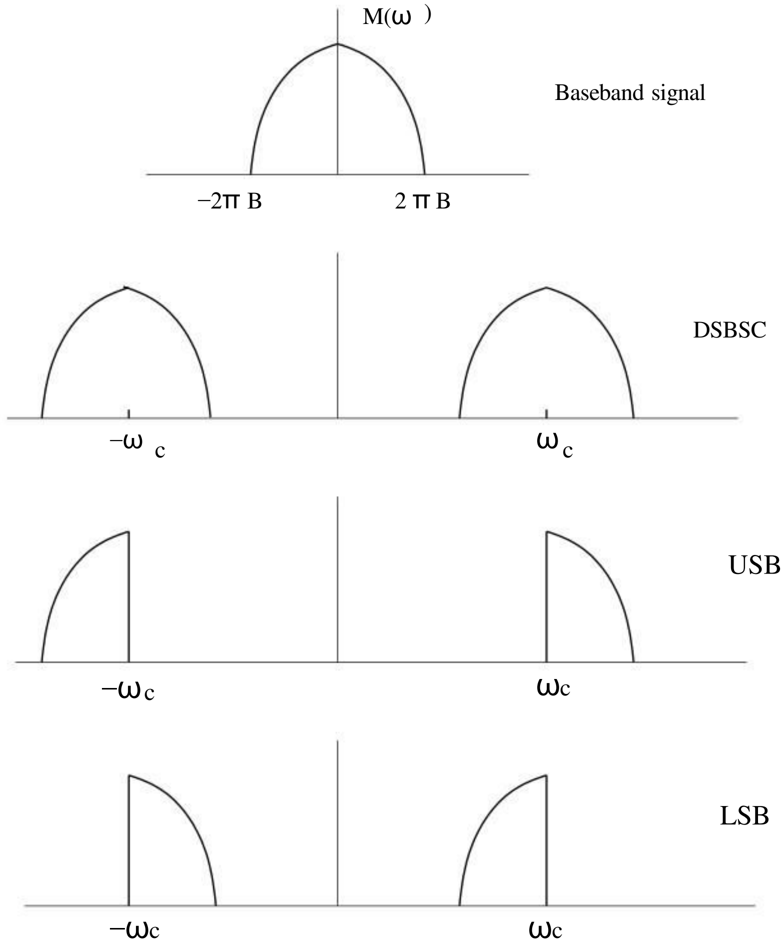

Figure 1: SSB signals from orignal signal

- Mathematical Analysis of SSB modulation

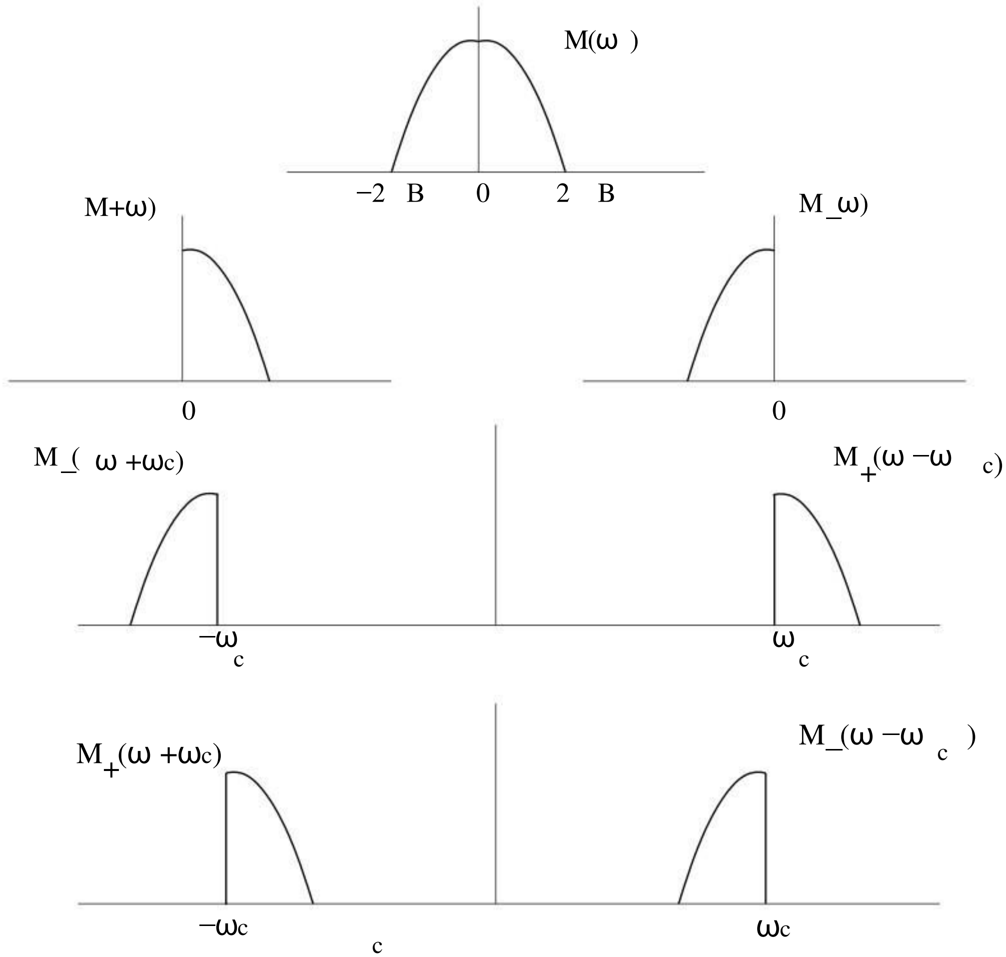

Figure 2: Frequency analysis of SSB signals

- From Figure 2 and the concept of the Hilbert Transform,

$$\begin{aligned}\Phi_{USB}(\omega) &= M_{+}(\omega - \omega_c) + M_{-}(\omega + \omega_c)\\ \phi_{USB}(t) &= m_{+}(t)e^{j\omega_c t} + m_{-}(t)e^{-j\omega_c t}\end{aligned}$$

But, from complex representation of signals,

$$\begin{aligned}m_{+}(t) &= m(t) + j\hat{m}(t)\\ m_{-}(t) &= m(t) - j\hat{m}(t)\end{aligned}$$

So,

$$\phi_{USB}(t) = m(t)\cos(\omega_c t) - \hat{m}(t)\sin(\omega_c t)$$

Similarly,

$$\phi_{LSB}(t) = m(t)\cos(\omega_c t) + \hat{m}(t)\sin(\omega_c t)$$

- Generation of SSB signals A SSB signal is represented by:

$$\phi_{SSB}(t) = m(t)\cos(\omega_c t) \pm \hat{m}(t)\sin(\omega_c t)$$