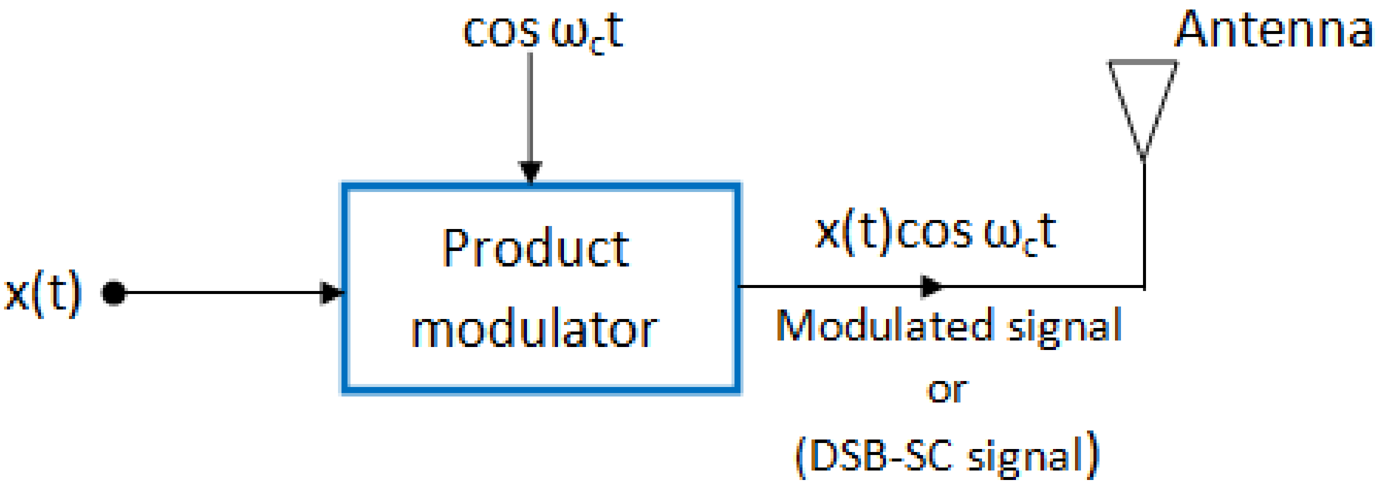
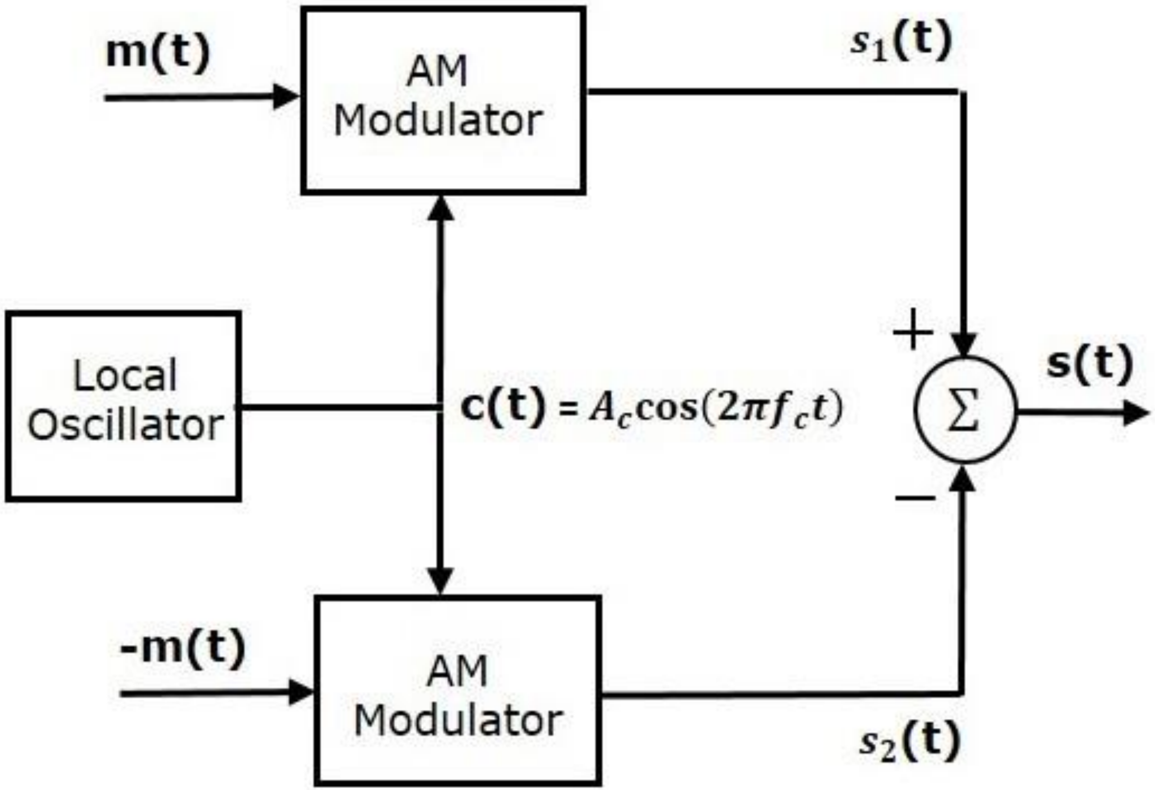
# SSB Generation

1. Frequency discrimination method
2. Phase discrimination method

# Block Diagram of DSB-SC



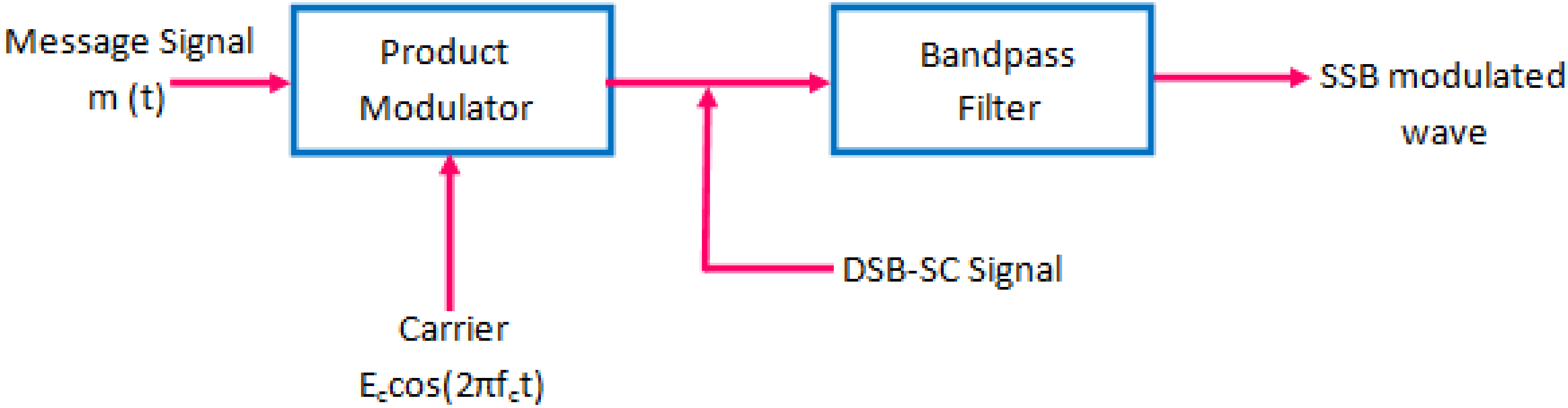
# Balanced Modulator



# SSB Generation

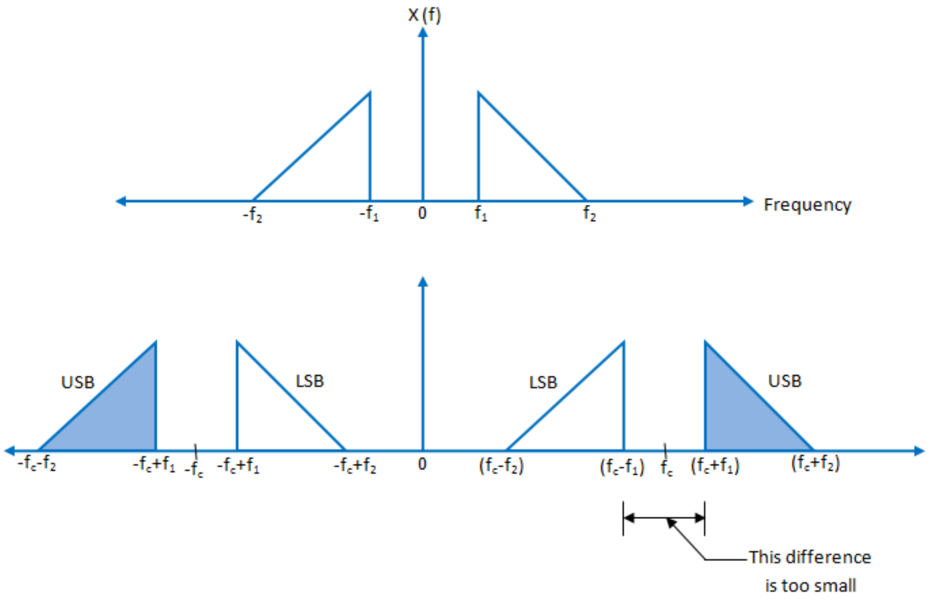
## Frequency Discrimination Method/Filter Method

## (By Adding Bandpass Filter at the output of DSB-SC generator)

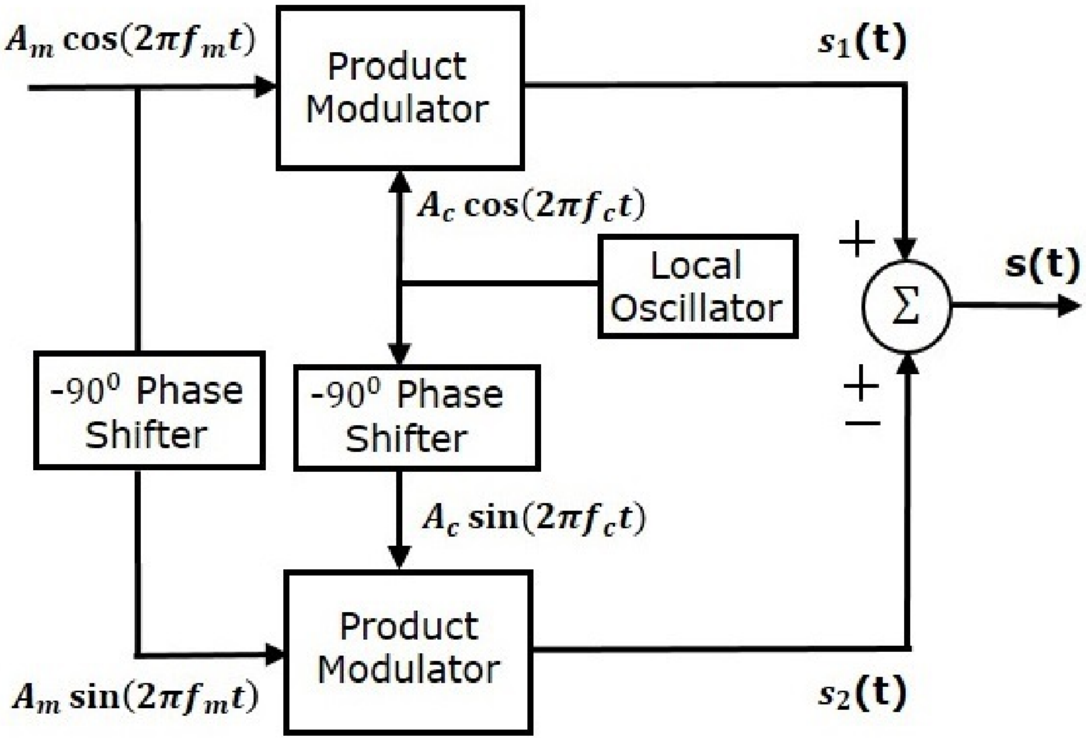


# Demerits - Filter Method (Freq Discrimination)

The design of the bandpass filter extremely difficult because its frequency response need to have very sharp change over from attenuation to pass band and vice versa.



# Phase Discrimination Method



# Phase Discrimination Method

The output of upper product modulator is

$$s_1(t) = A_m A_c \cos(2\pi f_m t)\cos(2\pi f_c t)$$

$$=> s_1(t) = \frac{A_m A_c}{2}\{\cos[2\pi(f_c + f_m)t] + \cos[2\pi(f_c - f_m)t]\}$$

The output of lower product modulator is

$$=> s_2(t) = A_m A_c \sin(2\pi f_m t)\sin(2\pi f_c t)$$

$$=> s_2(t) = \frac{A_m A_c}{2}\{\cos[2\pi(f_c - f_m)t] - \cos[2\pi(f_c + f_m)t]\}$$

Add $\boldsymbol{s_1(t)}$ and $\boldsymbol{s_2(t)}$ in order to get the SSBSC modulated wave $s(t)$ having a lower sideband.

$$\boldsymbol{s(t) = \frac{A_m A_c}{2}\{\cos[2\pi(f_c + f_m)t] + \cos[2\pi(f_c - f_m)t]\}}$$
$$\boldsymbol{+ \frac{A_m A_c}{2}\{\cos[2\pi(f_c - f_m)t] - \cos[2\pi(f_c + f_m)t]\}}$$

$$\boldsymbol{=> s(t) = A_m A_c\ \cos[2\pi(f_c - f_m)t]}$$

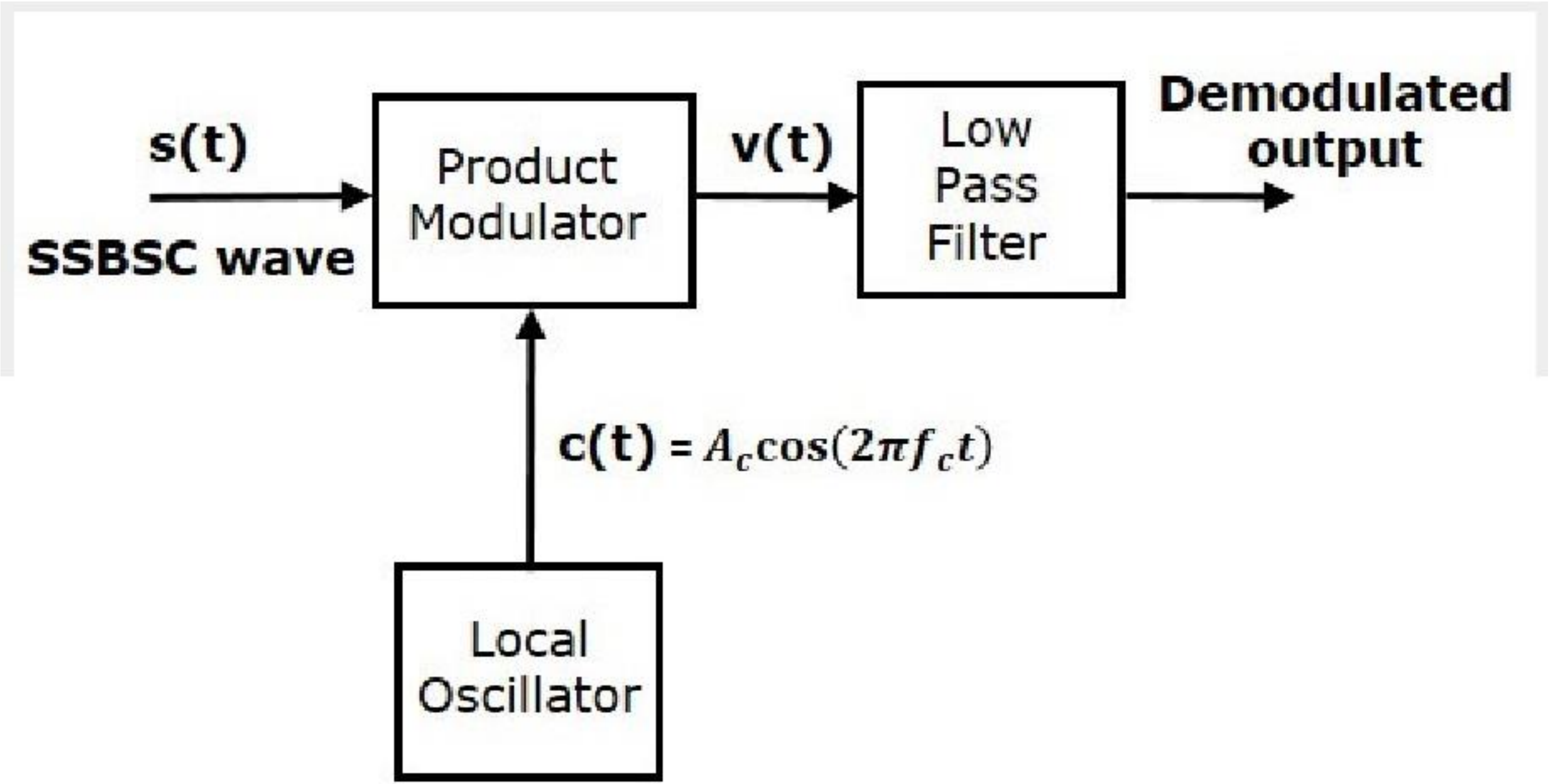
Subtract $\boldsymbol{s_2(t)}$ from $\boldsymbol{s_1(t)}$ in order to get the SSBSC modulated wave $\boldsymbol{s(t)}$ having a upper sideband.

$$\boldsymbol{s(t) = \frac{A_m A_c}{2}\{\cos[2\pi(f_c + f_m)t] + \cos[2\pi(f_c - f_m)t]\}}$$
$$\boldsymbol{- \frac{A_m A_c}{2}\{\cos[2\pi(f_c - f_m)t] - \cos[2\pi(f_c + f_m)t]\}}$$

$$\boldsymbol{=> s(t) = A_m A_c\ \cos[2\pi(f_c + f_m)t]}$$

# Detection of SSB Signals

# Coherent Detection



Consider the following **SSBSC** wave having a **lower sideband**.

$$s\left(t\right) = \frac{A_m A_c}{2} \cos[2\pi\left(f_c - f_m\right)t]$$

The output of the local oscillator is

$$c\left(t\right) = A_c \cos(2\pi f_c t)$$

From the figure, we can write the output of product modulator as

$$v\left(t\right) = s\left(t\right)c\left(t\right)$$

$$v(t) = \frac{A_m A_c}{2} \cos[2\pi(f_c - f_m)t] A_c \cos(2\pi f_c t)$$

$$= \frac{A_m A_c{}^2}{2} \cos[2\pi(f_c - f_m)t] \cos(2\pi f_c t)$$

$$= \frac{A_m A_c{}^2}{4} \{\cos[2\pi(2f_c - fm)] + \cos(2\pi f_m)t\}$$

$$v(t) = \frac{A_m A_c{}^2}{4} \cos(2\pi f_m t) + \frac{A_m A_c{}^2}{4} \cos[2\pi(2f_c - f_m)t]$$

In the above equation, the first term is the scaled version of the message signal. It can be extracted by passing the above signal through a low pass filter.

# Advantages and Disadvantages

**Advantages:**

- More bandwidth efficient than DSB-SC.
- Carrier power and one sideband power saving. Power saving 83.33% for 100% modulation.
- Reduced interference of noise, because of low bandwidth.

**Disadvantages:**

- Generation and reception is complicated.
- The SSB transmitter and receiver need to have excellent frequency stability. It is needed ideal filters in implementations.

Q.No:2

How much power is saved for SSBSC signal as compared to that of DSBSC