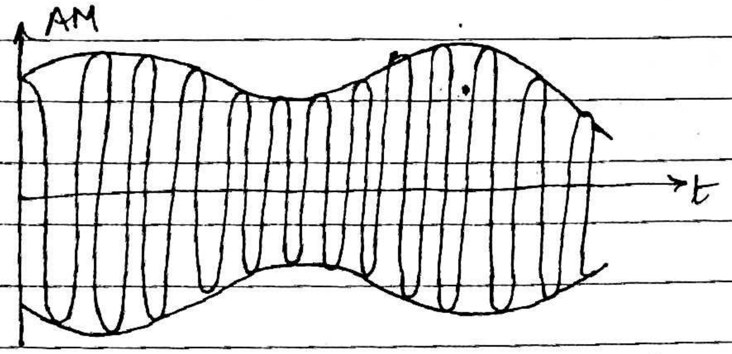
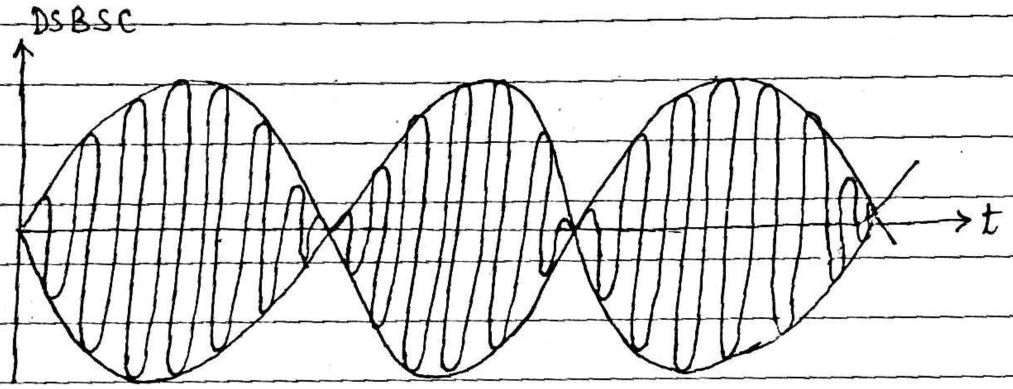
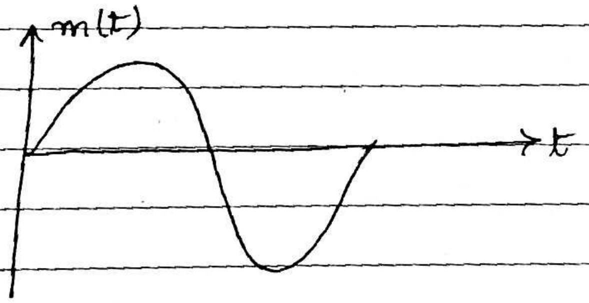
SSBSC Modulation





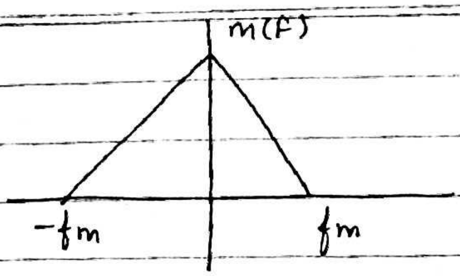


$$S(t) = \frac{V_c}{2}\left\{ m(t)\cos w_c t \mp \hat{m}(t)\sin w_c t \right\}$$

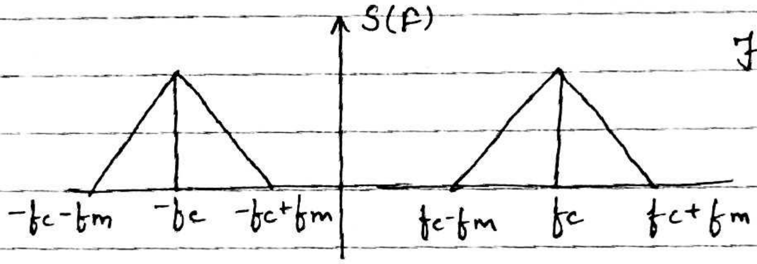
$\hat{m}(t)$ = Hilbert transform of $m(t)$, phase shifts by $\pi/2$.
(−) = SSBSC / USB , (+) = SSBSC/LSB

The LSB and USB are real images of each other (symmetrical). If we suppress one side band further from DSBSC signal then there is no effect on message signal and we have same 50% power of DSBSC or 16.5% power of conventional AM wave.
(After suppression of one side band from DSBSC signal). Now the remaining signal is called SSBSC modulated signal and the technique is known as SSBSC modulation technique.

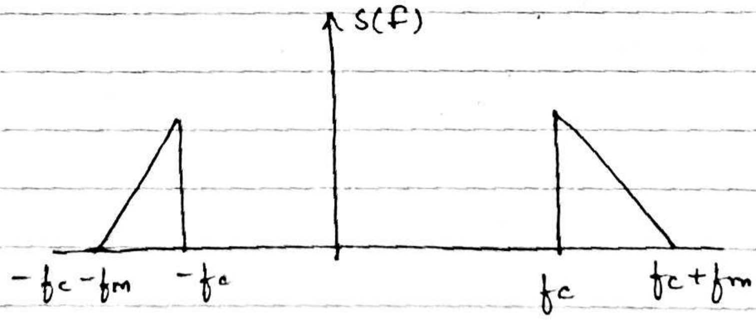
Frequency spectrum of AM



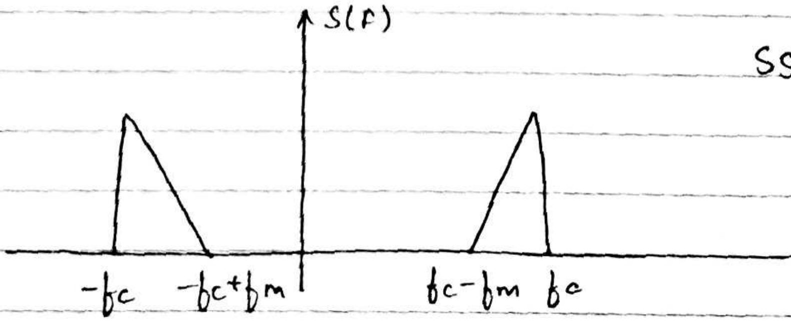
Frequency Response of DSBS

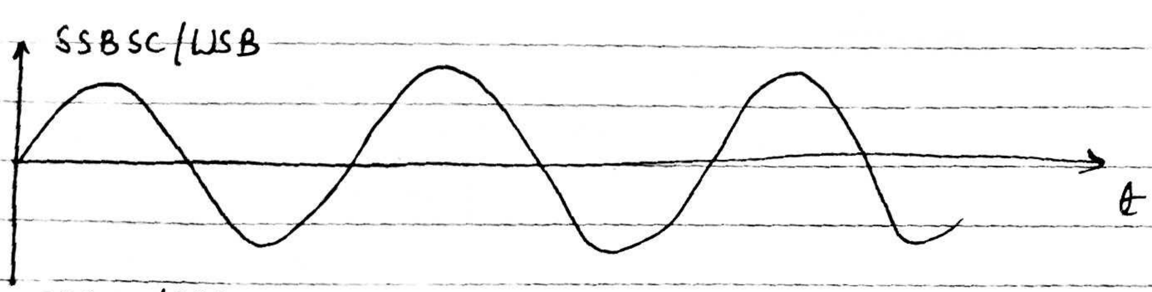


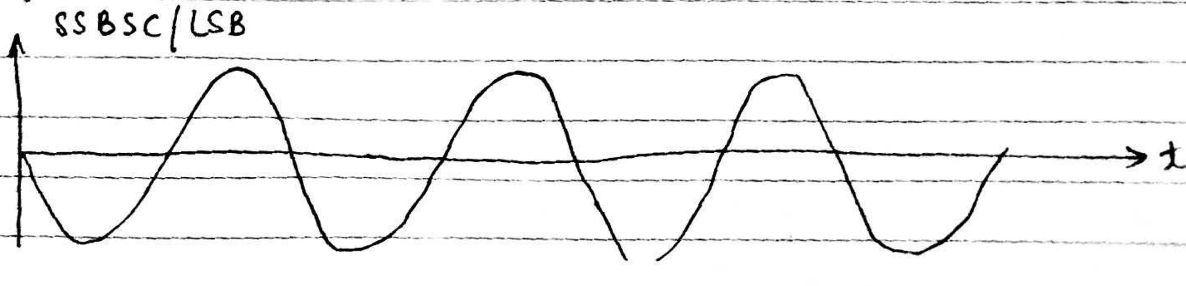
SSBBC/USB



SSBBC/LSB







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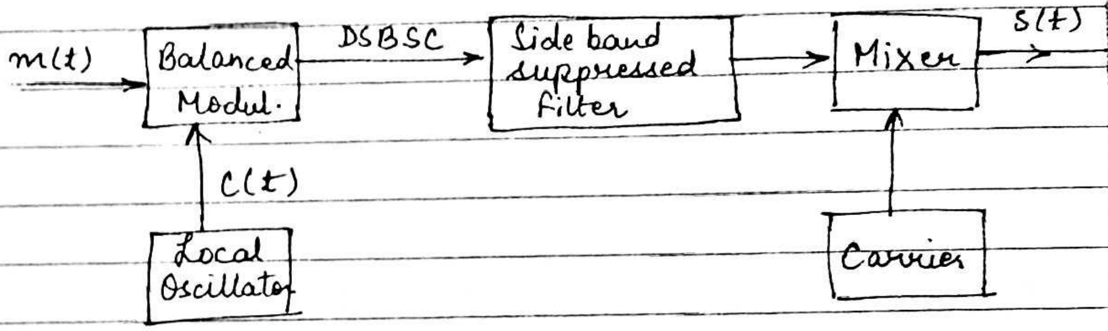
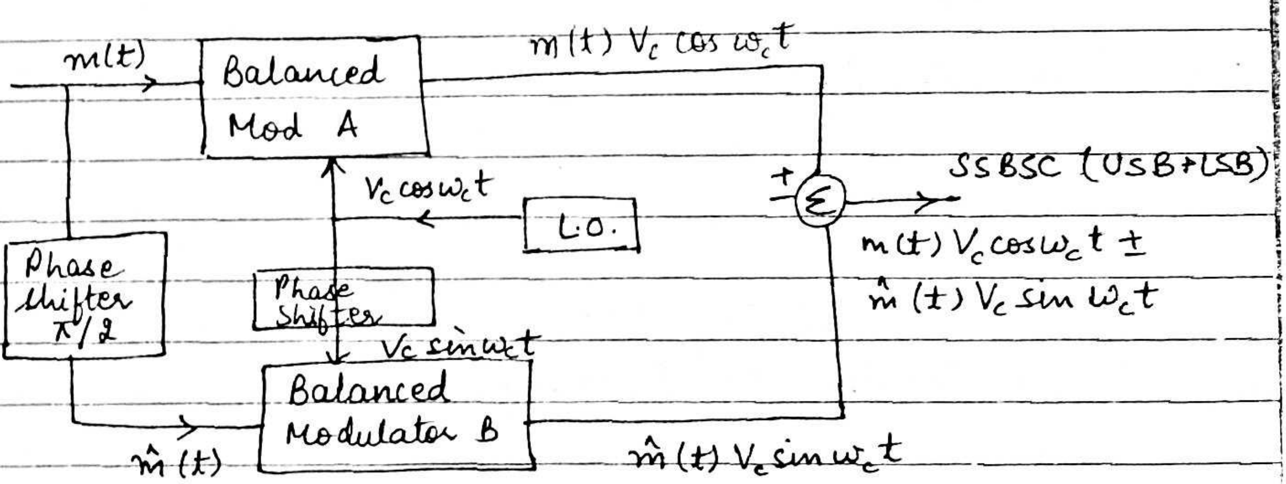
Generation of SSBSC

i) Filter method
ii) Phase shift method
iii) Third method.

Filter Method:



Block Diagram of filter method



Block Diagram of Phase Shift Method

Q. Explain the nature of SSBSC spectrum if the modulating signal $m(t) = \cos 2\pi \cdot 1000t + \cos 2\pi \cdot 2000t$ and carrier signal $c(t) = \cos 2\pi \cdot 10000t$ ~~+ sin 2π~~.

Soln

$$S(t) = \frac{V_c}{2}\left[m(t)\cos\omega_c t \pm \hat{m}(t)\sin\omega_c t\right]$$

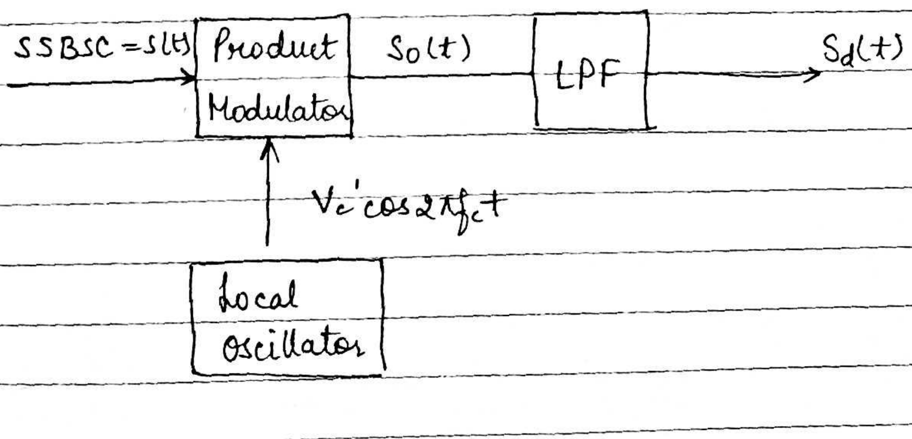
$$S(t) = \frac{V_c}{2}\left[(\cos 2\pi\times 1000t + \cos 2\pi\times 2000t)\cos\omega_c t \pm (\sin 2\pi\times 1000t + \sin 2\pi\times 2000t)\sin\omega_c t\right]$$

$$S(t) = \frac{V_c}{2}\left[(\cos 2\pi \times 1000t + \cos 2\pi \times 2000t)(\cos 2\pi \times 10000t) \pm (\sin 2\pi \times 1000t + \sin 2\pi \times 2000t)(\sin 2\pi \times 10000t)\right]$$

Study the Hilbert transform - Assignment.

Demodulation of SSBSC

i) Coherent / synchronous demodulation
ii) Carrier Re-Inserting Technique



$$S(t) = \frac{V_c}{2}\left[m(t)\cos 2\pi f_c t \pm \hat{m}(t)\sin 2\pi f_c t\right]$$

$$S_o(t) = S(t) \cdot V_c' \cos 2\pi f_c t$$

$$S_o(t) = \frac{V_c}{2}\left[m(t)\cos 2\pi f_c t \pm \hat{m}(t)\sin 2\pi f_c t\right] V_c'\cos 2\pi f_c t$$

$$S_o(t) = \frac{V_cV_c'}{2} m(t)\cos^2 2\pi f_c t \pm \frac{V_cV_c'}{2}\hat{m}(t)\sin 2\pi f_c t\cdot\cos 2\pi f_c t$$

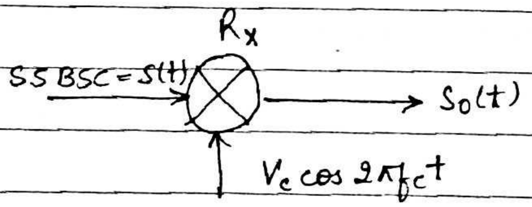
$$S_o(t) = \frac{V_cV_c'}{2}\left\{m(t)\frac{(1+\cos 4\pi f_c t)}{2}\right\} + \frac{V_cV_c'}{2\times 2}\hat{m}(t)\left[\sin 4\pi f_c t + \sin 0\right]$$

$$S_o(t) = \frac{V_cV_c'}{4} m(t) + \frac{V_cV_c'}{2}\,\frac{\cos 4\pi f_c t\, m(t)}{2} + \frac{V_cV_c'}{2\times 2}\hat{m}(t)\sin 4\pi f_c t$$

$$\boxed{S_d(t) = \frac{V_cV_c'}{4}m(t)}$$

Determine phase and frequency errors of in the demodulation of SSBSC using the coherent demodulation technique - Assignment

Carrier Re-Inserting Technique



$$S_o(t) = S(t) + C(t)$$

$$S(t) = \frac{V_c}{2}\left[m(t)\cos 2\pi f_c t \pm \hat{m}(t)\sin 2\pi f_c t\right]$$

For USB/SSBSC

$$S(t) = m(t)\cos 2\pi f_c t - \hat{m}(t)\sin 2\pi f_c t$$

$$S_o(t) = S(t) + C(t)$$
$$= (m(t)\cos 2\pi f_c t - \hat{m}(t)\sin 2\pi f_c t) + V_c\cos 2\pi f_c t$$
$$= (m(t) + V_c)\cos 2\pi f_c t - \hat{m}(t)\sin 2\pi f_c t$$