Iftekhar Hakim Raowsan
170 5045

$\omega = 2\pi f$

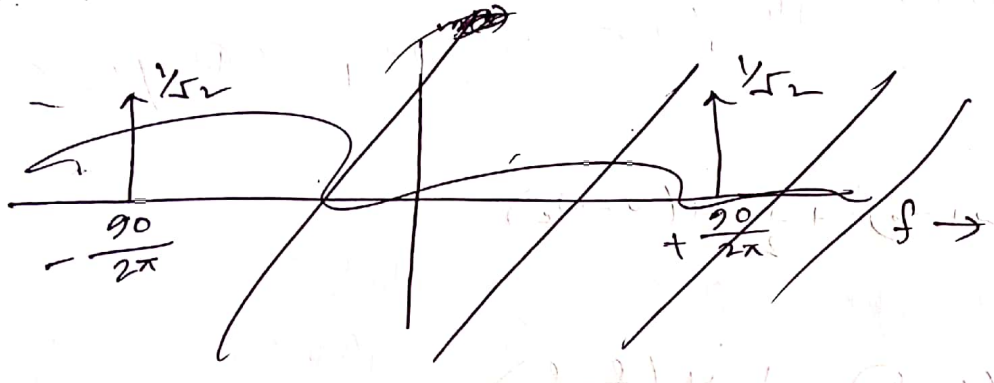
carrier is $\cos 1000\pi t$

a)

$$m(t) = \cos(45t)\cos(90t) = \frac{1}{2}[2\cos(45t)\cos(90t)]$$

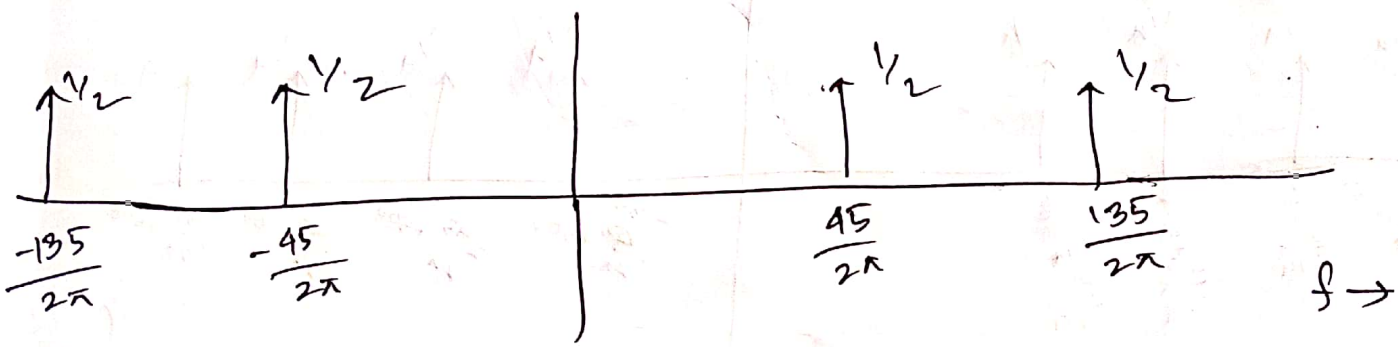
$$= \frac{1}{2}\cdot\cos(135t) + \frac{1}{2}\cos(45t)$$

~~b) spectrum~~



~~a) carrier is $\cos 1000\pi t$~~

b) spectrum



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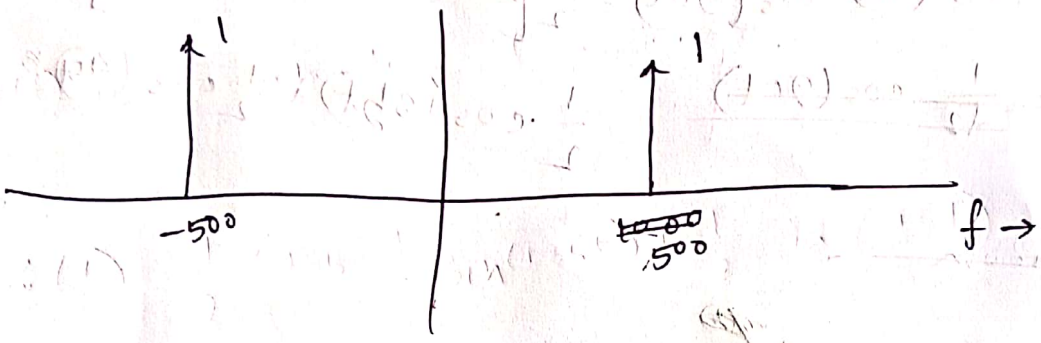
c) carrier $\cos(1000\pi t)$

$f_c = \frac{1000\pi}{2\pi} = 500\,Hz$

Spectrum of carrier



DSB-SC

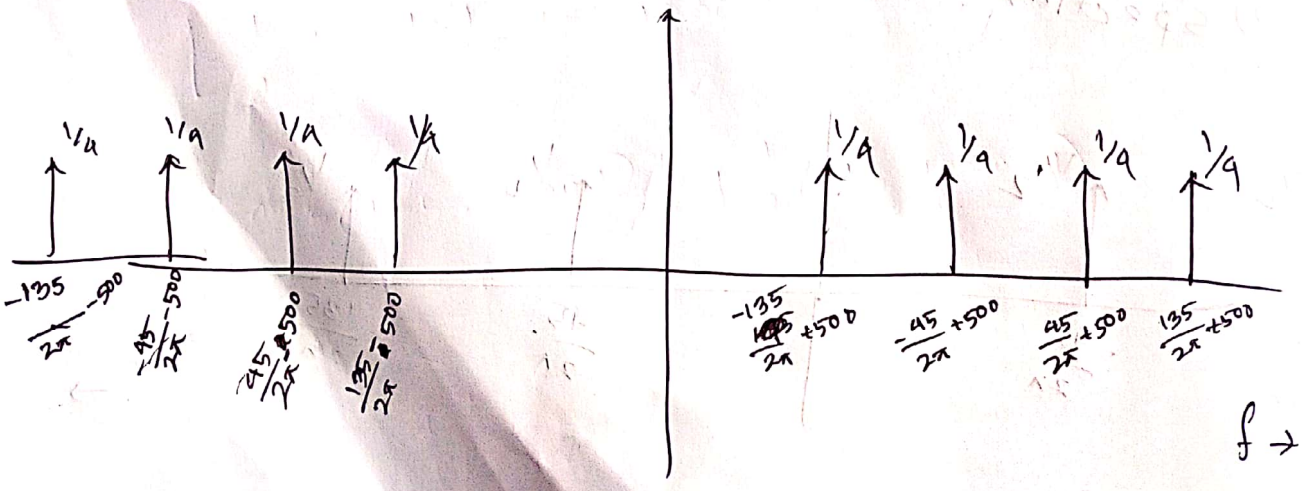
$$M(\omega) = \frac{1}{2} M(\omega + \omega_c) + \frac{1}{2} M(\omega - \omega_c)$$

Similarly,

$$M(f) = \frac{1}{2} M(f + f_c) + \frac{1}{2} M(f - f_c)$$

So, spectrum,

Here, $f_c = 500\,Hz$



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d)

We know,

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

m(t) is a combination of cosine functions.

So, as

$$m(t) = \frac{1}{2}\cos(135t) + \frac{1}{2}\cos(45t)$$

$$\hat{m}(t) = \frac{1}{2}\sin(135t) + \frac{1}{2}\sin(45t)$$

$$\therefore M_{LSB}(\omega) = \frac{1}{2}\cos(135t)\cos(1000\pi t) + \frac{1}{2}\cos(45t)\cos(1000\pi t) + \frac{1}{2}\sin(135t)\sin(1000\pi t) + \frac{1}{2}\sin(45t)\sin(1000\pi t)$$

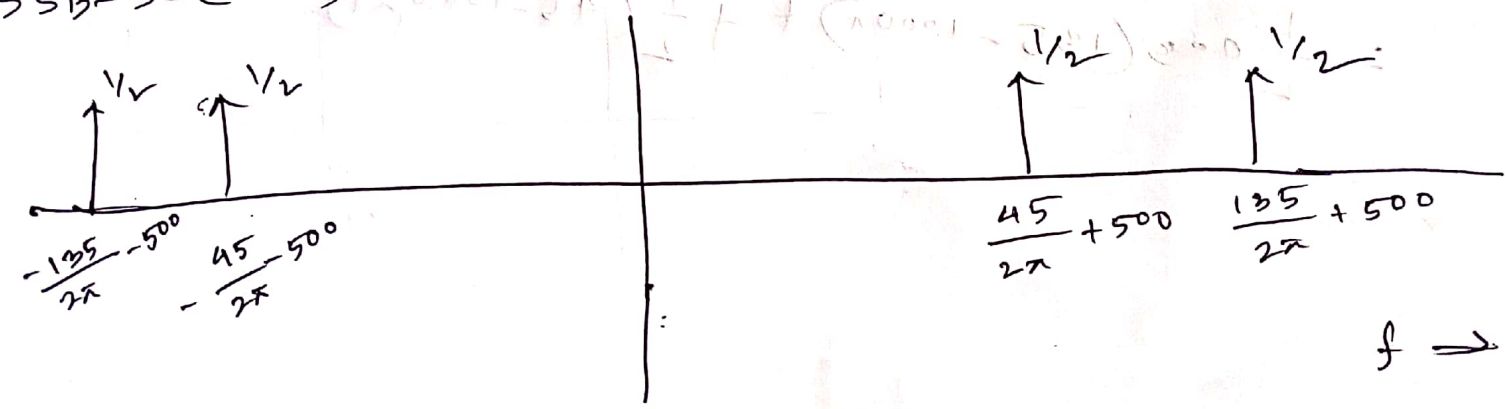
$$= \frac{1}{4}\left[\cos(135+1000\pi)t + \cos(135-1000\pi)t\right]$$

$$= \frac{1}{2}\left[\cos(135t)\cos(1000\pi t) + \sin(135t)\sin(1000\pi t)\right] +$$

$$\frac{1}{2}\left[\cos(45t)\cos(1000\pi t) + \sin(45t)\sin(1000\pi t)\right]$$

$$= \frac{1}{2}\cos(135+1000\pi)t + \frac{1}{2}\cos(45+1000\pi)t$$

SSB-SC (LSB)



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c)

For USB,

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

$m(t)$ is combination of cosines.

So,

$\hat{m}(t) = \frac{1}{2}(\frac{1}{2}\sin(135t) + \frac{1}{2}\sin(45t))$

~~$M_{USB}(t)$~~

transmitted signal=

$\frac{1}{2}\cos(135t)\cos 1000\pi t + \frac{1}{2}\cos 45t \cos 1000\pi t$

$-\frac{1}{2}\sin(135t)\sin 1000\pi t - \frac{1}{2}\sin 45t \sin 1000\pi t$

$= \left[\frac{1}{2}\cos 135t \cos 1000\pi t + (-\frac{1}{2}\sin 135t \sin 1000\pi t)\right] +$

$\left[\frac{1}{2}\cos 45t \cos 1000\pi t - \frac{1}{2}\sin 45t \sin 1000\pi t\right]$

$= \frac{1}{2}\cos(135 - 1000\pi)t + \frac{1}{2}(45 - 1000\pi t)$

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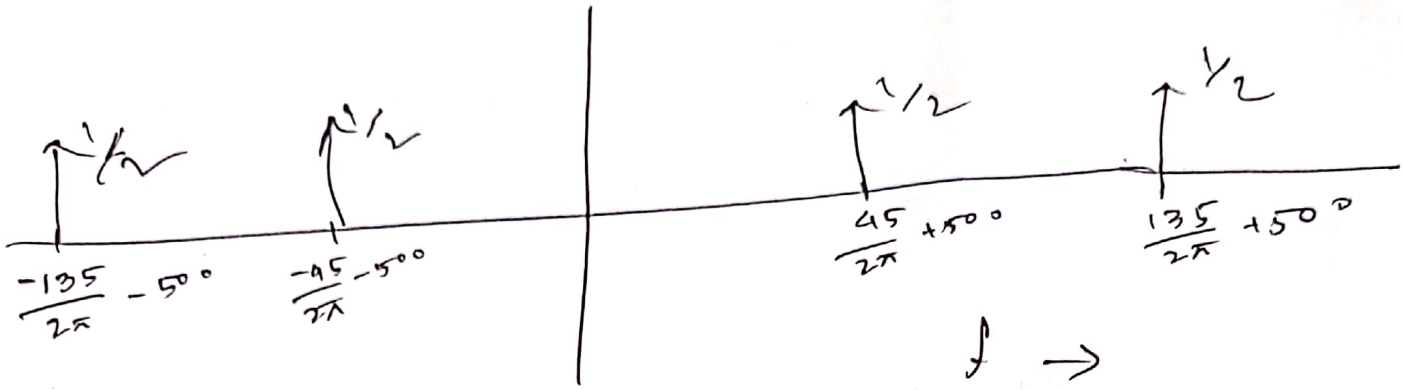

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