L4)

1) $V_{m1}(t) = 2 + \sin(40\pi t) + 3\cos(60\pi t)$

$V_{m1}(t) = 2 + \cos(40\pi t + \frac{\pi}{2}) + 3\cos(60\pi t)$

$V_{dsb1}(t) = V_{m1}(t) \cdot V_c \cos(2\pi f_c t)$

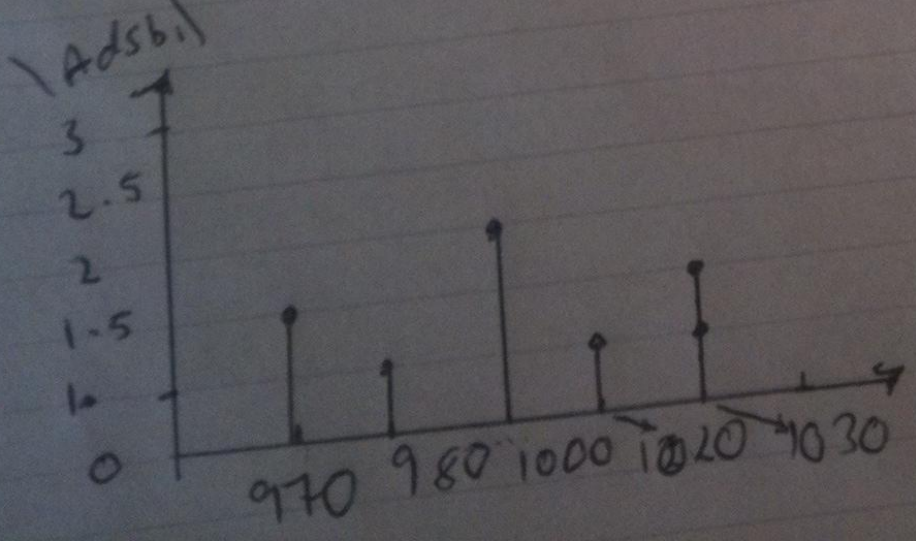
$V_{dsb}(t) = 2\cos(2\times10^3 \pi t) + \cos(40\pi - \frac{\pi}{2})\cos(2\times10^3 \pi t)$

$+ 3\cos(60\pi t)\cos(2\times10^3 \pi t)$

$V_{dsb1}(t) = 2\cos(2\times10^3 \pi t) + \cos(1960\pi t + \frac{\pi}{2})$

$+ \cos(2040\pi t - \frac{\pi}{2})$

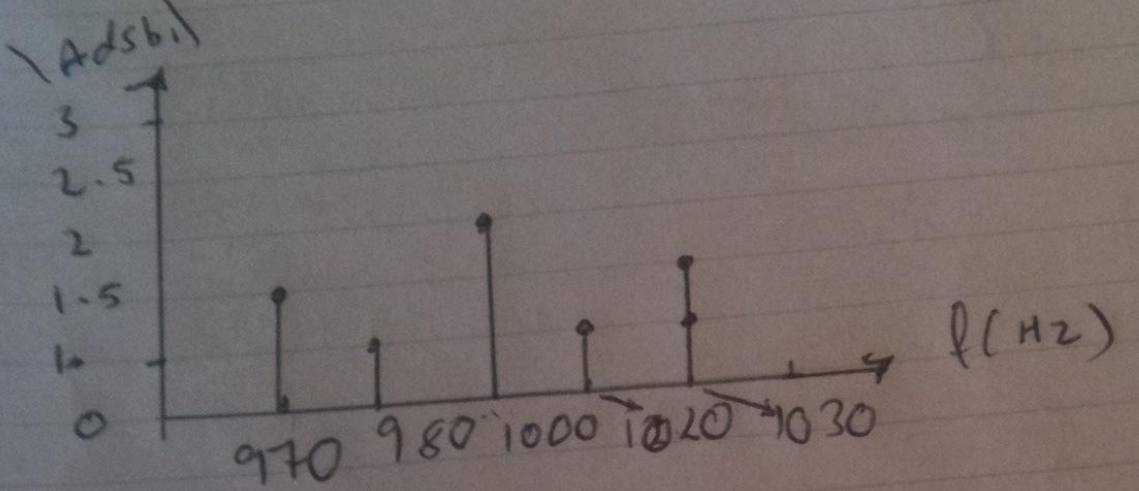
$+ \frac{3}{2}\cos(1940\pi t) + \frac{3}{2}\cos(2060\pi t)$

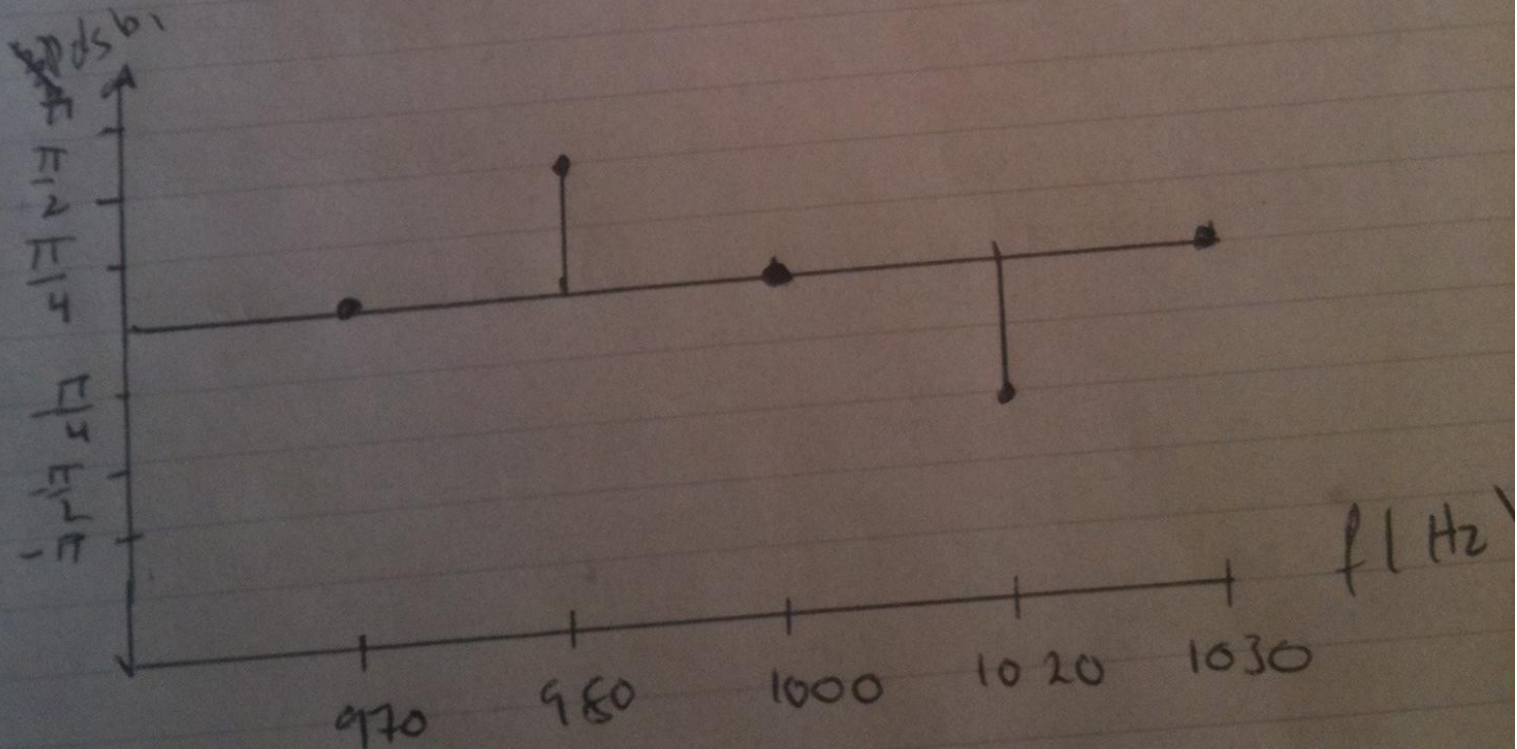


$V_{dsb}(t) = 2\cos(2\times10^{\ldots}$

$+ \cos(2040\pi t - \frac{\pi}{2})$

$+ \frac{3}{2}\cos(1940\pi t) + \frac{3}{2}\cos(2060\pi t)$





2)

$$V_{ab}(t) = \cos(2\times10^3\pi t) + \frac{1}{10}\cos(1960\pi t + \frac{\pi}{2}$$

$$+ \frac{9}{10}\cos(2040\pi t - \frac{\pi}{2})$$

$$+ \frac{3}{2}\cos(2060\pi t)$$

3) $V_{ssb}(t)$ ** upper side band:

$$V_{ssb}(t) = V_m(t) \cdot V_c(t) - V_m(t)_{90^\circ} V_c(t)_{90^\circ}$$

$$V_{ssb}(t) = [3\cos(20\pi t + \frac{\pi}{4}) + 2\sin(60\pi t) - \cos(100\pi t)]\cos(2\pi\times10^3 t)$$

$$- [3\sin(20\pi t + \frac{\pi}{4}) + 2\cos(60\pi$$

$$- \sin(100\pi t)]\sin(2\pi\times1$$

$+ \frac{1}{10}\cos(2040\pi t - \frac{\pi}{2})$

$+ \frac{3}{2}\cos(2060\pi t)$

3) $V_{ssb}(t)$ ** upper side band:

$V_{ssb}(t) = V_m(t) \cdot V_c(t) - V_m(t)_{90^\circ} V_c(t)_{90^\circ}$

$V_{ssb}(t) = [3\cos(20\pi t + \frac{\pi}{4}) + 2\sin(60\pi t) - \cos(100\pi t)]\cos(2\pi \times 10^3 t)$

$- [3\sin(20\pi t + \frac{\pi}{4}) + 2\cos(60\pi t) - \sin(100\pi t)]\sin(2\pi \times 10^3 t)$

$V_{ssb}(t) = 3\cos(20\pi t + \frac{\pi}{4})\cos(2\pi \times 10^3 t)$

$+ 2\sin(60\pi t)\cos(2\pi \times 10^3 t)$

$- \cos(100\pi t)\cos(2\pi \times 10^3 t)$

$- 3\sin(20\pi t + \frac{\pi}{4})\sin(2\pi \times 10^3 t)$

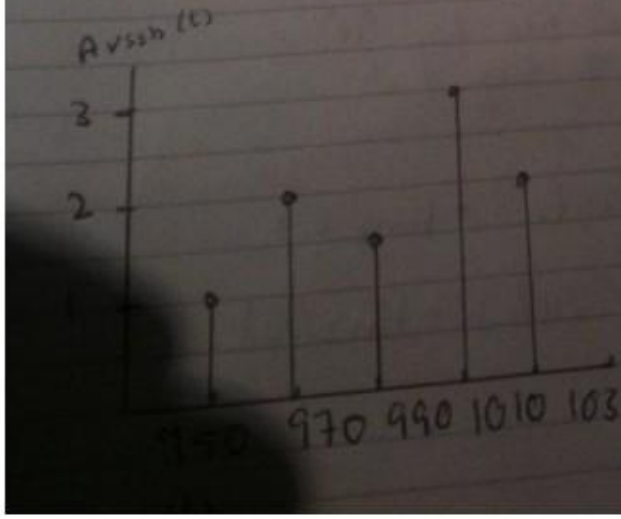
$+ 2\cos(60\pi t)\sin(2\pi \times 10^3 t)$

$+ \sin(100\pi t)\sin(2\pi \times 10^3 t)$

3) continued..

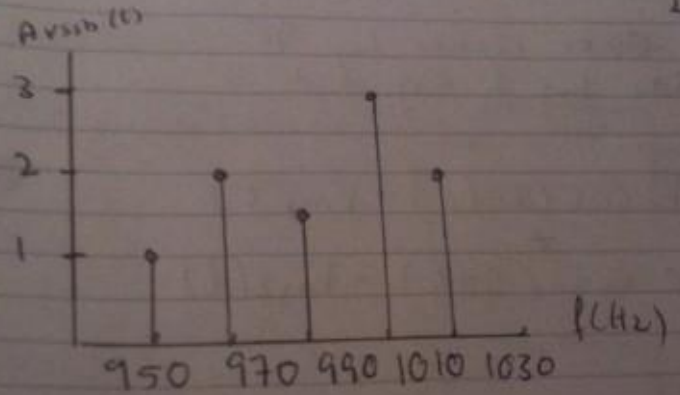
$$V_{ssb}(t) = \frac{3}{2}\cos\left(1980\pi t - \frac{\pi}{4}\right) + \frac{3}{2}\cos\left(2020\pi t + \frac{\pi}{4}\right) + \cos\left(1940\pi t + \frac{\pi}{2}\right) + \cos\left(2060\pi t - \frac{\pi}{2}\right) + -\frac{1}{2}\cos(1900\pi t) - \frac{1}{2}\cos(2100\pi t) - \frac{3}{2}\cos(1980\pi t) + \frac{3}{2}\cos(2020\pi t) + \cos\left(1940\pi t + \frac{\pi}{2}\right) + \cos\left(2060\pi t - \frac{\pi}{2}\right) + -\frac{1}{2}\cos(1900\pi t) + \frac{1}{2}\cos(2100\pi t)$$

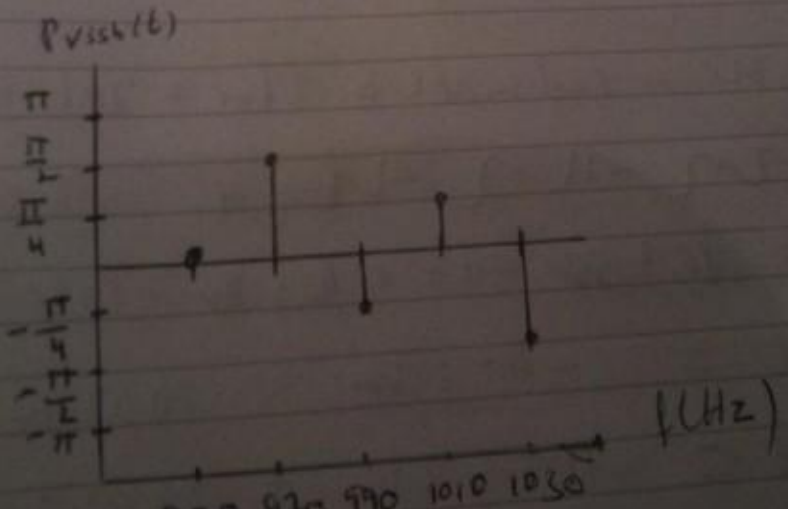
$$V_{ssb}(t) = \frac{3}{2}\cos\left(1980\pi - \frac{\pi}{4}\right) + 3\cos\left(2020\pi t + \frac{\pi}{4}\right) + 2\cos\left(1940\pi t + \frac{\pi}{2}\right) + 2\cos\left(2060\pi t - \frac{\pi}{2}\right) - \cos(1900\pi t) - \frac{3}{2}\cos(1980\pi)$$



$$-\frac{3}{2}\cos(1980\pi t) + \frac{3}{2}\cos(2020\pi t)$$
$$+ \cos(1940\pi t + \frac{\pi}{2}) + \cos(2060\pi t - \frac{\pi}{2})$$
$$- \frac{1}{2}\cos(1900\pi t) + \frac{1}{2}\cos(2100\pi t)$$

$$V_{SSB}(t) = \frac{3}{2}\cos(1980\pi - \frac{\pi}{4}) + 3\cos(2020\pi t + \frac{\pi}{4})$$
$$+ 2\cos(1940\pi t + \frac{\pi}{2}) + 2\cos(2060\pi t)$$
$$- \cos(1900\pi t) - \frac{3}{2}\cos(1980\pi)$$





4)

$$V_{ISB}(t) = \underset{①}{V_{m1}(t)} \cdot V_c(t) - V_m(t)_{90^\circ} \cdot V_c(t)_{90^\circ} + \underset{②}{V_{m2}(t)} \cdot V_c(t) + V_m(t)_{90^\circ} \cdot V_c(t)_{90^\circ}$$

① we already have this part (the upper side band)

② Now we need the low side band of the signal.

* adding them together will give us $V_{ISB}(t)$.

5) QAM.

"phase shift carrier by 90° and multiply by 1 signal."

+ $V_{usb}(t)$

① we already have this part (the upper side band)

② Now we need the lower side band of the signal.

* adding them together will give us $V_{usb}(t)$.

5) QAM.

"phase shift carrier by 90° and multiply by 1 signal."

* $V_{QAM} = V_c \cos(2\pi f_c) \cdot V_{m1}(t) + V_c \sin(2\pi f_c) \cdot V_{m2}(t)$

6) ① DSBSC - Bandwidth = $2f_m = 2060\,Hz$

② $V_{SB} = -11- = f_m + B_r = 1030 + ?$

③ SSBSC = $-11- = f_m = 1030\,Hz$

④ ISB = $-11- = 2f_m = 2060\,Hz$