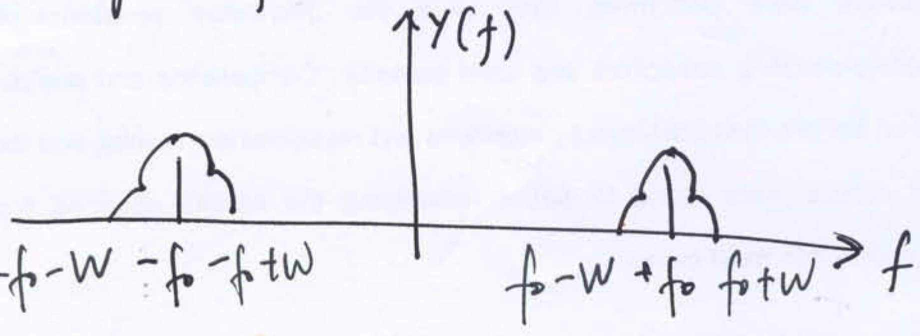
Test 1

①

$y(t) = 2m(t)\cos 2\pi f_0 t$

$Y(f) = M(f+f_0) + M(f-f_0)$ 2

Spectrum of $Y(f)$:



\# 2

Bandwidth $= f_0 + W - (f_0 - W) = 2W$ \# 2

$y_1(t) = 2m(t)\cos 2\pi f_0 t \cos 2\pi f_0 t$

from trigonometric function :

$2\cos x \cos y = \cos(x+y) + \cos(x-y)$ Working 2

$\therefore y_1(t) = m(t)\left[\cos(2\pi f_0 + 2\pi f_0)t + \cos(2\pi f_0 - 2\pi f_0)t\right]$

$= m(t)\left[\cos 4\pi f_0 t + 1\right]$

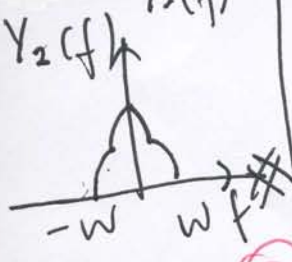
$= m(t)\cos 2\pi(2f_0)t + m(t)$

$Y_1(f) = \frac{1}{2}M(f+2f_0) + \frac{1}{2}M(f-2f_0) + M(f)$ 2

LPF has a BW of W

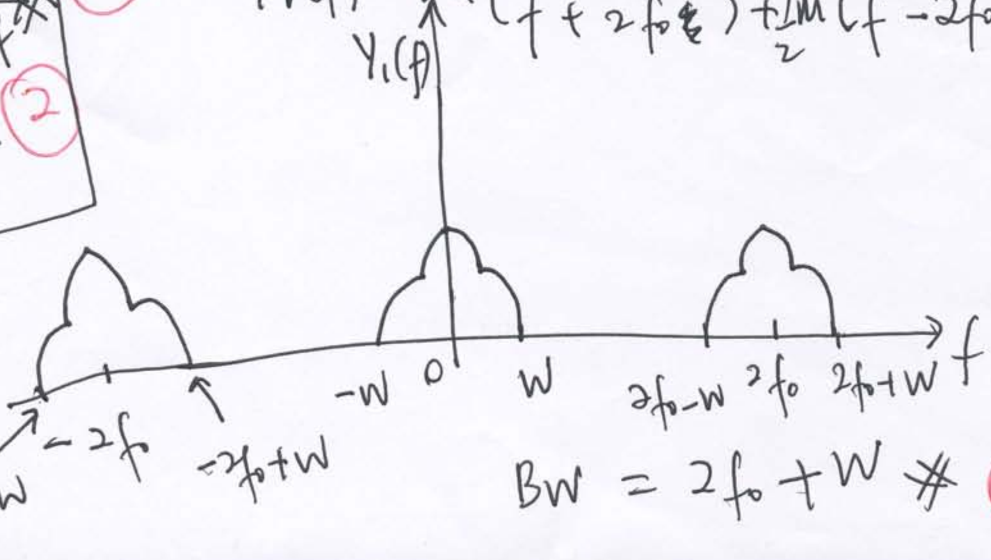
$y_2(t) = m(t)$

$Y_2(f) = M(f)$ 2



\# 2

BW = W \# 2



\# 2

BW = 2fo + W \# 2

(2)

$$u(t) = A_c\left[1 + m\cos W_m t\right]\cos W_c t$$

$$= A_c \cos W_c t + mA_c \cos W_m t \cos W_c t$$

Trigonometric function: $\cos x \cos y = \frac{1}{2}\left[\cos(x+y) + \cos(x-y)\right]$

$x = W_m t$

$y = W_c t$

$$\cos W_m t \cos W_c t = \frac{1}{2}\left[\cos(W_m + W_c)t + \cos(W_c - W_m)t\right]$$

$$\therefore u(t) = A_c \cos W_c t + \frac{mA_c}{2}\cos(W_m + W_c)t + \frac{mA_c}{2}\cos(W_c - W_m)t$$

$$u(t) = 5\cos 1800\pi t + 20\cos 2000\pi t + 5\cos 2200\pi t$$

$2200\pi t = (W_m + W_c)t$

$= 2\pi(f_m + f_c)t$

$f_m + f_c = 1100$ —— (1)

$(W_c - W_m)t = 1800\pi t$ Working (2)

$2\pi(f_c - f_m)t = 1800\pi t$

$f_c - f_m = \frac{1800}{2} = 900$ —— (2)

$2\pi f_c t = 2000\pi t$

$f_c = 1000$ (2)

$\therefore f_m = 100$ (2) from (1) and also (2)

$A_c = 20$ (2)

$\frac{mA_c}{2} = 5$ (2)

(b) $m = \frac{5 \times 2}{20} = 0.5$ (2)

$m = \frac{V_m}{V_c} = \frac{V_m}{A_c}$

$V_m = 0.5 \times 20$ (2)

$= 10$ Volt peak. (2)

(a) $m(t) = 10\cos 2\pi\, 100 t$

$c(t) = 20\cos 2\pi\, 1000 t$ (2)

(c) $P_T = P_c\left(1 + \frac{m^2}{2}\right)$ (2)

$= \frac{A_c^2}{2}\left(1 + \frac{m^2}{2}\right)$ (2)

$\frac{P_{SB}}{P_c} = \frac{\frac{A_c^2 m^2}{4}}{\frac{A_c^2}{2}}$ (2)

$= \frac{A_c^2 m^2}{4 A_c^2} \times 2 = \frac{0.5^2}{2}$

$= 0.125$

$= 12.5\%$ (2)

(3)

(a) DSB SC $u(t) = 100\, m(t) \cos 2\pi f_c t$

$f_c = 1 MHz$

$m(t) = 2\cos 2000\pi t + \cos 6000\pi t$

$\therefore u(t) = 100\left[2\cos 2000\pi t + \cos 6000\pi t\right] \cos 2\pi 10^6 t$

$= 200 \cos 2000\pi t \cos 2\pi 10^6 t + 100 \cos 6000\pi t \cos 2\pi 10^6 t$

(b) For components at ± 0.999 MHz and ± 1.001 MHz, the average power is $\frac{(100)^2}{2} = 5000 W$ #

For components at ± 0.997 MHz and ± 1.003 MHz, the average power is $\frac{50^2}{2} = 1250 W$ #

2

2

Trigonometric function:

$\cos x \cos y = \frac{1}{2}\left[\cos(x+y) + \cos(x-y)\right]$.

Working (2)

$200 \cos(\underset{x}{2000\pi t}) \cos(\underset{y}{2\pi 10^6 t}) = \frac{1}{2}(200)\left[\cos(2000 + 2\times 10^6)\pi t + \cos(2\times 10^6 - 2000)\pi t\right]$

$100 \cos 6000\pi t \cos 2\pi 10^6 t = \frac{1}{2}(100)\left[\cos(6000 + 2\times 10^6)\pi t + \cos(2\times 10^6 - 6000)\pi t\right]$

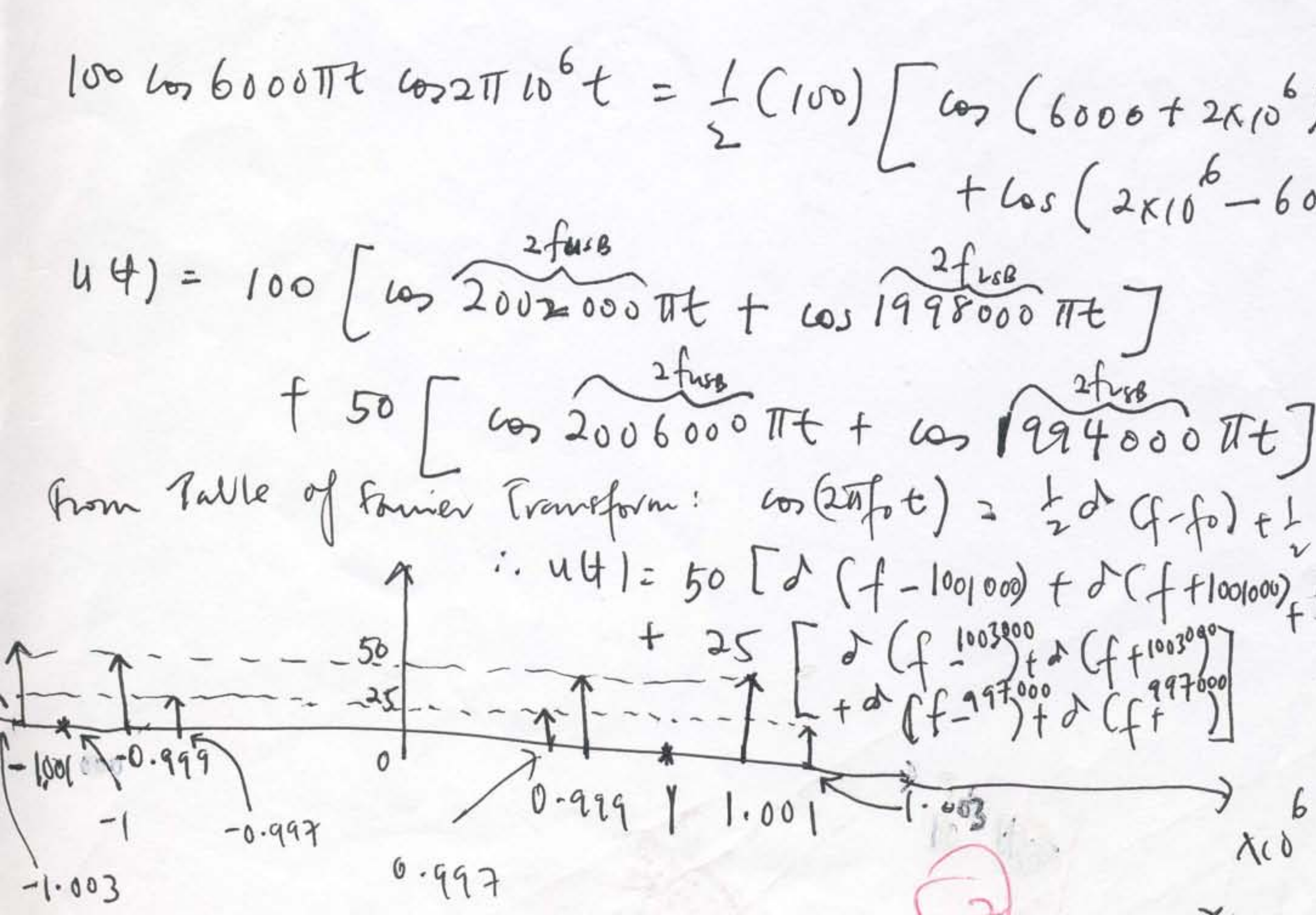
$u(t) = 100\left[\cos \overbrace{2002000}^{2f_{USB}} \pi t + \cos \overbrace{1998000}^{2f_{LSB}} \pi t\right]$

$+ 50\left[\cos \overbrace{2006000}^{2f_{USB}} \pi t + \cos \overbrace{1994000}^{2f_{LSB}} \pi t\right]$ (2)

From Table of Fourier Transform: $\cos(2\pi f_0 t) = \frac{1}{2}\delta(f-f_0) + \frac{1}{2}\delta(f+f_0)$

$\therefore u(f) = 50\left[\delta(f-1001000) + \delta(f+1001000) + \delta(f-999000) + \delta(f+999000)\right]$

$+ 25\left[\delta(f-1003000) + \delta(f+1003000) + \delta(f-997000) + \delta(f+997000)\right]$



(2)

(2)

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