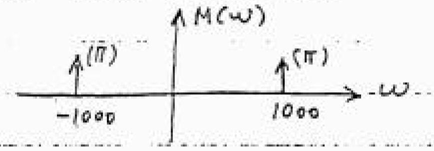
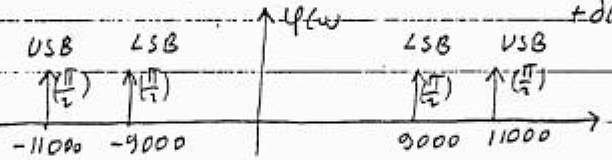
4.2-1 (i) a) $m(t) = \cos 1000t \iff M(\omega) = \pi[\delta(\omega - 1000) + \delta(\omega + 1000)]$




b&c) $\varphi(t) = \cos 1000t \cos 10000t$

$= \frac{1}{2}[\cos 9000t + \cos 11000t]$

$\Phi(\omega) = \frac{\pi}{2}[\delta(\omega - 9000) + \delta(\omega + 9000) + \delta(\omega - 11000) + \delta(\omega + 11000)]$




d) Baseband freq. : 1000 r/s

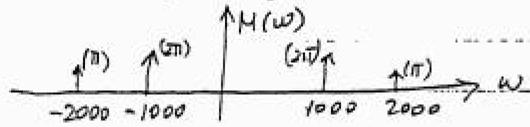
DSB freq. : 9000 r/s , 11000 r/s

USB " : 11000 r/s

LSB " : 9000 r/s

ii) a) $m(t) = 2\cos 1000t + \cos 2000t$

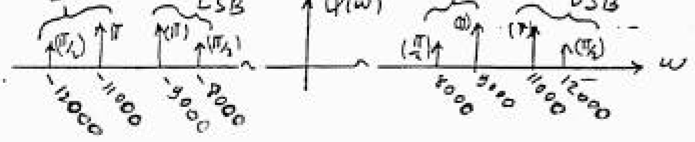
$M(\omega) = 2\pi[\delta(\omega - 1000) + \delta(\omega + 1000)] + \pi[\delta(\omega - 2000) + \delta(\omega + 2000)]$




b&c) $\varphi(t) = [2\cos 1000t + \cos 2000t]\cos 10000t$

$= \cos 9000t + \cos 11000t + \frac{1}{2}\cos 8000t + \frac{1}{2}\cos 12000t$

$\Phi(\omega) = \pi[\delta(\omega + 9000) + \delta(\omega - 9000) + \delta(\omega + 11000) + \delta(\omega - 11000)] + \frac{\pi}{2}[\delta(\omega + 8000) + \delta(\omega - 8000) + \delta(\omega + 12000) + \delta(\omega - 12000)]$



4.2.1 (ii) cont d) Baseband Freq. : 1000 r/s , 2000 r/s

DSB Freq. : 8000, 9000, 11000, 12000 r/s

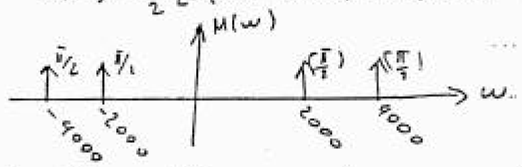
USB Freq. : 11000, 12000 r/s

LSB Freq. : 8000, 9000 r/s

(ii) a) $m(t) = \cos 1000t \cos 3000t$

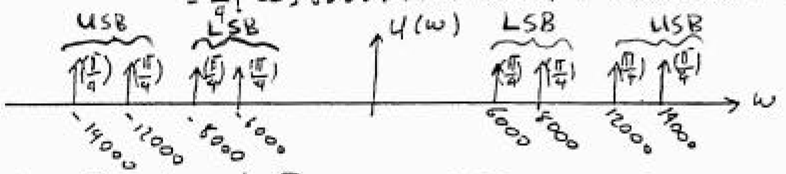
$$= \frac{1}{2}[\cos 2000t + \cos 4000t]$$

$$M(\omega) = \frac{\pi}{2}[\delta(\omega+2000) + \delta(\omega-2000) + \delta(\omega+4000) + \delta(\omega-4000)]$$




b&c) $\varphi(t) = \frac{1}{2}[\cos 2000t + \cos 4000t]\cos 10000t$

$$= \frac{1}{4}[\cos 8000t + \cos 12000t + \cos 6000t + \cos 14000t]$$




d) Baseband Freq. : 2000, 4000

DSB Freq. : 6000, 8000, 12000, 14000

USB Freq. : 12000, 14000

LSB Freq. : 6000, 8000

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4-2-4 a) The signal at point b is

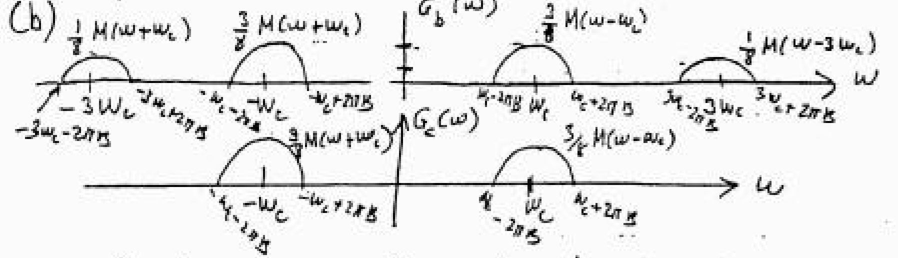
$$g_b(t) = m(t)\cos^3 \omega_c t$$

using $\cos^3\theta = \frac{3}{4}\cos\theta + \frac{1}{4}\cos 3\theta$

$$g_b(t) = \frac{3}{4}m(t)\cos \omega_c t + \frac{1}{4}m(t)\cos 3\omega_c t$$

1st term is desired modulated signal. A bandpass filter centered at $\mp\omega_c$ allows DSB-SC generation. The filter allows (cont),

4.2-4 (a) cont.
to pass the desired term $\frac{3}{4} m(t) \cos \omega_c t$, but suppresses the unwanted term $\frac{1}{4} m(t) \cos 3\omega_c t$.

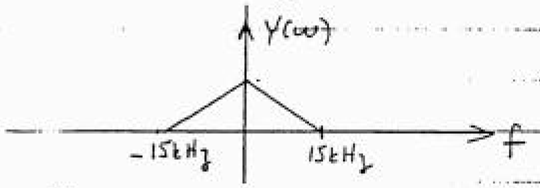
(b)



c) Minimum usable value of $\omega_c$ is $2\pi B$.

d) $g_b(t) = m(t) \cos^2 \omega_c t = \frac{m(t)}{2} + \frac{m(t)}{2} \cos 2\omega_c t$.
The system will not work because it does not contain $k m(t) \cos \omega_c t$ term.

e) The system will work with $\cos^n \omega_c t$ when n is an odd integer.

4-2.9 a)




b) Note that $Y(\omega)$ is same as $M(\omega)$ with spectrum inversed. To get back the original spectrum $M(\omega)$, we need to invert $Y(\omega)$ once again. This can be done by passing the scrambled signal $y(t)$ through the same scrambler.

4.3-1 At the output of multiplier we have
$g_b(t) = [A + m(t)] \cos^2 \omega_c t$

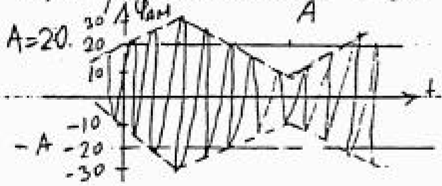
4.3-1 (cont.) $g_b(t) = \frac{1}{2}[A+m(t)] + \frac{1}{2}[A+m(t)]\cos 2\omega_c t$

Low-pass filter allows the 1st term to pass, but suppresses the second term. The output of the filter is

$$g_c(t) = A + m(t)$$

D.C. blocker suppresses the D.C. term. Hence we get baseband signal $m(t)$ at the output of D.C. blocker.

13-2 a) $\mu = 0.5 = \frac{10}{A} \Rightarrow A = 20$




b) $\mu = 1 = \frac{10}{A}$ $A = 10$


c) $\mu = 2 = \frac{10}{A}$ $A = 5$


d) $\mu = \infty = \frac{10}{A}$ $A = 0 \Rightarrow$ DSB-SC