AV314 - Communication Systems I
Assignment-5

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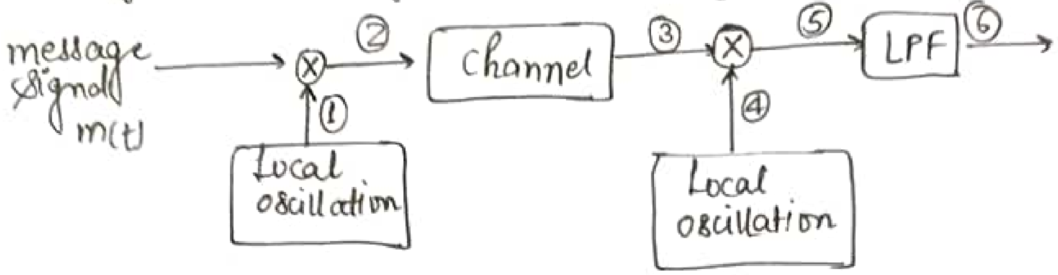
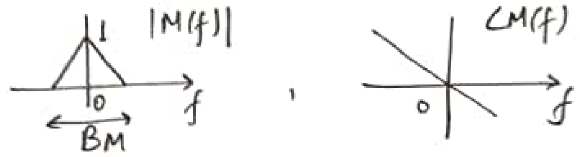
SC22B146

1. The signal flow diagram of a DSB system is shown below.

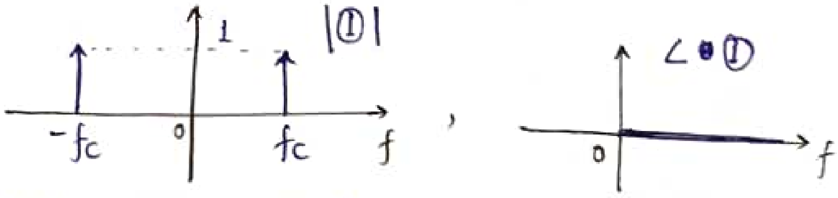


Suppose m(t) has the spectrum

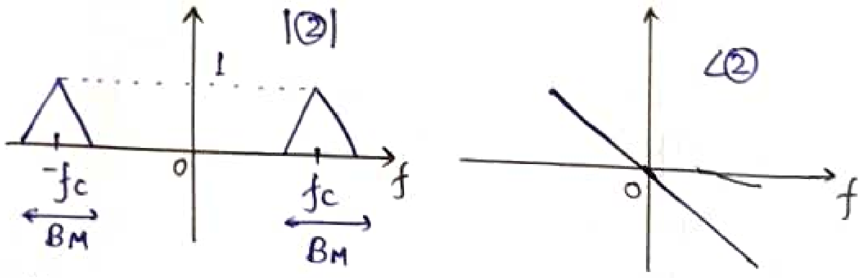


Draw the spectrum of the signals at ①, ②, ③, ④, ⑤ and ⑥. If the channel is an ideal BPF centered at f_c with a bandwidth $B_c \geq 2B_M$ and it is required that the signal at ⑥ is a replica of the signal m(t).

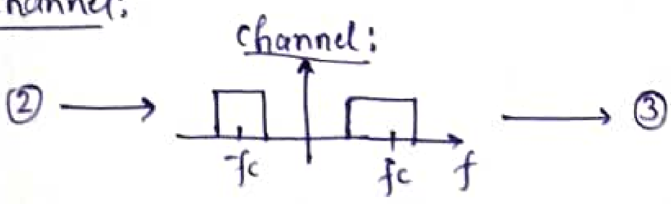
Sol^n: ①: $[\delta(f-f_c)+\delta(f+f_c)] \xleftarrow{F} 2\cos(2\pi f_c t)$

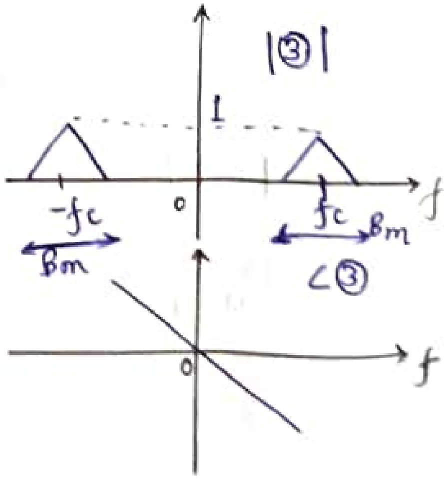


②: $[M(f-f_c)+M(f+f_c)]$

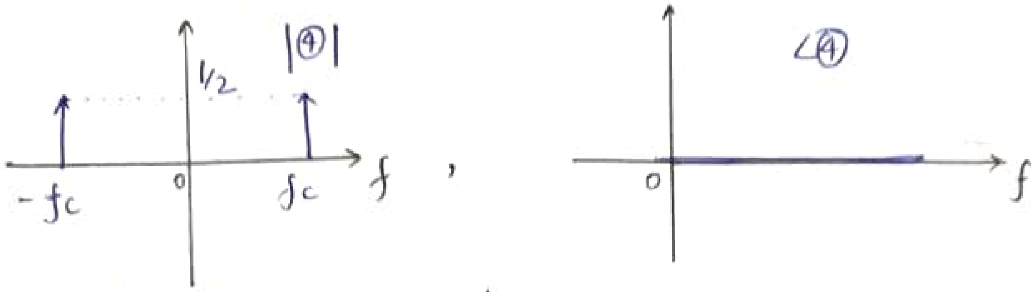


③: Channel;

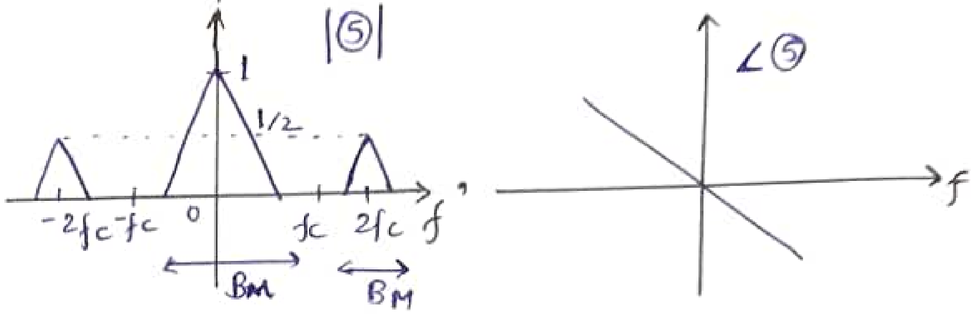




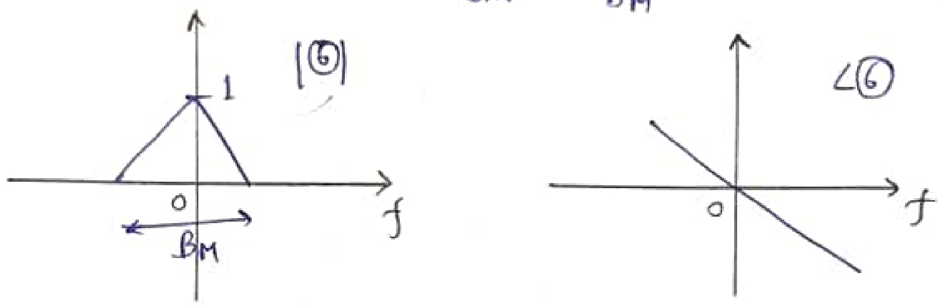
④: $\cos(2\pi f_c t) \xrightarrow{\mathcal{F}} \frac{1}{2}\left[\delta(f-f_c) + \delta(f+f_c)\right]$



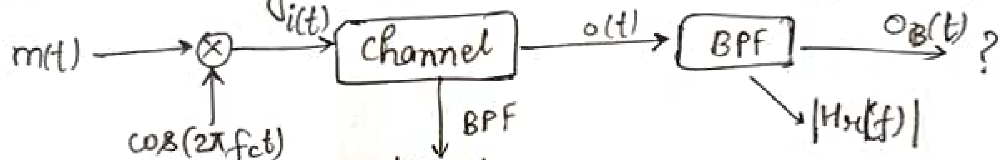
⑤: ③ → ⊗ → ⑤, ④ (L.O.)

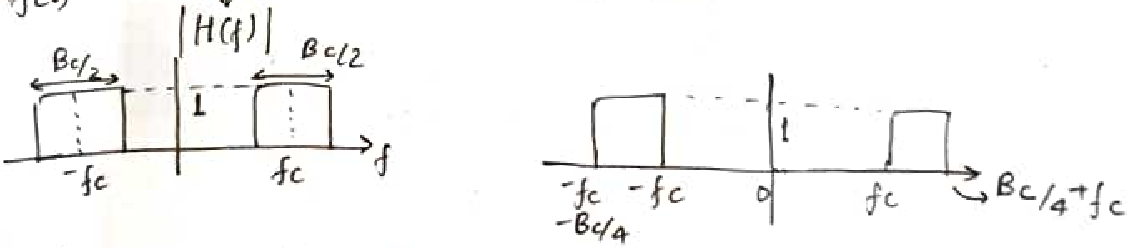


⑥: = ①



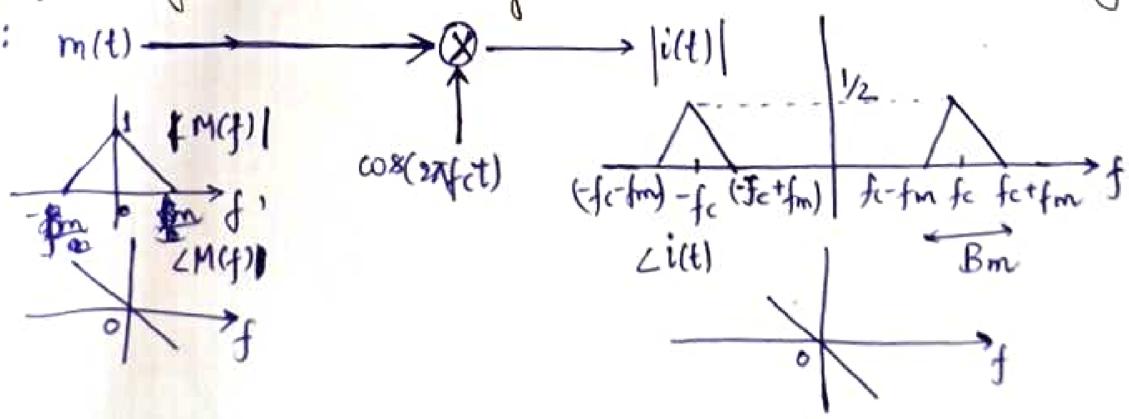
② Consider a DSB system as shown: m(t) is same as in Q.①; $B_C \geq 2B_M$.

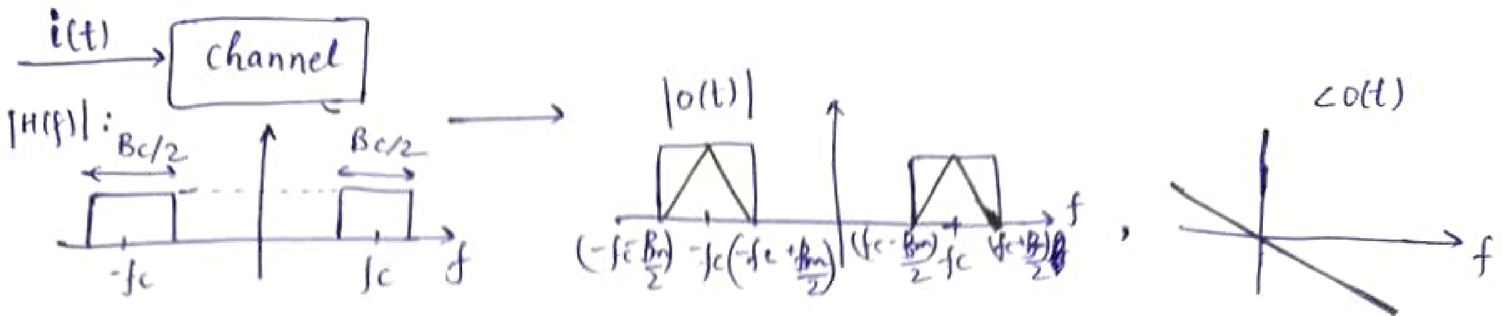


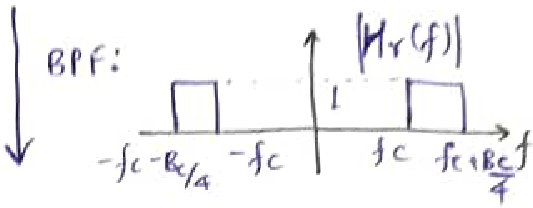


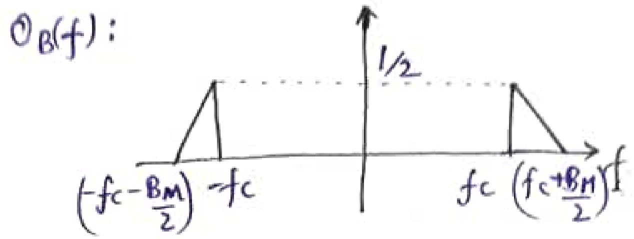
The channel and the BPF have the frequency response shown by $|H(f)|$ and $|H_R(f)|$ (and linear phase response). Draw the spectrum of $O_B(t)$. How will you recover m(t) from $O_B(t)$? Draw a signal flow diagram / block diagram which shows this recovery is done.

Soln:

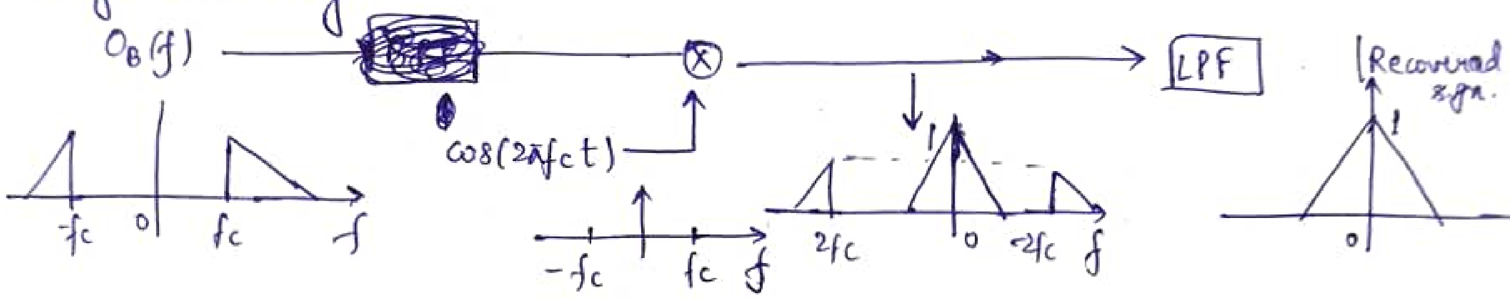




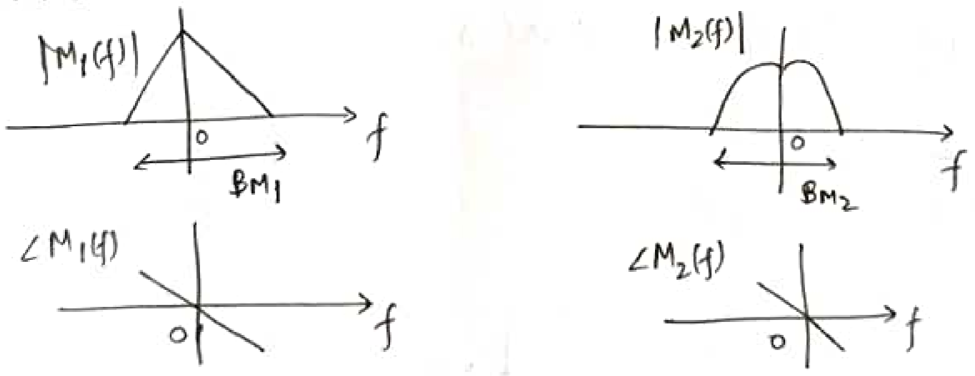




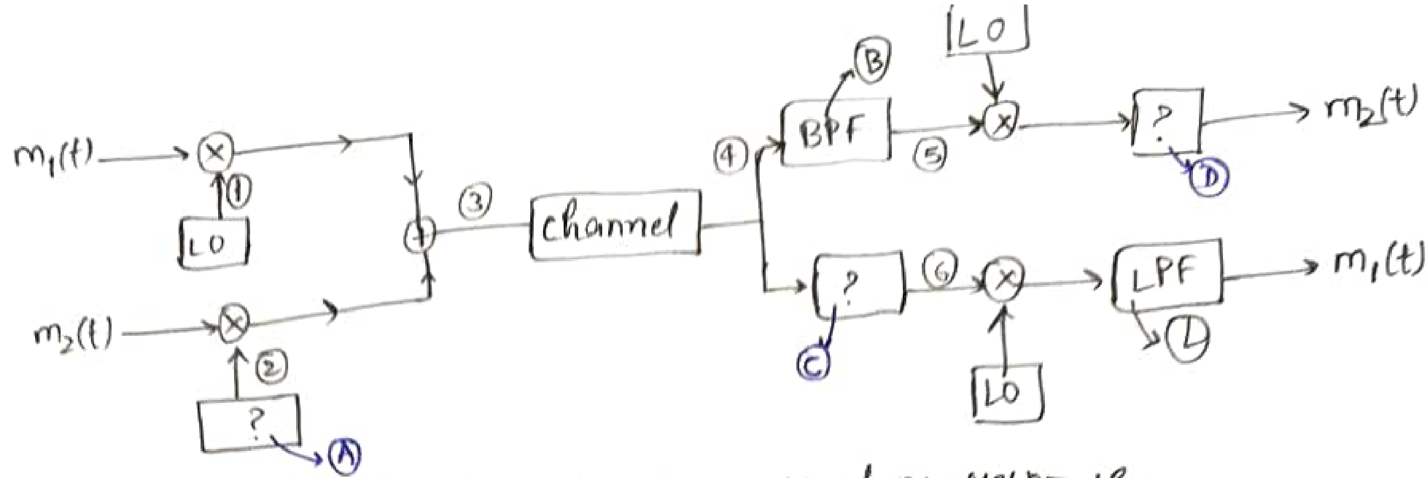
Signal recovery:



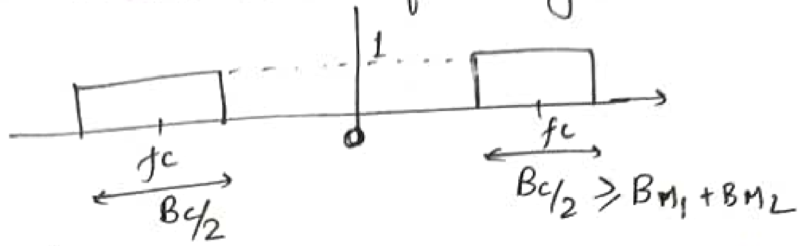
③ Suppose I have two sidebands signals $m_1(t)$ and m_2 with spectra as shown:



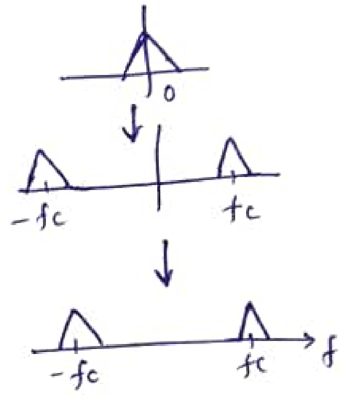
write down the functions (input → output map) of the blocks marked by '?' in the following signal flow diagram. write down what the signals are at ①, ②, ③, ④, ⑤, ⑥. What should be the freq. responses of Ⓑ and Ⓛ ?



Assume that the channel has the following freq. response.



Sol: ?(A) $\longrightarrow$ Local oscillator (L.O.)



(1) $\longrightarrow \cos(2\pi f_{c_1} t)$

$\Rightarrow$ (2) $\longrightarrow 2\cos(2\pi f_{c_2} t)$

?(C) $\longrightarrow$ Band Pass Filter (BPF)

?(D) $\longrightarrow$ Low Pass Filter (LPF)

(3) $=$ (1) $\times m_1(t)$ $+$ (2) $\times m_2(t)$

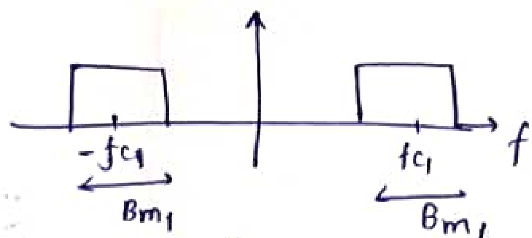
$= m_1(t)\cos(2\pi f_{c_1} t) + m_2(t)\cos(2\pi f_{c_2} t)$

(4) $\longrightarrow m_1(t)\cos(2\pi f_{c_1} t) + m_2(t)\cos(2\pi f_{c_2} t)$

(5) $\longrightarrow m_2 \cos(2\pi f_{c_2} t)$

(6) $\longrightarrow m_1 \cos(2\pi f_{c_1} t)$

(B) $\Rightarrow$



(D) $\Rightarrow$