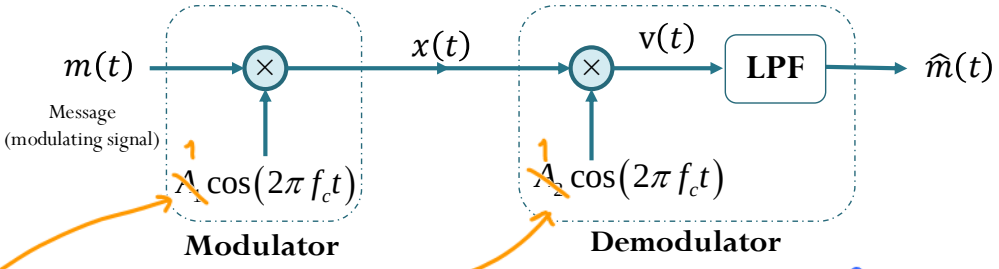
ECS 332: In-Class Exercise # 7

Instructions

1. Separate into groups of no more than three persons. **The group cannot be the same as any of your former groups.**
2. **Write down all the steps** that you have done to obtain your answers. You may not get full credit even when your answer is correct without showing how you get your answer.
3. **"ENRPr"** = Explanation is not required for this problem.
   "ENRPa" = Explanation is not required for this part.
4. **Do not panic.**

Date: **19** / **09** / 2018			
Name	ID (last 3 digits)		
Prapun	**5**	**5**	**5**

1. Consider the DSB-SC modem with no channel impairment shown below.



Let $A_1 = 1, A_2 = 1$, f_c = 2017 Hz, and $H_{\text{LPF}}(f) = \begin{cases} 1, & |f| \le 777, \\ 0, & \text{otherwise.} \end{cases}$

$v(t) = \cos(2\pi f_c t)\, x(t)$
$= \cos^2(2\pi f_c t)\, m(t)$
$= \frac{1}{2}\left(1 + \cos(2\pi(2f_c)t)\right) m(t)$
$= \frac{1}{2}\left(1 + \cos(2\pi(4034)t)\right) m(t)$

For each of the following $m(t)$, find the corresponding $\hat{m}(t)$.

(a) $m(t) = 4\cos(456\pi t) = 4\cos(2\pi(228)t)$

$v(t) = \frac{1}{2}\times 2\cos(2\pi(228)t)\left(1+\cos(2\pi(4034)t)\right)$

Here, we apply the product-to-sum formula [2.5e in lecture notes]

$= 2\cos(2\pi(228)t) + \cos(2\pi(4034-228)t) + \cos(2\pi(4034+228)t)$

$H(\pm 226) = 1$; $3806 > 777$, $H(\pm 3806) = 0$; $4262 > 777$, $H(\pm 4262) = 0$

$\hat{m}(t) = 2\cos(456\pi t)$

Recall that $\sum_k a_k \cos(2\pi(f_k)t) \to \boxed{H(f)} \to \sum_k H(f_k) a_k \cos(2\pi(f_k)t)$ when $H(-f_k) = H(f_k)$

(b) $m(t) = 4\cos(3456\pi t) = 4\cos(2\pi(1728)t)$

$v(t) = \frac{1}{2}\times 2\cos(2\pi(1728)t)\left(1+\cos(2\pi(4034)t)\right)$

$= 2\cos(2\pi(1728)t) + \cos(2\pi(4034-1728)t) + \cos(2\pi(4034+1728)t)$

>777; $H(\pm 1728) = 0$; $2306 > 777$, $H(\pm 2306) = 0$; $5762 > 777$, $H(\pm 5762) = 0$

$\hat{m}(t) \equiv 0$

(c) $m(t) = 4\cos(6666\pi t) = 4\cos(2\pi(3333)t)$

$v(t) = \frac{1}{2}\times 2\cos(2\pi(3333)t)\left(1+\cos(2\pi(4034)t)\right)$

$= 2\cos(2\pi(3333)t) + \cos(2\pi(4034-3333)t) + \cos(2\pi(4034+3333)t)$

>777; $H(\pm 3333) = 0$; $701 < 777$, $H(\pm 701) = 1$; $7367 > 777$, $H(\pm 7367) = 0$

$\hat{m}(t) = \cos(1402\pi t)$

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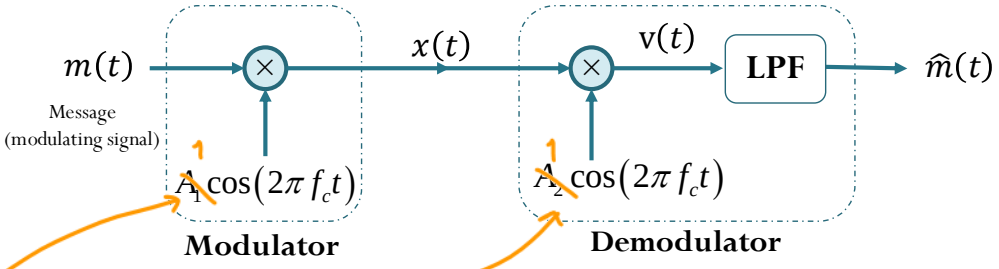
1. Consider the DSB-SC modem with no channel impairment shown below.

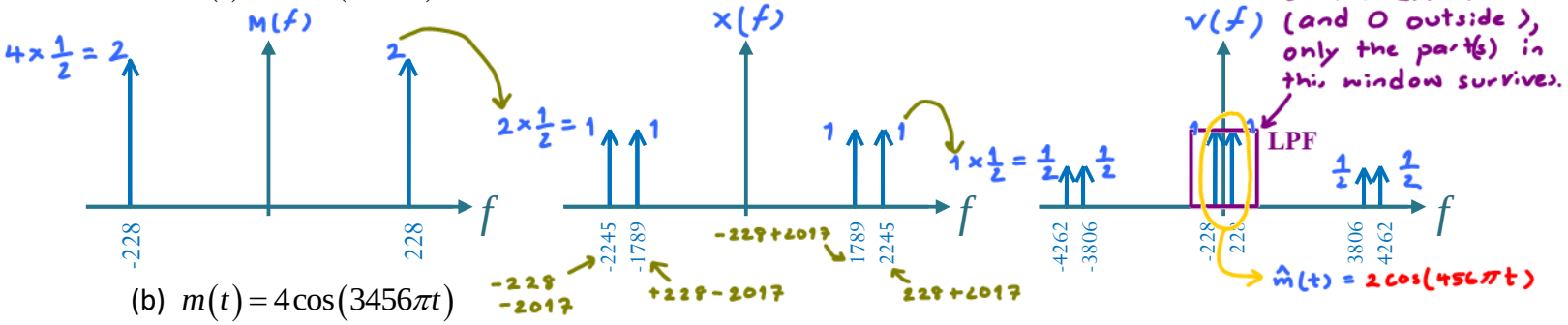


Let $A_1 = 1, A_2 = 1$, f_c = 2017 Hz, and $H_{\text{LPF}}(f) = \begin{cases} 1, & |f| \le 777, \\ 0, & \text{otherwise.} \end{cases}$

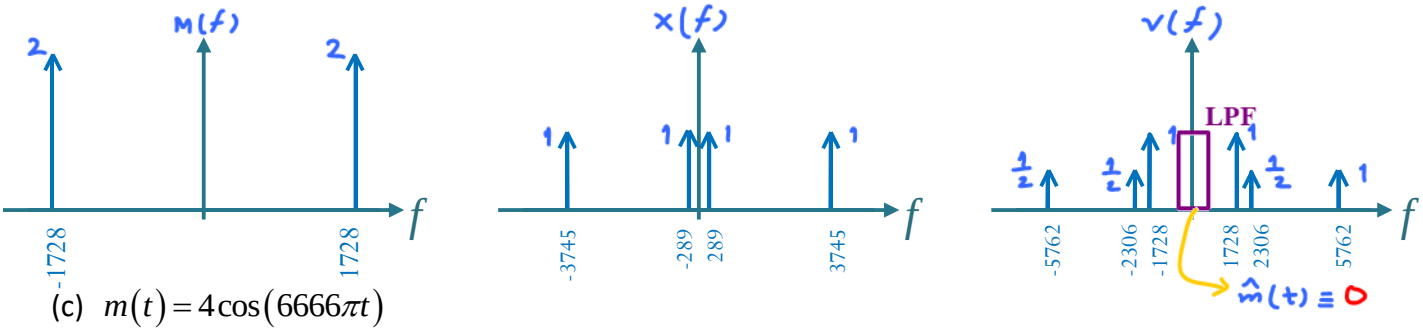
Recall that
when $a(t) = b(t)\cos(2\pi f_c t)$
$A(f) = \frac{1}{2}B(f-f_c) + \frac{1}{2}B(f+f_c)$.
Here, we apply the above process twice.

For each of the following $m(t)$, find the corresponding $\hat{m}(t)$.

(a) $m(t) = 4\cos(456\pi t)$



(b) $m(t) = 4\cos(3456\pi t)$



(c) $m(t) = 4\cos(6666\pi t)$