Principles of Communication Systems Lab (303 P)

Lab-3 (Amplitude modulation and demodulation)

(Due Date: 31-8-2021, Time: 1 pm)

Instructions:

1. NO PLAGIARISM. Your solution must be written in your words.
2. Please strictly follow the LaTex template for making lab reports. The template has been uploaded on LMS.
3. Please mention legends, axis labels, titles etc in your plot/subplot for better understanding and clarity.
4. For best quality, please add .eps format of simulation plot in the report. You can directly export .eps plot from MATLAB.
5. The report to be submitted must include MATLAB code and all observations pertaining to each plot below the same.
6. Kindly number your answers correctly.
7. Please feel free to ask any questions in class or via LMS..

Questions:

1. Consider an amplitude modulated signal $s(t) = A_c(1+k_a m(t))\cos(2\pi f_c t)$ with message signal $m(t) = A_m \cos(2\pi f_m t)$. Assume $k_a = 1$, $f_m = 100$ Hz and $f_c = 10$ KHz.

   (a) Plot the message signal $m(t) = A_m \cos(2\pi f_m t)$ for complete two cycles with $A_m = 1$.

   (b) Plot the carrier signal $c(t) = A_c \cos(2\pi f_c t)$ for a duration equal to the duration of the message signal $m(t)$. Assume $A_c = 1$

   (c) Plot the AM signal for $\mu = \{0.5, 1, 2\}$ and $A_c = 1/\mu$ where μ is the modulation index.

   (d) Plot the frequency spectrum of the signals in part (a) and (b) and identify the tones of carrier signal and the message signal.

   (e) Demodulate the above AM signal using the synchronous detector discussed in the class for $\mu = \{0.5, 1, 2\}$. Plot the demodulated signal and its spectrum. Assume that the receiver can generate a carrier $c(t) = A_c \cos(2\pi f_c t)$.

   Note: Do not use inbuilt function 'modulate' and 'demodulate'! Take a large no. of samples to get a smooth curve. Plot all the sub-parts in the same plot using subplot.

2. Consider a multi-tone signal $m(t) = A_1 \cos(2\pi f_1 t) + A_2 \cos(2\pi f_2 t)$ and a carrier signal $A_c \cos(2\pi f_c t)$ with $A_c = A_1 = A_2 = 1$, $f_1 = 100$ Hz, $f_2 = 200$ Hz and $f_c = 10$ KHz.

   (a) Plot the signal $A_1 \cos(2\pi f_1 t)$ for complete two cycles.

   (b) Plot the signal $A_2 \cos(2\pi f_2 t)$ and the carrier signal $A_c \cos(2\pi f_c t)$ over the duration of signal $A_1 \cos(2\pi f_1 t)$.

   (c) Plot the frequency spectrum of the message signal $m(t)$ and the carrier signal $c(t) = A_c \cos(2\pi f_c t)$

   (d) Plot the frequency spectrum of the AM signal $s(t) = A_c(1+m(t)) \cos(2\pi f_c t)$ and identify the tones of the message signal and the carrier signal and .

   (e) Demodulate the above AM signal using the synchronous detector discussed in the class and plot the demodulated signal and its spectrum. Assume that the receiver knows the the carrier signal perfectly.

Note: Do not use the inbuilt function 'modulate' and 'demodulate'. Take a large no. of samples to get a smooth curve. Plot all the sub-parts in the same plot using subplot.