Homework Assignment 5

Due: No need to submit

Problem 1. The message signal $m(t)$, whose Fourier transform is shown in Figure 1, is transmitted from Point A to Point B.

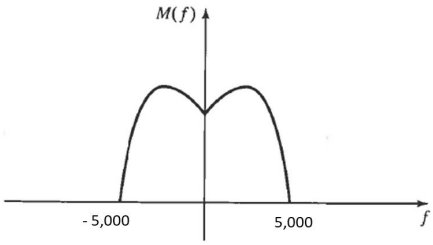

Figure 1: Frequency spectrum for the message in Problem 2.

a) If LSSB AM is employed, what is the bandwidth of the modulated signal?

b) If DSB-SC AM is employed, what is the bandwidth of the modulated signal?

c) If conventional AM is employed where $k_a = 0.8$, what is the bandwidth of the modulated signal?

Problem 2. An SSB-AM signal is generated by modulating an 10kHz carrier by the message signal

$$m(t) = 2B\text{sinc}^2(2Bt),$$

where B =2kHz. The amplitude of the carrier is $A_c = 100$.

a) $\hat{m}(t)$ is the Hilbert transform of $m(t)$. Draw the frequency spectrum (both magnitude spectrum and phase spectrum) of $\hat{m}(t)$.

b) Find $S_{\text{USSB}}(f)$, the Fourier transform of the USSB AM signal. Draw its the magnitude spectrum.

Problem 3. A QAM system is shown in Figure 2. Consider $m_1(t) = sinc(t)$ and $m_2(t) = sinc^2(t)$.

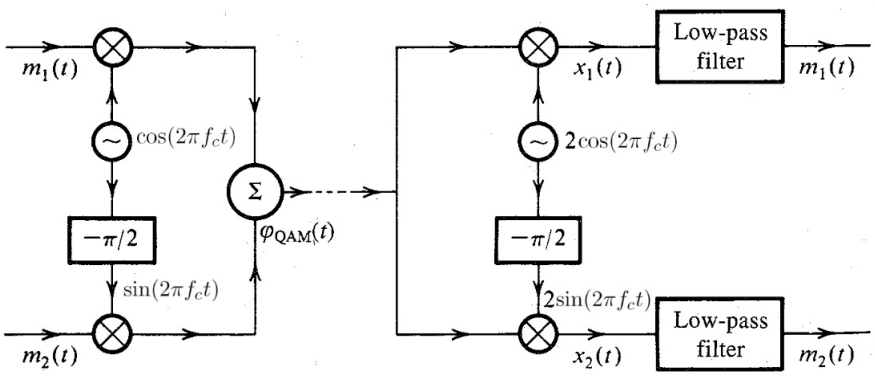

Figure 2: A QAM system in Problem 4.

a) Find $\varphi_{QAM}(t)$ and its bandwidth in Hz.

b) Find the required bandwidth for the low-pass filters at the receiver.

c) If $m_2(t) = \frac{1}{2}sinc^2(2t)$, repeat parts (a) and (b).

d) what does happen if $m_2(t)$ is the Hilbert transform of $m_1(t)$? Comment on the type of the modulation of $\varphi_{QAM}(t)$.