1) Lathi and Ding Chapter 6: 6.1.1, 6.1.6, 6.2.1, 6.2.4.

2) In class and in lab we considered generating PAM signals by multiplying the message signal by a pulse train. Here we consider flattop PAM which is generated in a slightly different way. Here the PAM signal is generated by

\[ x(t) = m(t) \Delta(t) \ast q(t) \]

where \( \Delta(t) = \sum_{k=-\infty}^{\infty} \delta(t-kT) \) is an impulse train and \( q(t) = \Pi((t-\tau/2)/\tau) \) is a pulse. Here we multiply the message signal by an impulse train and then convolve with a pulse. We assume that the pulse width \( \tau < T \), the sampling rate.

a) Using MATLAB generate the a baseband signal, \( m(t) \) and the flattop PAM signal \( x(t) \). Plot signals in time and frequency domain.

b) Write an expression for \( X(f) \) in terms of the baseband signal, \( \tau \), and \( T \).

c) Discuss conditions when \( m(t) \) can be recovered from \( x(t) \). Implement the reconstruction filter in MATLAB and plot the output signal in time and frequency domain. Find expressions for reconstruction filter frequency response, \( H(f) \) and impulse response, \( h(t) \).

3) Find the bandwidth of each of the signals \( d(t) \), \( e(t) \), and \( f(t) \) below. Assume \( l(t) \) and \( m(t) \) are baseband signals with \( B_l = 7000 \text{Hz} \), \( B_m = 5000 \text{Hz} \), \( |l(t)| \leq 10 \), \( |m(t)| \leq 20 \), \( |dl/dt| \leq 200 \), and \( |dm/dt| \leq 100 \), \( f_0 = 10^6 \text{Hz} \), and \( T = 1/12000 \text{sec} \).

\[ d(t) = \sum_{k=-\infty}^{\infty} [m(t)\delta(t-kT)] \ast \Pi(10t/T) \]

\[ e(t) = \sum_{k=-\infty}^{\infty} [l(t)\delta(t-kT/2-T/4)] \ast \Pi(20t/T) + \sum_{k=-\infty}^{\infty} [m(t)\delta(t-kT)] \ast \Pi(10t/T) \]

\[ f(t) = \sum_{k=-\infty}^{\infty} [l(t)\delta(t-kT/2)] \ast (\Pi(10t/T) \cos(\omega_0 t)) + \sum_{k=-\infty}^{\infty} [m(t)\delta(t-kT)] \ast (\Pi(5t/T) \cos(\omega_0 t)) \]

4) If possible, from problem (3) find the simplest system to recover \( m(t) \) and/or \( l(t) \) from each of the signals \( d(t) \), \( e(t) \), and \( f(t) \).

5) Using matlab, generate 10,000 random samples of a signal that is between -.5 and .5. If the signal values are all equally likely between -.5 and .5 (uniform signal), find the power of the message signal. Pass each of the 10,000 samples through a uniform quantizer and determine the MSQE and SNR for quantizers where \( L = 2, 4, 8, 16, \ldots, 512, 1024 \). Make log plots of the MSQE and SNR for the different sized quantizers.