Question 1:

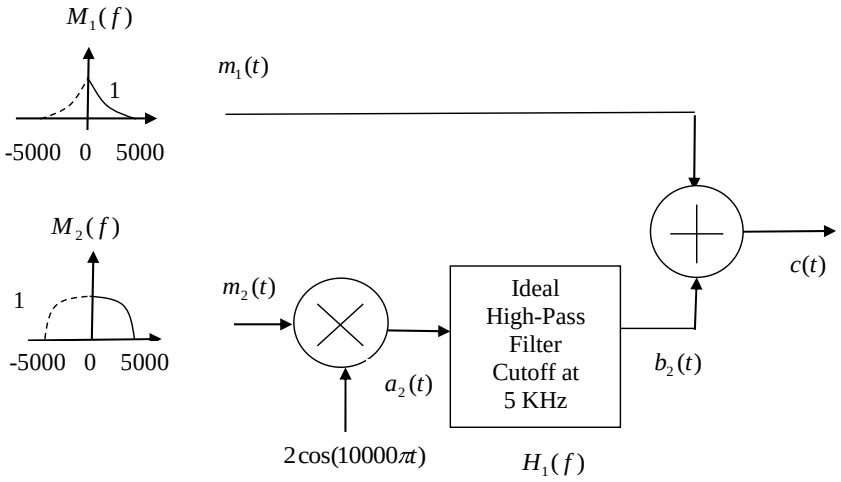
The message signal $m(t)$ with power of 20 mWatts is applied to an analog-to-digital convertor with dynamic range of -1 volt to 1 volt.

a) To transmit this signal by PCM, uniform quantization is adopted. If the SQNR is required to be at least 43 dB, determine the minimum number of bits required to code the uniform quantizer. Determine the SNR obtained with this quantizer.
b) Repeat part a, if a $\mu-$law compander is applied with $\mu=100$ to achieve a uniform quantizer.
c) If the power of the signal $m(t)$ is reduced to 5 mWatts, solve parts a and b and discuss the results.

Question 2:

Two signals $m_1(t)$ and $m_2(t)$ band-limited to 5000 Hz are to be transmitted on a single wireless link. Following steps are considered to prepare these signals for transmission on the wireless link.

a) First following frequency multiplexer is used. Show the frequency spectrum of the output of this system.



b) The output of the system in part "a" is sampled with ideal impulses which have frequency of 150% of the Nyquist rate. Draw the frequency spectrum after the sampler.
c) The sampler output is applied to a $\mu-$law compander with $\mu=100$ and then to a linear quantizer. SQNR of the quantizer has to be at least 45 dB. The output of the quantizer is transferred to a serial bit stream to be transmitted via a digital communication link. Calculate minimum required baseband bandwidth of the wireless link, if the information is sent bit by bit.

   Note: Assume that equation 6.36 can be used for SQNR.

d) What is the baseband bandwidth of the wireless link if a Raised cosine pulse shaping with roll-off factor of 20% is used.

Question 3:

Two signals $m_1(t)$ and $m_2(t)$ band-limited to 5000 Hz are to be transmitted on a single wireless link. Following steps are considered to prepare these signals for transmission on the wireless link.

a) Each of the signals $m_1(t)$ and $m_2(t)$ are sampled with ideal impulses which have frequency of 150% of the Nyquist rate.
b) Then the output of each sampler output is applied to a $\mu-$ law compander with $\mu = 100$ and then to a linear quantizer. Calculate the minimum number of bits required to represent each sample (L) of the quantizer, if SQNR of the quantizer has to be at least 45 dB.

   Note: Assume that equation 6.36 can be used for SQNR.

c) The outputs of quantizers are time multiplexed and a bit stream is produced to be transmitted via a digital communication link. Calculate minimum required baseband bandwidth of the wireless link if the information is sent bit by bit.
d) What is the baseband bandwidth of the wireless link if a Raised cosine pulse shaping with roll-off factor of 20% is used.

Question 4:

The Fourier transform $P(f)$ of the basic pulse $p(t)$ used in a binary communication system is shown in the figure.

a) From the shape of $P(f)$, explain at what pulse rate this pulse would satisfy Nyquist's first criterion.
b) Explain why using this pulse does not cause inter bit interference (ISI).
c) Explain how much is the excess bandwidth and find the roll-off factor.