(13%) 1. A receiver is constructed as shown in Figure 1.
r(t)=(1-t)[u(t)-u(t-1)]+n(t), where u(t)=unit step function, and n(t) is AWGN with PSD=A.
(a) Determine and sketch the impulse response of h(t) to maximize SNR at the sampling time Ts. (6%)
(b) What is the SNR at the sampling time Ts ? (7%)

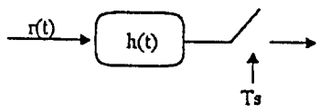

Figure 1.

(14%) 2. (a)If the amplitude of signal x(t) is uniformly distributed over (-1,1), design a 8-level optimal uniform quantizer for this signal and determine S/Nq, the signal to quantization noise ratio.
(b)If the probability density function of the amplitude of x(t) is a triangular function over (-1,1), determine S/Nq if we still use the same uniform quantizer designed in (a).

(15%) 3. If the one-sided mainlobe bandwidth of a channel is limited to 3KHz, what is the maximum achievable data rate by using the following modulation schemes?
(a) 16QAM (b)QPSK (c)Unipolar NRZ (d)Manchester code (e)duobinary code.

(16%) 4. (a)Determine the correction probability of a 4-bit message which is sent by an uncoded system. Assume the coherent BPSK system is used and the received Eb/No=7dB. You may express your answer in term of Q(x), where

$$Q(x)=\int_x^\infty \frac{1}{\sqrt{2\pi}} e^{-y^2/4}\,dy.$$

(b)Same as (a) except that the message is sent through a (7,4) error- correction code with dmin=3.

(10%) 5. Are the following functions suitable to be the power spectral density function of some real random signal? You must explain the reasons and u(·) is the unit step function.
(a) A[u(f)-u(f-2)]
(b) A cos (5f)
(c) A[u(f+1)-u(f-1)]
(d) A[u(f-1)-u(f+1)]
(e) A[u(f-1)+u(-f-1)]

(16%) 6. An FM modulator has unmodulated carrier c(t)=10cos(200 π t) and the frequency-deviation constant fd=10. The modulator has input m(t)=2cos(10 π t).
(a) Express the output of this modulator.
(b)Determine the peak frequency deviation.
(c)Determine the power of the output signal.
(d)What is the bandwidth according to the Carson's rule?

(16%) (7) An AM modulator is shown in Figure 2.
The input message is m(t)=2cos(10 π t)-5cos(20 π t). The carrier is c(t)=10cos (100 π t). The modulation index of this system is 0.5.
(a)What is the value of A?
(b) Determine the total output power.
(c) Determine the power efficiency of the modulator.
(d)Sketch the single-sided spectrum of the modulator output.

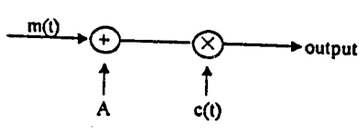

Figure 2.