ECEG-3174: Introduction to Communication Engineering
Worksheet III

Review of random Processes

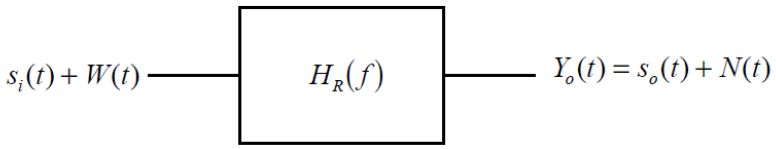
Q#1

Given a random process x(t) = k, where k is an RV uniformly distributed in range (-1,1).

a) Sketch the ensemble of this process.
b) Determine $\overline{x(t)}$.
c) Determine $R_x(t,\tau)$.
d) Is the process wide-sense stationary?
e) If the process wide-sense stationary, what is its power P_x[that is, its mean square value$\overline{x^2(t)}$]?

Q#2

Real valued additive white Gaussian noise (two sided spectral density $N_0/2$) is input into a linear time invariant filter with a real valued impulse response $h_R(t)$ where $h_R(t)$ is constrained to have a unit energy (see Fig. below where $s_i(t) = 0$).



$$H(f) = 2 \quad |f| \le 10$$
$$= 0 \quad \text{elsewhere.}$$

Calculate the output correlation function and PSD of Y_o(t)

Effect of Noise on Linear Modulation

Q#1

A 10 KW transmitter amplitude modulates a carrier with a tone $m(t) = \sin(2000\pi t)$, using 50 percent modulation. Propagation losses between the transmitter and the receiver attenuate the signal by 90 dB. The receiver has a front-end noise with spectral density $N_o = -113$ watts/Hz and includes a bandpass filter with bandwidth $B_T = 2W = 10\ KHz$. What is the post-detection signal-to-noise ratio, assuming that the receiver uses an envelope detector?

Q#2

An FM system, operating at a pre-detection SNR of 14 dB, requires a post-detection SNR of 30 dB, and has a message power of 1 watt and bandwidth of 50 kHz. Using Carson's rule, estimate what the transmission bandwidth of the system must be. Suppose this system includes preemphasis and de-emphasis network with of 10 kHz. What transmission bandwidth is required in this case?

Q#3 In a cetain FM system used in space commuication, the output SNR is found to be 23.4 dB with $\beta = 2$. The message signal m(t) is gaussian with banwidth of 10 KHz, and

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Introduction to Digital Communication Systems

Q#1

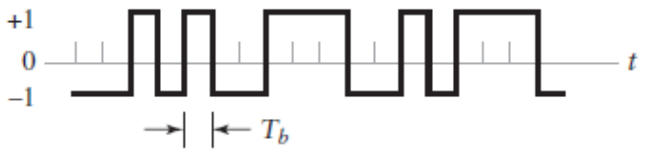
A sinusoidal signal $m(t)$ band limited to 3 kHz is sampled at a rate $33\frac{1}{3}\%$ higher than the Nyquist rate. The maximum acceptable error in the sample amplitude (the maximum quantization error,$\Delta/2$) is 0.5% of the peak amplitude m_p. The quantized samples are binary coded. Find

a. The quantization level and signal to-quantization noise (SNRq)
b. The transmission rate and the minimum bandwidth of a channel required to transmit the encoded binary signal.
c. If 24 such signals are time-division-multiplexed, determine the minimum transmission bandwidth required to transmit the multiplexed signal.

Q#2

Figure 2 shows a PCM signal in which the amplitude levels of $+1$ volt and -1 volt are usedto represent binary symbols 1 and 0, respectively. The code word used consists of three bits. Find the Quantized sampled version of an analog signal from which this PCM signal is derived.

Fig 1.



Q#3

Given the data stream 1110010100, sketch the transmitted sequences of pulses for each of the following line codes:

a. Unipolar nonreturn-to-zero
b. Polar nonreturn-to-zero
c. Unipolar return-to-zero
d. Bipolar return-to-zero
e. Manchester code