Concordia University
Department of Electrical and Computer Engineering
ELEC6831/ELEC462: Digital Transmission Systems
Midterm Exam
Summer 2011

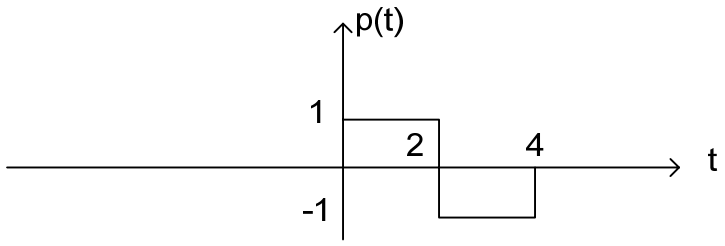
1) Consider a random signal where every T seconds a pulse of amplitude +2 or -1 is generated. The two levels have the same probability. The start time of the first pulse for $t > 0$ is denoted as t_d and is a random variable distributed uniformly between 0 and T.

a) Find the autocorrelation function of the above signal (2 Marks).
b) Find the power spectral density (2 Marks).

2) An analog video signal with a bandwidth of 5 MHz. is sampled at one and half times the Nyquist rate. The signal is then quantized using a uniform quantizer. The resulting output is then sent over a channel with a bandwidth of 94 MHz. using binary PAM with a raised cosine pulse with a roll-off factor of $\alpha = 0.25$.

a) Find the maximum number of quantiozation levels possible (2 Marks).
b) Find the resulting Signal-to-Quantization-Noise Ratio (make any reasonable assumption if necessary). (1 Mark).

3) Find the matched filter for the following baseband pulse (1 Mark):



b) Find the output of the matched filter (2 Marks).

4) A communication system uses binary PAM where a 1 is represented by +1 and 0 is represented as -1. The bit rate is 1 Mbps. The channel noise is AWGN with a spectral density of $N_0 / 2 = 10^{-7}$.

a) Find the bit error rate (2 Marks).
b) What would be the bit error rate if the data rate is reduced to 500 kbps (1 Mark).
c) What would be the bit error rate if, in part (b) the signalling is changed to quaternary PAM? (2 Marks)

5) Twelve analog channels each with a bandwidth of 3.6 kHz are sampled at 25% higher than the Nyquist rate. Each sample is then quantized and encoded using a 258 level quantizer. The resulting bit streams are then multiplexed. In each frame, in addition to the information from each channel, there will be one bit for synchronization and two bits for signalling.

a) What is the bit rate of each channel? (1 Mark).
b) Find the overall bit rate (3 Marks).
c) What is the efficiency of the system? (1 Mark).