

Concordia University
Department of Electrical and Computer Engineering
ELEC462: Digital Transmission Systems
Midterm Exam
Winter 1999

- 1) A Gaussian random variable X has a mean A and a variance A^2 . What is the probability that X is greater than $4A$? (20 Marks) (Numerical value is required.)
- 2) A random process $x(t)$ has the following autocorrelation function,

$$R_X(\tau) = \frac{K}{4} \exp\left(-\frac{|\tau|}{K}\right).$$

Find the mean squared value of $x(t)$. (5 Marks)

- 3) An analog audio signal with a bandwidth of 15 kHz. has to be sampled and quantized using a uniform quantizer.
 - a) What is the minimum required sampling rate? (5 Marks)
 - b) For a signal-to-quantization-noise ratio of 89 dB, what is the required number of bits per sample? (Make any *reasonable* assumption you judge necessary.) (10 Marks)
 - c) What is the required bandwidth for transmitting the quantized signal if a raised cosine pulse with a roll-off factor of $\alpha = 0.4$ is used? (15 Marks).
- 4) In a binary transmission system, a "1" is represented by a positive voltage $+A$ for T_b seconds and a "0" is represented by a ground (zero volts) for T_b seconds. The channel is AWGN with power spectral density $\frac{N_0}{2}$ and the input symbols are equiprobable.
 - a) Draw the block diagram of the receiver. (5 Marks)
 - b) Find the probability of bit error in terms of A , N_0 and T_b . (20 Marks)
 - c) Find a relationship between A , N_0 and T_b such that the bit error probability is 10^{-6} . (10 Marks)
 - d) What would be the error probability if the transmission rate is doubled? (everything else remaining unchanged) (10 Marks)