AMERICAN UNIVERSITY OF BEIRUT
FACULTY OF ENGINEERING AND ARCHITECTURE
ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT

QUIZ # 2

FALL 2002-2003

Friday, January 3, 2003

TIME: 1 HOUR

CLOSED BOOK EXAM

INSTRUCTOR: DR. JEAN J. SAADE

NAME:______________________ **ID #:** _________________

All problems are equally graded

QUESTION # 1

Consider a rectangular pulse g(t) extending between 0 and T seconds and having a height equal to A volts. Let g(t) be present at the input of a ***normalized*** matched filter receiver with impulse response h(t). Determine and plot the output, $g_o(t)$, of the matched filter prior to sampling.

QUESTION # 2

Consider again Problem # 1 and let the pulse g(t) added to noise, W(t), be present at the input of the ***normalized*** matched filter receiver h(t). W(t) is a stationary white and Gaussian noise process with zero mean and spectral height $N_0/2$. Let the matched filter output, Y(t), be written as: $Y(t) = g_o(t) + N(t)$. Determine the average power of the noise process at the output of the matched filter.

QUESTION # 3

Consider again Problem # 2 and let [g(t)+W(t)] be present at the input of the matched filter receiver if bit 1 is transmitted and W(t) only be present at the input of h(t) if bit 0 is transmitted. Let Y(t=T)=Y be the input of the decision-making device used after the matched filter-sampler combination. Determine the probability density functions of the random variable Y given that 1 is transmitted and then given that 0 is transmitted.

QUESTION # 4

Consider again Problem # 3 and let the decision-making device implement the following decision rule: Decide 1 if $y > \frac{A\sqrt{T}}{2}$ and decide 0 if $y < \frac{A\sqrt{T}}{2}$. Determine the expression of the error probability if bits 0 and 1 have equal a priori probability values.

QUESTION # 5

Consider PNRZ transmission technique and let g(t), which is a rectangular pulse extending between 0 and T seconds and having a height equal to A volts, be used to represent the bit 1. Let the channel-detector combination be represented by the following linear, time invariant and non-ideal filter impulse response:

$$h(t) = \begin{cases} exp\{-t\}, \ t \geq 0, \\ 0, elsewhere. \end{cases}$$

Consider the transmission of the 2-bit sequence 11. Let the output of the channel-detector combination be sampled at t=T and 2T. Determine and show graphically the value of the ISI term at t=2T.

QUESTION # 6

Consider the obtained optimum transmitter and receiver in base-band data transmission and under the case of a non-ideal channel. Assume that the channel frequency response H(ω) is known. Use the relationship between P(ω), G(ω), C(ω) and H(ω) to show that if P(ω) is used to realize G(ω) and C(ω), then P(ω) or p(t) is guaranteed to be obtained at the output of the receiver.