GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING
Quiz - Spring, 2008
ECE 4601: Communication Systems

Aids Allowed: Text, $8\frac{1}{2} \times 11$ crib sheet (one side)
Attempt all questions
Questions are of equal value

DATE: Thursday February 21, 2008.
TIME: 9:35 - 10:55
INSTRUCTOR: Dr. G.L. Stüber

1) Consider a wide sense stationary random process $X(t)$ having an autocorrelation function

$$\phi_{XX}(\tau) = \text{sinc}(2\tau/T) \ .$$

The process is applied to a linear time invariant filter having the impulse response

$$h(t) = A\text{sinc}((t - t_o)/T)$$

a) 1 mark What is the input mean μ_X?

b) 1 mark What is the total power in the process $X(t)$?

c) 4 marks What is the output autocorrelation function $\phi_{YY}(\tau)$?

d) 2 marks For what sampling rates, R, are the output samples $y_k = y(k/R)$ uncorrelated?

e) 2 marks What is the covariance matrix, $\mathbf{\Lambda}$, for the random variables $Y_1 = Y(t_1)$ and $Y_2 = Y(t_1 + T/2)$?

2) Consider a binary antipodal communication system (one where $0 \rightarrow -g(t)$ and $1 \rightarrow g(t)$) using the pulse $g(t) = \text{rect}((t-T)/T)$. The channel has the impulse response

$$c(t) = 0.5\delta(t - T/2) + 0.25\delta(t - T)$$

and AWGN $n(t)$ is present with a power spectral density of $N_o/2$ watts/Hz. The receiver employs a filter $h(t)$ that is matched to the pulse $g(t)$. The filter output is $y(t)$.

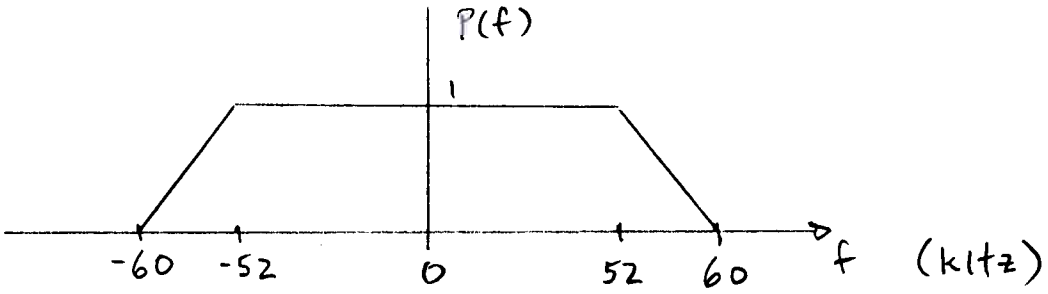
a) 4 marks Determine and sketch the overall pulse $p(t)$.

b) 3 marks Does the sampled pulse $p_k = p(kT)$ result in zero ISI?

c) 3 marks What is the output of the receiver filter at time kT, i.e., what is $y_k = y(kT)$?

3)

a)5 marks: Consider the pulse $P(f)$ shown below. Can this pulse be used to communicate with zero-ISI and, if so, at what baud rate?



b)5 marks: Suppose that baseband binary data is transmitted over an ideal channel at a rate of 54 Mbps, such that the overall pulse $p(t)$ is a raised cosine pulse with roll-off factor α. Determine transmission bandwidth that is required for $\alpha = 0.25, 0.5, 0.75, 1$.