GEORGIA INSTITUTE OF TECHNOLOGY
SCHOOL OF ELECTRICAL AND COMPUTER ENGINEERING
Quiz - Spring, 2010
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 25, 2010.
TIME: 9:35 - 10:55
INSTRUCTOR: Dr. G.L. Stüber

1) Random Processes: Suppose that the inputs $X(t)$ and $Y(t)$ to a multiplier are independent random processes with power spectral densities

$$\begin{aligned} S_X(f) &= 5\text{rect}\left(\frac{f}{10}\right) \\ S_Y(f) &= 2\text{rect}\left(\frac{f}{6}\right) \end{aligned}$$

a) 7 marks: Compute and sketch the power spectral density at the output of the multiplier.

b) 3 marks: What is the total power at the output?

2) Consider a binary communication system that transmits information using the pulse

$$g(t) = A[-u(t) + 2u(t - T/2) - u(t - T)]$$

according to the mapping rule

$$\begin{aligned} \text{“0”} &\longrightarrow -g(t) \\ \text{“1”} &\longrightarrow +g(t) \end{aligned}$$

The “0”s and “1”s are transmitted with equal probability, and the channel is an AWGN channel, with a two-sided noise power spectral density of $N_o/2$ watts/Hz.

a) 3 marks Determine and sketch the filter $h(t)$ that is matched to $g(t)$.

b) 3 marks Determine and sketch the overall pulse $p(t) = g(t) * h(t)$ for the filter you found in part (a), labelling all important points.

c) 2 marks Determine the pulse energy, E, and the energy per bit, E_b.

d) 2 marks What is the probability of bit error in terms of E_b/N_o?

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 $\alpha = 1/3, 2/3, 1$.