ECEN5533 Exam #2 11 November 2008 Name_____

1) m(t) is a 700 symbol/second random 3-ary square wave. 1/3rd of the time m(t) is a +4 volt pulse, 1/3rd of the time m(t) = 0 volts, and 1/3rd of the time m(t) = -4 volts. Suppose m(t) is contaminated by 3.1 watts of additive Gaussian noise n(t), yielding y(t) = m(t) + n(t).
[25] If y(t) is input to a *single sample detector*, **compute** the P(symbol error). [Answer: 0.1707]

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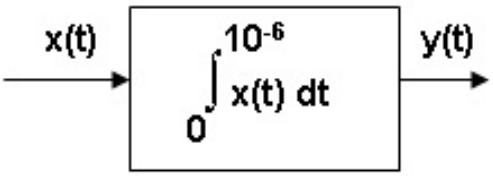
2) **Find** the transfer function H(f) for the system shown. **Sketch** |H(f)|.
[$H(f) = 10^{-6}\text{sinc}(f10^{-6})e^{-j0.5f10-6}$. You should sketch a |sinc| function with peak value 10-6 and nulls at interger multiples of 1 MHz.]



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3) A zero mean, 1 watt noise voltage n(t) is being observed on a digital oscilliscope. An average voltage y(t) is formed by adding together two sampled voltages taken 0.1 seconds apart, i.e. y(t) = [n(t) + n(t + 0.1)]/2. From statistics you know that the two sampled voltages would be statistically independent if drawn from a wideband noise signal and therefore the power of the average y(t) would be the power of n(t)/2, or 1/2 watt. However in our case the noise waveform n(t) is narrow band with autocorrelation $R_{NN}(\tau) = e^{-|\tau|}$.
[25] Given this autocorrelation, **compute** the power of y(t). [0.9524 watts]

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4) Your boss wants you to design a 10 Mbps wireless system, yet only use 40 KHz of RF bandwidth.
4a) [10] What would be the maximum symbol rate you would expect to be able to successfully move through this amount (40 KHz) of bandwidth? Explain. [From notes and p.524 of text, 40 K symbols/sec to maybe 56 K to 72 K symbols/sec]

4b) [5] An M-Ary signaling scheme is going to have to be used. What value of M will this system require? Explain. [Each symbol needs to represent somewhere between 138.9 to 250 bits, depending on the baud rate, so need $M \geq 6.502*10^{41}$ to $1.809*10^{75}$. This doesn't look too practical.]

4c) [10] What SNR will you need? Explain. [Using Channel Capacity equation, and assuming a 40 KHz bandwidth, $1.809*10^{75}$].

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