ECEN4503 Final Exam 2 May 2011

1) A zero mean, 5 watt, 10,000 bps random binary square wave x(t) is input to a differentiator, yielding $y(t) = \frac{d}{dt} x(t)$.

1a [20] Sketch $S_{XX}(\omega)$. [You should sketch a sinc^2 function with a peak value of 0.0005 watts/(rad/sec) and nulls at ± intervals of 20,000π radians/sec.]

1b [20] Sketch $S_{YY}(\omega)$. [You should sketch 10 - 10 cos(2πt/10,000)]

<<<<<>>>>>

2) A random voltage $Y = e^X$, where X is a voltage with PDF $f_X(x) = (x + 1)/2$; $-1 \le x \le 1$.

[40] **Find a simplified equation** for $f_Y(y)$. [$f_Y(y) = (\ln(y) + 1)/(2y)$; $0.3679 \le y \le 2.718$]

<<<<<>>>>>

3) A waveform y(t) = x(t) + n(t), where x(t) is a 1 vdc, seven watt Gaussian distributed signal and n(t) is statistically independent, 1 vdc, two watt, Gaussian distributed white noise.

3a [5] **Compute** the DC voltage of the output y(t). [2 volts DC]

3b [10] **Compute** the AC rms voltage of the output. [2.646 volts rms]

3c [10] **Compute** the P($y(t) \ge 4.7$ volts). [0.1539]

3d [10] **Compute** the P($y(t) > 4.7$ volts). [0.1539]

<<<<<>>>>>

4) In a climate controlled rain forest exhibit at a museum during the month of October, suppose the (temperature at noon tomorrow) = 0.99(temperature at noon today) + (a zero mean Gaussian distributed random number with a variance of 3 degrees).

[20] **Compute** P(temperature at noon tomorrow ≥ 89° F | temperature at noon today = 86° F) [0.1291]

5) You've purchased a house that's on a 30 year flood plain, i.e. the probability your house floods in any single year is 1/30.

[15] **Compute** P(your house will flood 1 or more times in the next 15 years). Note any assumptions you've made in determining your answer. [Assuming floods from one year to the next are independent, 0.3986]