

ECEN4503 Exam #2 8 April 2011

1) A random signal $z(t)$ is formed by adding together two statistically independent random signals $x(t)$ and $y(t)$, i.e. $z(t) = x(t) + y(t)$. Note that this is equivalent to stating a random voltage Z equals the sum of two other random voltages X and Y ; i.e. $Z = X + Y$. $x(t)$ has voltage PDF $f_X(x) = 0.9\delta(x+7) + 0.1\delta(x-1)$, while $y(t)$ has voltage PDF $f_Y(y) = 0.4\delta(y) + 0.6\delta(y-6)$.

[25] **Sketch** $f_Z(z)$.

[You should sketch $f_Z(z) = 0.36\delta(x+7) + 0.54\delta(x+1) + 0.04\delta(x-1) + 0.06\delta(x-7)$]

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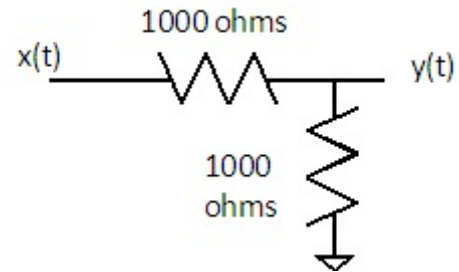
2) The input to a digital receiver $y(t)$ consists of a 10,000 bits/second random binary square wave $x(t)$ contaminated by statistically independent noise $n(t)$; i.e. $y(t) = x(t) + n(t)$. $x(t)$ is known to have voltage PDF $f_X(x) = 0.5\delta(x) + 0.5\delta(x-5)$. $n(t)$ is known to be a zero mean, 0.4 watt, Gaussian distributed random noise voltage.

2a) [10] **Compute** the DC voltage of $y(t)$. [2.5 volts DC]

2b) [15] **Compute** the total power of $y(t)$. [12.9 watts]

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3) A random signal $x(t)$ is known to be Gaussian Distributed with a mean $E[X] = 0$ volts and standard deviation $\sigma = 2$ volts. This voltage is input to circuit shown to the right, yielding an output $y(t)$.



[25] **Compute** $P(y(t) > 1 \text{ volt})$ [0.1587]

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4) A waveform $x(t) = 3.2\sin(2\pi 5000t)$

4a [15] **Sketch** the autocorrelation $R_{XX}(\tau)$. [You should sketch a 5000 Hz, 5.12 watts/peak cosine.]

4b [5] You hook a volt-ohmmeter to this waveform and flip it to V dc. What value will you read? [0 volts DC]

4c [5] You hook a volt-ohmmeter to this waveform and flip it to V ac. What value will you read? [2.263 volts rms]

