ECS 452: In-Class Exercise # 17

Instructions

1. Separate into groups of no more than three persons.
2. The group cannot be the same as any of your former groups for this class.
3. Only one submission is needed for each group.
4. ***Write down all the steps*** that you have done to obtain your answers. You may not get full credit even when your answer is correct without showing how you get your answer.
5. **Do not panic.**

Date: 1 8/ 0 5/ 2017			
Name	ID (last 3 digits)		
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A digital communication system transmits a stream of bits by mapping each block of four bits to one of the possible waveforms $s_1(t), s_2(t), \ldots, s_M(t)$. The waveform is then transmitted via a communication channel which corrupts the waveform by independently adding a white noise process $N(t)$ whose power spectral density is given by $S_N(f) = \frac{N_0}{2} = 4$.

a. What is the value of *M*?

Four bits $\Rightarrow$ 16 possibilities for the block

$\Rightarrow$ need 16 different waveforms to represent 16 blocks.

b. What is the expected power of the noise in the band of frequency from -3 to 3?

Because $S_N(f)$ is the power spectral density of the noise process, we integrate it to get the amount of power:

$$\int_{-3}^{3} S_N(f)\,df = \int_{-3}^{3} \frac{N_0}{2}\,df = 6 \times \frac{N_0}{2} = 6 \times 4 = 24$$

Remark: compare this with the concept of probability density function; we integrate the pdf to get probability.

c. Suppose we apply GSOP to the *M* waveforms to obtain the orthonormal axes $\phi_1(t), \phi_2(t), \ldots, \phi_K(t)$.

See 7.26f

Assume that we get *K* = 2. Let $N_j = \langle N(t), \phi_j(t) \rangle$. Find

i. $\mathbb{E}[N_1] = 0$

ii. $\mathrm{Var}[N_1] = \frac{N_0}{2} = 4$

iii. $\sigma_{N_1} = \sqrt{\mathrm{Var}[N_1]} = \sqrt{4} = 2$

iv. $\mathbb{E}[N_1 N_2] = 0$