

Homework #10

Due on December 7 Tuesday, in Class

1. [10 points](L&D Exercise 10.2-1) For a DSB-SC system with a channel noise PSD of $S_n(f) = 10^{-12}$ and a baseband signal of bandwidth 5 kHz, the receiver output SNR is required to be at least 47 dB. The receiver is as shown in lecture notes.

- (a) What must be the signal power S_i received at the receiver input?
- (b) What is the receiver output noise power N_0 ?

2. [10 points](L&D Exercise 10.2-2) Repeat Problem 1 for SSB-SC.

3. [10 points](Adapted from L&D Exercise 10.2-3) Assume $\max_t m(t) = m_p$ in an AM system.

- (a) Show that the output SNR for AM given in

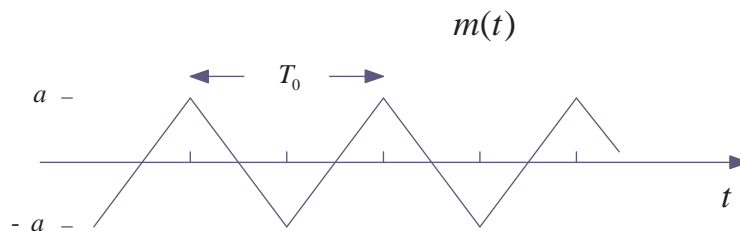
$$\frac{S_0}{N_0} = \frac{E[m^2]}{A^2 + E[m^2]} \gamma$$

can be expressed as

$$\frac{S_0}{N_0} = \frac{\mu^2}{k^2 + \mu^2} \gamma$$

where $k^2 = m_p^2/E[m^2]$ and μ is the modulation index.

(b) For the periodic triangle message signal shown below, suppose $\mu = 1$. Express the SNR given in (a) in terms of γ , a , and T_0 . (Hint: Compute $E[m^2]$ as the time average.)



4. [10 points] Consider a single tone signal $m(t) = \alpha \cos 2\pi f_m t$. Express S_0/N_0 for FM in terms of α , f_m , k_f , and γ .

5. [10 points] Consider the message signal $m(t)$ shown in the figure in problem 3(b). Assume that the bandwidth of $m(t)$ is the frequency of its fifth harmonic frequency. Show that PM is superior to FM by a factor of approximately 20 from the SNR point of view, i.e., compute $\frac{\{S_0/N_0\}_{PM}}{\{S_0/N_0\}_{FM}}$.