

**EECS 353, Winter 2004**  
**Introduction to Communications Systems**

Homework 8  
Due: Fri Mar 19, 2004

• Reading:

1. **Lathi:** Sec. 12.2-12.3

• Exercises in Lathi:

1. Ex. 12.1-2 p. 572
2. A baseband system is described by Fig. 12.2 (p. 533) where  $H_p(\omega) = H_c(\omega) = 1$ . A non-ideal lowpass noise rejection filter (LPF) with transfer function  $H_d(\omega) = W/(W + j\omega)$  is implemented as the baseband receiver. Assume that the noise  $n(t)$  is white with PSD  $S_n(\omega) = \mathcal{N}/2$  and that the transmitted signal has PSD:

$$S_m(\omega) = \begin{cases} S_i/2B, & |\omega| \leq 2\pi B \\ 0, & o.w. \end{cases}.$$

- (a) Derive an expression for the output SNR  $\gamma = S_o/N_o$  as a function of  $W$ .
  - (b) Derive an expression for the power of the signal distortion  $m(t) - h_d(t) * m(t)$  at the output of the LPF (Hint: the signal distortion has PSD  $|1 - H_d(\omega)|^2 S_m(\omega)$ ).
  - (c) Find an expression for the output distortion as a function of  $\gamma$  (Hint: find  $W$  in terms of  $\gamma$  in the expression obtained in part (a) and plug into your expression for (b)). Plot this function for  $B = 15\text{kHz}$ .
3. Ex. 12.2-1, p 573
  4. Ex. 12.2-2, p 573
  5. Ex. 12.2-6, p 573