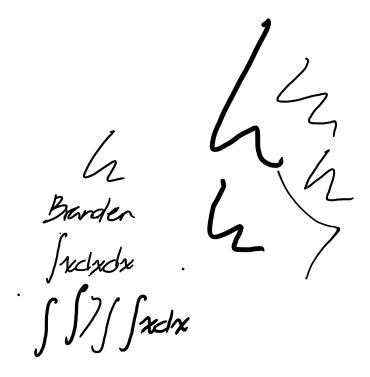# EE 343 Problem Set 6

1. **9.4-1** Two independent random voltage processes $x_1(t)$ and $x_2(t)$ are applied to an RC network, as shown in figure 9.14. The two random noise processes have the following PSD:

$$S_{x_1} = \frac{2\alpha}{\alpha^2 + (j2\pi f)^2} \qquad S_{x_2} = K$$

Find the PSD and the power P_y of the output random process y(t).

• **11.1-4** An alternative to the optimum filter is a suboptimum filter, where we assume a particular filter form and adjust its parameters to maximize ρ. Such filters are inferior to the optimum filter but may be simpler to design.

For a rectangular pulse $p(t)$ of height A and width T_b at the input, determine ρ_{max} if, instead of the matched filter, a one-stage RC filter with $H(\omega) = 1/(1 + j\omega Rc)$ is used. Assume a white Gaussian noise of PSD $\mathcal{N}/2$. Show that the optimum performance is achieved when $1/RC = 1.26/T_b$.

Hint: Set $d\rho^2/dx = 0 (x = T_b/RC)$.

2. Let X1 and X2 be iid Gaussian random variables with mean 0 and variance 1.
   (a) Let $Y_1 = X_1 - 2X_2 + 1$ and $Y_2 = 2X_1 + X_2 - 1$. Find the E(Y1), E(Y2), VAR(Y1), VAR(Y2),
   and the COV(Y1,Y2).
   (b) Find the joint pdf of Y_1 and Y_2. What type of random vector is this?
   (c) Find a linear transformation of Y_1 and Y_2 to produce Z_1 and Z_2 that are iid

Gaussian random variables with mean 0 and variance 1.

(d) Implement the random variables in a) -c) on MATLAB. Find the sample means, variances, and
covariances. Is the transformation unique?

3.