Assignment-8 : Papoullis Chapter 10

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Outline

Question

Problem 10.23

(Cauchy inequality) Show that $|\sum_i a_i b_i|^2 \leq \sum_i |a_i|^2 \sum_i |b_i|^2$ with equality iff aj $=$kb$_i^*$.

Solving a

(a)

Since $|\sum_i a_i b_i|^2 \leq \sum_i |a_i|^2 \sum_i |b_i|^2$, it suffices to assume that the numbers a_i and b_i are real. The quadratic

I(z) $= \sum_i (a_i - zb_i)^2 =$ z$^2 \sum_i b_i^2$ - 2z $\sum_i a_i b_i + \sum a_i^2$

is nonnegative for every real z, hence, its discriminant cannot be positive. This yields (i).

Solving b

(b)

With f[n] and $R_v[m] = S_o\delta[m]$.

$$y_f[n_o] = \sum h[n]f[n_o - n] \qquad y_v[n] = \sum h[n]v[n]$$

$$Ey_v^2[n] = s_o p[o] = s_o \sum |h[n]|^2$$

From $S_{xx}(e^{jw} \geq 0)$ and (i) yields

$\frac{y_f^2[n_o]}{Ey_v^2[n]} = \frac{\sum h[n]f[n_o - n]}{s_o \sum |h[n]|^2} \leq \frac{1}{s_o} \sum |h[n]|^2$

with the equality iff $h[n] = kf^*[n_o - n]$.