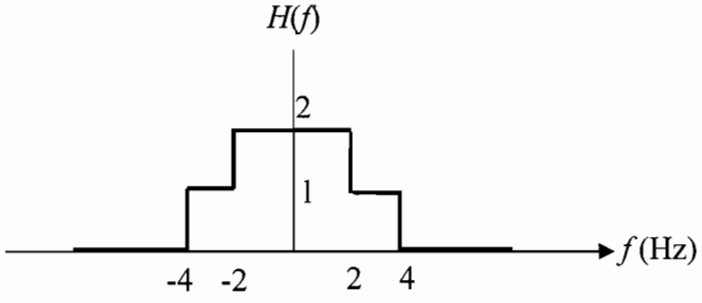
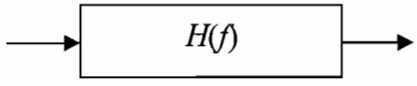
King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE571: Communications Engineering II (081)
Quiz 1

Serial #
0
- 1 points for not writing your serial number

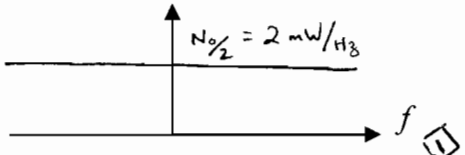
Name: KEY

A white Gaussian noise $w(t)$ with zero mean and N_0= 4E-3 Watts/Hz is applied to the input of a linear time invariant system. The transfer function of the filter is shown in the Figure:

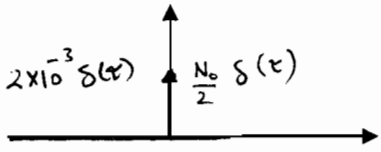




a) Sketch the power spectral density and the autocorrelation for the input white noise.

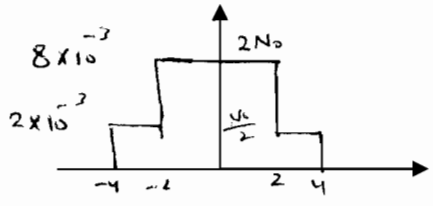


[1]



[1]

b) Sketch the power spectral density of the filtered noise?



[2]

$$\Phi_{yy}(f) = \Phi_{xx}(f)\,|H(f)|^2$$

c) Calculate the output noise power.

[1] Average power = area of $\Phi_{yy}(f) = 2N_0(2) + \frac{N_0}{2}(2+2) = 8N_0 + 2N_0 = 40$ mWatts.

d) Find and the autocorrelation of the filtered noise. Hint: $2W\,\mathrm{sinc}(2Wt) \Leftrightarrow \Pi\left(\frac{f}{2W}\right)$

$$\Phi_{yy}(f) = \frac{N_0}{2}\Pi\left(\frac{f}{8}\right) + \frac{3}{2}N_0\Pi\left(\frac{f}{4}\right)$$

[2]

$$\phi_{yy}(\tau) = \frac{N_0}{2}(8)\,\mathrm{sinc}(8\tau) + \frac{3N_0}{2}(4)\,\mathrm{sinc}(4\tau)$$

$$= 4N_0\,\mathrm{sinc}(8\tau) + 6N_0\,\mathrm{sinc}(4\tau) = 16\times10^{-3}\,\mathrm{sinc}(8\tau) + 24\times10^{-3}\,\mathrm{sinc}(4\tau)$$

e) Do you think the output noise will be correlated or uncorrelated? State why?

[1] Yes in general samples will be correlated except at certain points because the auto correlation function is not delta any more.

f) If the input signal is sinusoidal wave corrupted with noise: $5\cos(\pi t) + w(t)$, What would be the signal to noise power ratio at the output.

[2] output will be $10\cos(\pi t_1) + n(t)$; $f = 0.5$

power $= \frac{10^2}{2} = 50$

$$SNR = \frac{50}{40\text{ m}} = 1.25\text{ K} = 1250$$

When you sketch show all important values on the sketch Good Luck, **Dr. Ali Muqaibel**