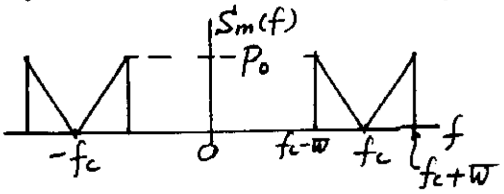
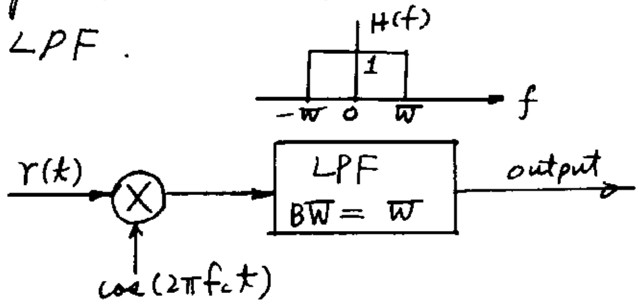
國立台灣工業技術學院 （命題用紙）
八十六學年度碩士班招生考試試題 第 1 頁共 2 頁

所別：學程別：電子工程技術研究所 組別：系統組 科目：通信系統

1. (20%) A DSB-SC AM signal with power-spectral density $S_m(f)$ as shown in figure is corrupted with additive noise that has a power-spectral density $N_0/2$ within the passband of the signal. The received signal-plus noise is demodulated and lowpass filtered as shown. Determine the SNR at the output of the LPF.

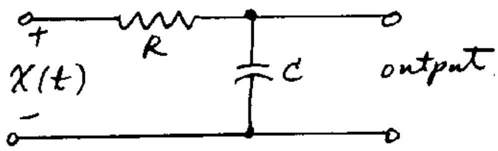




2. (20%) ① Consider a random process with the sample function as

$$x(t) = A + w(t)$$

where A is a constant, w(t) is a white Gaussian noise with zero mean and power spectral density $\frac{N_0}{2}$. Now, x(t) is applied to a RC low pass filter. Taking A as a signal, find the output signal-to-noise ratio.



② Same problem as ①, but A is replaced by $A_c \cos(2\pi f_c t)$.

3. (20%) Find the Hilbert transform for the following signals, given that m(t) is a low-pass signal with $M(f)=0$ for $|f| \geq \bar{W}$ and

$$f_0 = \omega_0/2\pi > \bar{W}$$

(a) $\cos(2\pi f_0 t)$, (b) $m(t)\cos(2\pi f_0 t)$

(c) $m(t)\sin(2\pi f_0 t)$ (d) $h(t) = B\,\mathrm{sinc}[B(t-t_0)]\cos\omega_0(t-t_0)$.

4. (10%) A signal

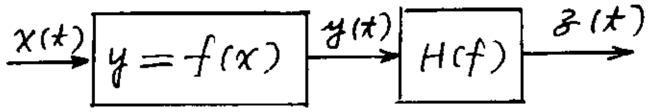
$$x(t) = 10\cos(60\pi t)\cos^2(160\pi t)$$

is sampled at the rate of 400 samples/sec. Find the range of cutoff frequencies of the ideal low-pass filter used to recover x(t).

命題請勿超出線外

5. (20%) Consider a transmission system as shown in figure, where $f(x) = x + x^2$

$$H(f) = \begin{cases} 1, & |f| \le B \\ 0, & |f| > B \end{cases}$$



$$x(t) = \frac{\sin(2\pi B t)}{2\pi B t}$$

① Determine the Fourier Transform $Y(f)$ of $y(t)$.

② Determine $z(t)$ and its Fourier transform.

6. (10%) Assume that the transfer functions of the pre-emphasis and de-emphasis filters of an FM system are scaled as follows:

$$H_{pe}(f) = k\left(1 + \frac{jf}{f_0}\right)$$

and $$H_{de}(f) = \frac{1}{k}\left(\frac{1}{1 + jf/f_0}\right)$$

where j denotes the unity imaginary. The scaling factor k is to be chosen so that the average power of the emphasized message signal is the same as that of the original message signal $m(t)$.

(a) Determine k that satisfies this requirement for the case when the power spectral density of $m(t)$ is given by

$$S_m(f) = \begin{cases} \dfrac{S_0}{1 + (f/f_0)^2}, & |f| \le W \\ 0, & \text{elsewhere} \end{cases}$$

(b) What are the simple circuit realization for this pair of pre-emphasis and de-emphasis filters?