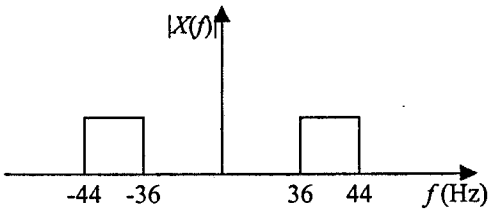
國立臺灣科技大學

九十一學年度碩士班招生考試試題

系所組別： 電機工程系丙二組

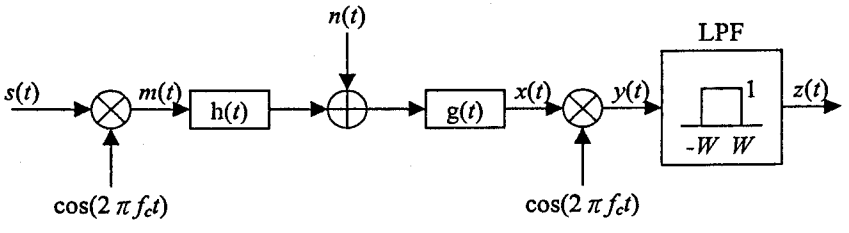
科　目： 通訊系統

1. For each of the following signals, find the minimum sampling frequency F_s such that sampling will not introduce aliasing.
   (a) $x(t) = \text{sinc}^2(20t)$ (5 %)
   (b) $x(t)$ with the following spectrum: (10 %)



2. Answer the following questions:
   (a) Find $\int_{-\infty}^{\infty}[\text{sinc}(t) * \text{sinc}(0.5t)]dt$, where * denotes convolution. (5 %)
   (b) Let $x(t) = \sin(2\pi f_c t)$ be input to a filter with frequency response $H(f)$. What is the filter output? (5 %)
   (c) Let $x(t)$ be any periodic signal with period T and $y(t) = x(t)*h(t)$. Find a filter $h(t)$ such that $\int_{-T/2}^{T/2} y(t)dt = 0$ (5 %)

3. Consider the following system:



Assume the noise $n(t)$ is white noise with power spectral density (PSD) $S_n(f) = N_0/2 = 0.2$ mW/Hz. The PSD $S_s(f)$ of $s(t)$ is defined as

$$S_m(f) = \begin{cases} 12\text{ mW/Hz} & |f| \le 0.3W \\ 4\text{ mW/Hz} & 0.3W \le |f| \le W \\ 0 & |f| > W \end{cases}$$

The frequency response of the channel $h(t)$ is defined as

$$H(f) = \begin{cases} 0.2 & f_c - 0.3W \le |f| \le f_c + 0.3W \\ 1 & else \end{cases}$$

   (a) What is the power of $m(t)$? (5 %)
   (b) Find the PSD of $z(t)$ in the absence of noise, assuming $G(f) = 1$. (5 %)
   (c) Find $G(f)$ such that $z(t) = s(t)$ in absence of noise. (5 %)
   (d) Find the PSD of $z(t)$ due to noise only, assuming $G(f)$ is the one found in part C. (5 %)

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4. The parity check matrix of a particular (7, 4) code is

$$[H] = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 \end{bmatrix}$$

(a) Find the generating matrix [G]. (5 %)
(b) What is the minimum distance between code words? (5 %)
(c) How many errors can be detected? How many errors can be corrected? (5 %)
(d) Find the corrected code, if we receive the code word of 1000011. (5 %)
(Assume that single bit error is mostly occurred.)

5. Consider an audio signal $s(t) = 3\ cos\ 500\ \pi t$.
(a) Find the mean square error of the quantization. (5 %)
(Assume that the quantization error is uniformly distributed in $[-\Delta/2, \Delta/2]$)
(b) Find the signal to quantization noise ratio when this signal is quantized by using 10-bit PCM. (7%)
(c) How many bits of quantization are needed to achieve a signal to quantization noise ratio of at least 40 dB? (8 %)

6. Show that the Poisson distribution $P_I[i] = e^{-m}\frac{m^i}{i!}$ yields $E[I] = m$ and $E[I^2] = m^2 + m$. (10%)