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： 電子工程系乙一組
科　目： 通信系統

(總分 100 分)

1.

(a) $x(t)=\sin ct$ is the input to a system with impulse response $h(t)=\text{sinc}^2 t$, plot the spectrum of the output signal y(t). (5%)

(b)Define $k(t)=\sum_{m=-\infty}^{\infty}\delta(t-mT)$ and let $p(t)=y(t)k(t)$. Given that $T=1\text{sec}$, plot the spectrum of $p(t)$. (5%)

(c) $j(t)$ is shown in Fig. 1. $j(t)$ is a periodic pulse train with width T. Given $T_s=0.5\text{sec}$ and let $q(t)=y(t)j(t)$, plot the spectrum of $q(t)$. (You need to present the detail calculation) (15%)

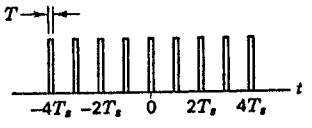

Fig. 1

2.

(a)A binary communication system transmits signals $s_i(t)$ (i=1, 2). The receiver test statistic $z(T)=a_i+n_0$, where the signal component a_i is either $a_1=+1$ or $a_2=-1$ and the noise component n_0 is uniformly distributed, yielding the conditional density functions $p(z|s_i)$ given by

$$p(z|s_1)=\begin{cases}\frac{1}{2} & for\ -0.2\le z\le 1.8\\ 0 & otherwise\end{cases}$$

and

$$p(z|s_2)=\begin{cases}\frac{1}{2} & for\ -1.8\le z\le 0.2\\ 0 & otherwise\end{cases}$$

Find the probability of a bit error, P_e, for the case of equally likely signaling and the use of an optimum decision threshold. (10%)

(b)Repeat problem(a) with the following changes.

n_0 is Gaussian noise.

$$p(z|s_1)=\frac{1}{\sigma_0\sqrt{2\pi}}\exp\left(-\frac{1}{2}\left(\frac{z-a_1}{\sigma_0}\right)^2\right)$$

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$$p(z|s_2)=\frac{1}{\sigma_0\sqrt{2\pi}}\exp(-\frac{1}{2}(\frac{z-a_2}{\sigma_0})^2)$$

$p(s_1)=p$, $p(s_2)=q$

Find the optimum decision threshold that minimize P_e. (10%)

3. A desired impulse response of a communication system is the ideal $h(t)=\delta(t)$, where $\delta(t)$ is the impulse function. Assume that the channel introduces ISI so that the overall impulse response becomes $h(t)=\delta(t)+\alpha\delta(t-T)$, where $\alpha<1$, and T is the symbol time. Derive an expression for the impulse response of a zero-forcing filter that will equalize the effects of ISI. Demonstrate that this filter suppresses the ISI. (15%)

4. Find the probability of bit error , P_e , for the coherent matched filter detection of the equally likely binary FSK signals

$$s_1(t)=0.5\cos 2000\pi t$$

and

$$s_2(t)=0.5\cos 2020\pi t \ ,$$

where the two-sided AWGN power spectral density is $N_0/2=0.0001$. Assume that the symbol duration is $T=0.01s$. (15%)

5. Suppose that the message signal is given as

$$m(t)=10+4\cos 2\pi t+8\cos 4\pi t+10\cos 20\pi t$$

Specify the frequency-response characteristic of a VSB filter that passes the upper sideband and first frequency component of the lower sideband. (10%)

6. Two independent white Gaussian noise with power spectral density $\frac{N_1}{2}$, $\frac{N_2}{2}$ are fed to $H_1(f)=(1+j\frac{f}{f_1})^{-1}$ and $H_2(f)=(1+j\frac{f}{f_2})^{-1}$ respectively. Let $x(t), y(t)$ be the output for $H_1(f)$ and $H_2(f)$.

(a)Find $R_x(\tau)$. (5%)

(b)Let $z(t)=x(t)y(t)$, find the power spectral density $S_z(f)$. (10%)