# 國立臺北科技大學九十六學年度碩士班招生考試

## 系所組別：1720 電腦與通訊研究所乙組

## 第二節 通訊系統 試題



**注意事項：**

1. 本試題共七題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

一、(15%)

1. What is power spectral density? (3%)
   Determine which, if any, of the following functions have the properties of power spectral density function. Justify your determination.
2. $X(f)=\delta(f)+\cos^2 2\pi f$ (3%)
3. $X(f)=10+\delta(f-10)$ (3%)
4. $X(f)=\exp(-2\pi|f-10|)$ (3%)
5. $X(f)=\exp[-2\pi(f^2-10)]$ (3%)

二、(10%) Consider an audio signal with spectral components limited to the frequency band 300 to 3300 Hz. Assume that a sampling rate of 8000 sample/s will be used to generate a PCM signal. Assume that the ratio of peak signal power to average quantization noise power at the output needs to be 30dB.

1. What is the minimum number of uniform quantization levels needed, and what is the minimum number of bits per sample needed? (5%)
2. Calculate the system bandwidth required for the detection of such a PCM signal. (5%)



三、(10%) Figure P3 shows a four-stage feedback shift register. The initial state of the register is 1000.

1. Find the output sequence of the shift register. (5%)
2. Calculate and plot the autocorrelation function of the PN sequence produced by this shift register. (5%)

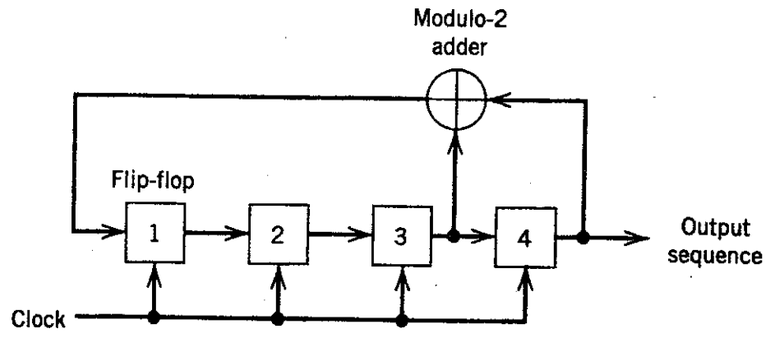


Figure P3.

四、(20%) The two signal waveforms for binary FSK signal transmission with discontinuous phase are

$$s_0(t)=\sqrt{\frac{2E_b}{T_b}}\cos[2\pi(f_c-\frac{\Delta f}{2})t+\theta_0],\ 0\le t\le T,\ \text{and}$$

$$s_1(t)=\sqrt{\frac{2E_b}{T_b}}\cos[2\pi(f_c+\frac{\Delta f}{2})t+\theta_1],\ 0\le t\le T$$

Assume $\Delta f=\frac{1}{T}<<f_c$, and $\theta_0$ and $\theta_1$ are uniformly distributed random variables on the interval $(0, 2\pi)$. The signals $s_0(t)$ and $s_1(t)$ are equal probable.

1. Determine the power-spectral density of the FSK signal. (10%)
2. Show that the power-spectral density decays as $\frac{1}{f^2}$ for $f>>f_c$ (10%)

注意：背面尚有試題

五・(10%) 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 components $a_i$ is either $a_1$=+1 or $a_2$=-1 and the noise component $n_0$ is uniformly distributed, yielding the conditional density function $p(z \mid s_i)$ given by

$$p(z \mid s_1) = \begin{Bmatrix} \frac{1}{2}, \text{ for } -0.2 \le z \le 1.8 \\ 0, \text{ otherwise} \end{Bmatrix}, \text{ and}$$

$$p(z \mid s_2) = \begin{Bmatrix} \frac{1}{2}, \text{ for } -0.2 \le z \le 1.8 \\ 0, \text{ otherwise} \end{Bmatrix}$$

Find the probability of a bit error, $P_B$, for the case of equally likely signaling and the use of an optimum decision threshold.

六・(20%) Consider a (7, 4) code whose generator matrix is

$$G = \begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

1. Find H, the parity-check matrix of the code (5%)
2. Is [1 1 0 1 1 0 1] a valid code vector? (5%)
3. What is the error-correcting capability of the code? (5%)
4. What is the error-detecting capability of the code? (5%)

七・(15%)

1. A modulated signal can be demodulated by using coherent or non-coherent detections, what is the difference between these two schemes? For PSK modulation, which one (coherent or non-coherent detection) has better bit error probability performance? Why? (3%)
2. What is bandwidth efficiency? How it effects on selecting the modulation schemes? (3%)
3. Is MSK a constant envelope modulation? MSK can be detected by coherent or non-coherent demodulation? (3%)
4. Figure P7 shows the power spectral density for complex envelope of MSK, GMSK, and QPSK/OQPSK, where R is the bit rate, which modulation has largest bandwidth efficiency? (3%)
5. What is the advantage of GMSK? (3%)

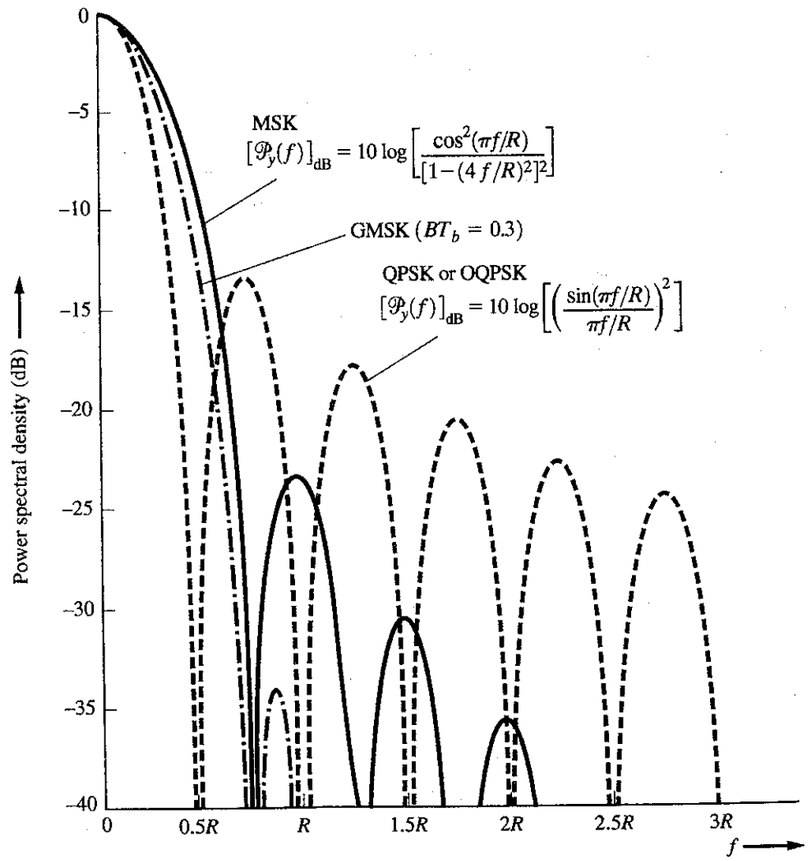


Figure P7