ee 4-1

國立臺北科技大學

九十三學年度電機工程系博士班入學考試

通訊組　通訊原理試題

填准考證號碼　　第一頁　共二頁

注意事項：

1. 本試題共 7 題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. Briefly answer the following questions.

(a) Why a PCM system can achieve better performance than an analog system? (4%)

(b) Why the non-uniform (μ-law or A-law) quantization is commonly used in telephone network? (4%)

(c) What is image station? How to overcome this problem? (4%)

(d) How to achieve the noise-quieting effect in an FM system? (4%)

2. A pair of sinusoidal waves of a coherent BPSK system are respectively represented by $s_1(t) = \sqrt{\frac{2E_b}{T_b}} \cos 2\pi f_c t$ and $s_2(t) = \sqrt{\frac{2E_b}{T_b}} \cos(2\pi f_c t + \pi)$, where $0 \le t \le T_b$, and E_b is the transmitted signal energy per bit. The received signal is $x(t) = s_k(t) + w(t)$, $0 \le t \le T_b$, $k = 1, 2$, where $w(t)$ is AWGN of zero mean and PSD $N_0/2$. Note: $s_1(t)$ for symbol 1 and $s_2(t)$ for symbol 0

(a) Assign orthonormal basis function(s) for this system. (4%)

(b) Plot signal-space diagram for this system with optimum decision boundary. (4%)

(c) Plot block diagrams of transmitter and receiver of this system. (4%)

(d) Simply describe your decision rule for this system. (4%)

6. Given that $Y(t) = X(t)\cos(2\pi f_c t + \Theta)$ where $X(t)$ is a wide-sense stationary random process, f_c is a constant, and Θ is a random variable that is uniformly distributed over the interval $[0, 2\pi]$. The signal $X(t)$ and Θ come from physically independent sources. Find the relationship of power spectral densities between $Y(t)$ and $X(t)$. (12%)

7. Two binary symmetric channels are connected in cascade, as shown in Fig. 9(a). Find the overall channel capacity of the cascaded connection, assuming that both channels have the same transition probability diagram shown in Fig. 9(b). (10%)

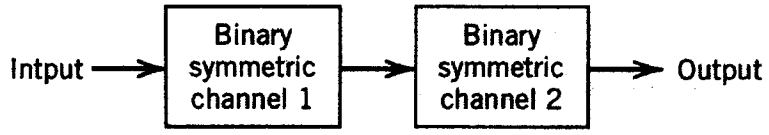


Fig. 9(a)

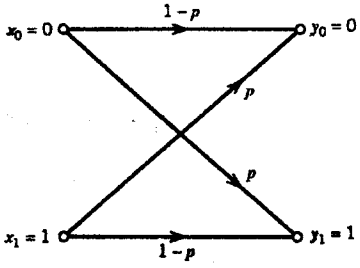


Fig. 9(b)

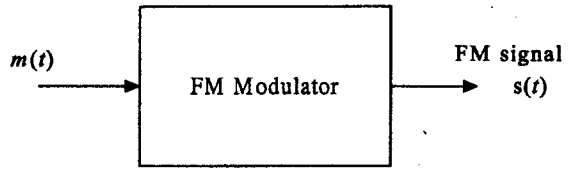
3. An FM modulation system with $k_f = 10^5$ Hz/volt and carrier wave $c(t) = \cos 2\pi 10^8 t$ is shown below. Assume that $m(t) = \cos 2\pi 10^4 t$ volt.

(a) Express $s(t)$ in terms of modulation index β, f_c, and f_m. (5%)

(b) Express $s(t)$ in the canonical form, i.e., $s(t) = s_I(t)\cos 2\pi f_c t - s_Q(t)\sin 2\pi f_c t$. (6%)

(c) Find the pre-envelope ($s_+(t)$) and complex envelope ($\tilde{s}(t)$) of $s(t)$. (6%)

(d) Estimate bandwidth of $s(t)$ using Carson's rule. (4%)



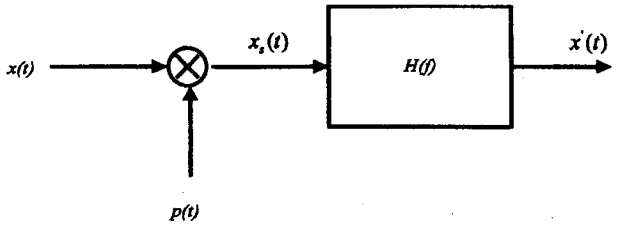
4. The signal $x(t) = \cos(100\pi t) + \cos(200\pi t)$ is sampled by the ideal sampling system shown below where $p(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT_s)$.

(a) Determine the minimum value of f_s (sampling frequency) such that $x(t)$ may be reconstructed without distortion. (3%)

(b) Sketch $X_s(f)$ of the sampled signal $x_s(t)$ if $f_s = 300$ Hz. (3%)

(c) Sketch $X_s(f)$ of the sampled signal $x_s(t)$ if $f_s = 100$ Hz. (3%)

(d) What phenomenon happened in (c)? How to overcome such a problem in practice? (6%)



5. A speech signal is transmitted using an M-ary PAM system. The sampling rate is 10000 samples/sec and each sample is quantized to one of 256 levels (i.e.,8-bit quantization). Determine the minimum required bandwidth for transmitting the PAM wave if

(a) M=4 using an ideal Nyquist channel. (5%)

(b) M=32 using channel with raised cosine spectrum of $\alpha = 1$. (5%)

注意：背面尚有試題