國立臺北科技大學

九十三學年度電腦通訊與控制研究所入學考試

通訊系統試題

填准考證號碼

注意事項：

1. 本試題共 5 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) (25%)

Consider a band-pass signal $x(t)$ with spectrum

$$X(f) = (1+2j)\delta(f-300000) + (3+4j)\delta(f-310000) + (5+6j)\delta(f-320000)$$
$$+ (1-2j)\delta(f+300000) + (3-4j)\delta(f+310000) + (5-6j)\delta(f+320000)$$

(a) Is $x(t)$ a periodic signal? Explain your answer.

(b) Find the complex envelope $\tilde{x}(t)$ of $x(t)$.

(c) Find the Nyquist rates of $\tilde{x}(t)$ and $x(t)$, respectively.

(2) (30%)

Consider a coherent BPSK system with signals

$s_1(t) = \sqrt{\frac{1}{T_b}}\cos(2\pi f_c t)$ and $s_2(t) = -s_1(t)$ and bit duration T_b. Assume that the probabilities of sending signals $s_1(t)$ and $s_2(t)$ are p and $1-p$, respectively. The signals are transmitted via an AWGN channel with noise mean 0 and noise power-spectral density $N_0/2$.

(a) Draw the coherent receiver for the system.

(b) Find the optimal decision rule for the decision device in the receiver. Is this rule a maximum likelihood decision rule?

(c) Find the average bit error rate of the system in (a)(b).

(3) (10%)

Sketch the spectrum of $x(t) = 10\cos(600\pi t)\cos^2(1600\pi t)$ and find the minimum allowable sampling rate.

(4) (10%)

The stationary random process $X(t)$ has a power-spectral density denoted by $S_X(f)$. What is the power-spectral density of $Y(t) = X(t) - X(t-T)$.

(5) (25%)

The received signal in a binary communication system that employs antipodal signal is $r(t) = s(t) + n(t)$ where $s(t)$ is shown in Figure 1 and $n(t)$ is AWGN with mean 0 and power-spectral density $N_0/2$ W/Hz.

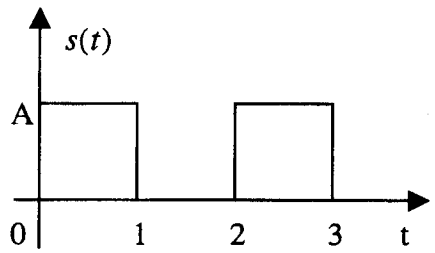

Figure 1

(a) Sketch the impulse response of the matched filter for $s(t)$.

(b) If the input of the matched filter is $s(t)$, sketch the output of the matched filter.

(c) If the input of the matched filter is $r(t)$, determine the probability density function of the output at $t = 3$.