國立臺北科技大學九十八學年度碩士班招生考試

系所組別：2220 電腦與通訊研究所乙組

第二節　通訊系統　試題

注意事項：

1. 本試題共六題，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。

1. Suppose $\mathrm{X}(t)$ is a random process with autocorrelation function $R_X(\tau)$. (20%)

   (a) What is the condition of wide-sense stationary? (4%)

   (b) If $\mathrm{X}(t)$ is an independent white Gaussian process with $R_X(\tau)=\frac{N_0}{2}\delta(\tau)$, what is power spectral density $S_X(f)$. (3%)

   (c) By observing $\mathrm{X}(t)$ in time t_1 and t_2, please write down the probability density functions of $\mathrm{X}(t_1)$ and $\mathrm{X}(t_2)$, respectively and their joint probability density function. (3%)

   (d) If $\mathrm{X}(t)$ is passed through an ideal low pass filter whose impulse response is $h(t)=AW\mathrm{sinc}(Wt)$. What are the mean, variance, and power spectral density of output signal $\mathrm{Y}(t)$? (6%)

   (e) Is $\mathrm{Y}(t)$ still a Gaussian process? Is $\mathrm{Y}(t)$ still a white process? (4%)

2. The stationary random process $\mathrm{X}(t)$ has power-spectral density $S_x(f)$. Let $\mathrm{Y}(t)=\mathrm{AX}(t)-\mathrm{BX}(t+T)$, where A is a random variable with zero mean and variance σ_A^2, B is also a random variable with zero mean and variance σ_B^2. The random variables A, B, and $\mathrm{X}(t)$ are mutually independent. Find the power-spectral density of $\mathrm{Y}(t)$. (10%)

3. Consider a signal $x(t)=A\cos(100\pi t)$. (10%)

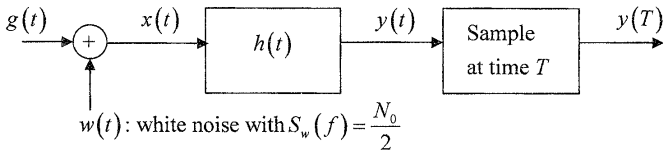
   (a) Find and sketch $X(f)$. (3%)

   (b) If $x(t)$ is sampled at 90 samples per second, the sampled version is denoted as $x_s(t)$, please sketch its spectrum, $X_s(f)$, after sampling. (3%)

   (c) If $x_s(t)$ is passed through an ideal low pass filter $H(f)=\mathrm{rect}\left(\frac{f}{100}\right)$, find the output signal $y(t)$ and sketch its frequency response. (4%)

4. (20%)

   (a) Calculate the signal-to-noise ratio (SNR) η of the output signal $y(t)$ and prove that the impulse response $h(t)=kg(T-t)$ is matched filter for maximizing SNR η. (10%)



   (b) If $w(t)$ is not white noise, find the frequency response of the matched filter for maximizing SNR η. (10%)

注意：背面尚有試題

5. Consider a coherent BPSK system in AWGN channel with zero mean and $\frac{N_0}{2}$ variance. The BPSK signals are denoted as $s_0(t) = A\cos(2\pi f_c t)$, $s_1(t) = 3A\cos(2\pi f_c t)$, $0 \le t \le T_b$, and the priori probability of $s_0(t)$ and $s_1(t)$ are $\frac{1}{3}$ and $\frac{2}{3}$, respectively. (20%)
   (a) Design a new signal constellation that the energy of transmitted signal is minimum (minimum energy signal for BPSK). (3%)
   (b) From (a), draw the coherent receiver for the system. (3%)
   (c) From (a), find the optimum decision threshold λ. (6%)
   (d) From (a), find the average BER of the system. (6%)
   (e) Is the BER of the system using old constellation different from that of the system using new constellation? Why? (2%)

6. Consider a binary FSK signal transmitted via an AWGN channel with zero mean and $\frac{N_0}{2}$ variance, where the signals $s_0(t) = \sqrt{\frac{2E_b}{T_b}}\cos(2\pi f_1 t)$, $s_1(t) = \sqrt{\frac{2E_b}{T_b}}\cos(2\pi f_2 t)$, $0 \le t \le T_b$. (20%)
   (a) The bases of FSK should be orthogonal. Explain the condition of f_1 and f_2. (10%)
   (b) Explain the decision rule specifically, and find the BER of the system. (10%)