國立高雄大學九十七學年度研究所碩士班招生考試試題

科目：通訊系統
考試時間：100 分鐘

系所：
電機工程學系碩士班通訊組　　是否使用計算機：是
本科原始成績：100 分

1、Briefly describe the following terminologies：(10%)

(a) Matched Filter

(b) Carson　Rule

(c) PCM

(d) Sampling Theorem

(e) Quantization Noise

2、Let a random process be given as

$Z(t) = X(t)\cos(w_0 t + \theta)$

where X(t) is a stationary random processes with $E\{X(t)\} = 0$, $E\{X^2(t)\} = \sigma_x^2$ and $E\{X(t)X(t+\tau\} = R_X(\tau)$.

(a) If θ is a random variable independent of X(t) and uniformly distributed in the interval (- π , π), Find $E\{Z(t)\}$ and $E\{Z^2(t)\}$. Is Z(t) wide-sense stationary？ Provide your explanation. (5%)

(b) Let $Z(t) = X(t)\cos(w_0 t + \theta) + Y(t)\sin(w_0 t + \theta)$ where X(t) and Y(t) are stationary Gaussian random process with $E\{X(t)\} = E\{Y(t)\} = 0$, $E\{X^2(t)\} = E\{Y^2(t)\} = \sigma^2$, and $E\{X(t)X(t+\tau)\} = E\{Y(t)Y(t+\tau)\} = R(\tau)$, X(t) and Y(t) are uncorrelated for any t. If θ is a random variable independent of X(t), Y(t) and uniformly distributed in the interval (- π , π), Find $E\{Z(t)\}$ and $E\{Z^2(t)\}$. Is Z(t) stationary？ Provide your explanation. (5%)

(c) If θ =0, find $E\{Z(t)\}$ and $E\{Z^2(t)\}$. Is Z(t) stationary？ Provide your explanation. (5%)

3、A binary communication system transmits signals $s_i(t)$ (i =1, 2). The receiver test statistic is $r = s_i + n$, where the signal component s_i is either $s_1 = 2$ or $s_2 = -2$ and the noise component n has a probability density function of

$$p(n) = \begin{cases} (3 - |n|)/9 & if\ |n| \le 3 \\ 0 & otherwise \end{cases}$$

(a) If $s_1(t)$ and $s_2(t)$ are transmitted with an equal probability, determine the probability of error when the optimum decision is made. (8%)

(b) If $s_1(t)$ is transmitted with a probability of 0.8, determine the value of the optimum decision threshold. (7%)

4、Draw the modulated waveforms of the binary sequence 10100010111 by using the baseband formats of　(10%)

(a) AMI (Bipolar)

(b) Manchester (Bi-phase)

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(c) NRZ (nonreturn-to-zero)

(d) RZ (return-to-zero)

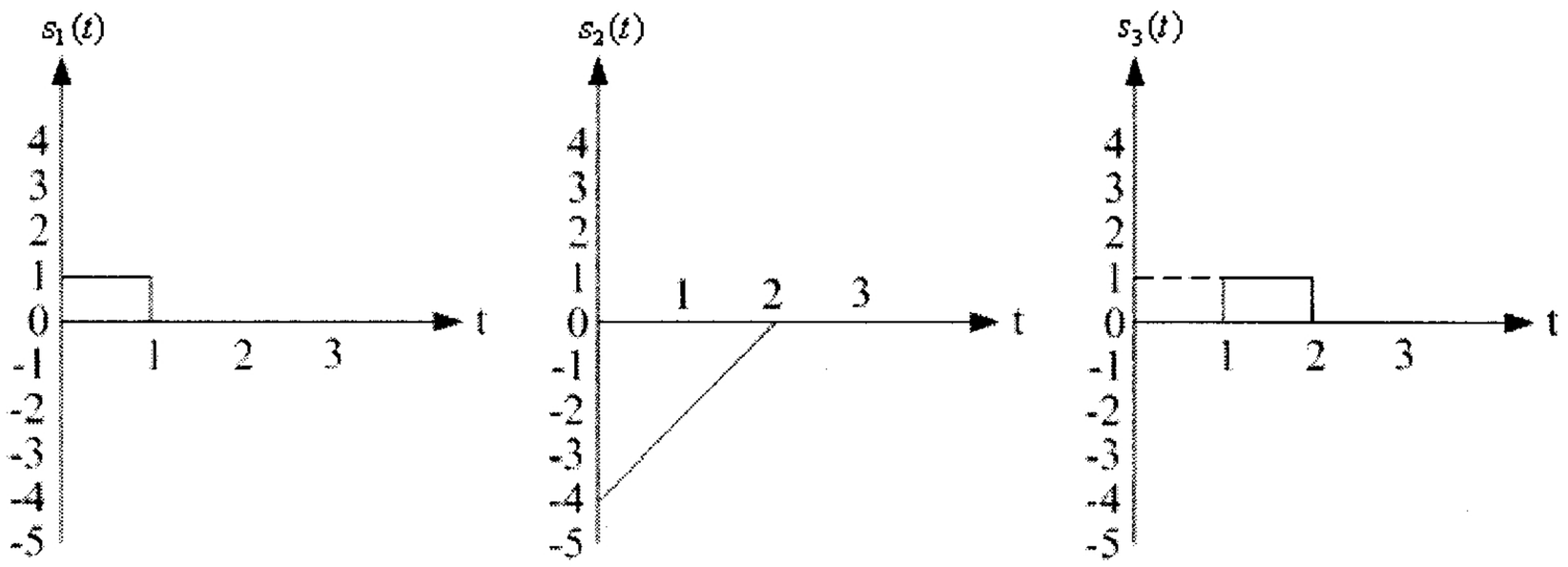
5、Suppose that MSK is used to transmit information over an AWGN with a two-sided power spectral density of 10^{-8} W/Hz. The transmitted signal is $4\cos(2\pi f_0 t + \phi_n)$, where ϕ_n is the modulated phase or the corresponding frequency shift.

(a) Draw the modulator. (5%)

(b) Draw the structure of optimal receiver. (5%)

(c) Determine the maximum data rate that can be sent with bit-error-rate $P_e = 10^{-6}$. (5%)

6、Consider three signals $s_1(t), s_2(t), s_3(t)$ shown in the following Figure, Express each of these signals in terms of a set of basis functions found by using the Gram-Schmidt orthogonalization procedure. (10%)



7、A source has six output denoted $(a_0, a_1, a_2, a_3, a_4, a_5)$ with respective probabilities (0.4 , 0.2 , 0.1 , 0.1 , 0.1 , 0.1) (15%)

(a) Calculate the entropy

(b) Determine the codeword using Huffman code

(c) Calculate the efficiency

8、You are allowed to use the frequency band B between 915 and 916 MHz. The allowed signal power is $P = 10^6$ power units. The noise in the band is additive white Gaussian noise with single-sided power spectral density N_0 = 1 power units per Hz. For the purposes of the feasibility study, you may assume optimally bandwidth-efficient modulation, ideal brick-wall (zero-rolloff) filters, perfect receiver synchronization, etc. What is the Shannon limit on the achievable data rate R in bits per second (b/s)? (10%)