國 立 臺 北 科 技 大 學

106 學年第二學期電機系博士班資格考試

數位通訊理論 試題

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. 全部答案均須答在試卷答案欄內，否則不予計分。
4. 考試時間:二小時。

1. (20%)

Let $x(t)$ be a stationary Gaussian process with auto-correlation function $1+\text{sinc}^2(\tau)$. If $x(t)$ is input to a LTI system with impulse response $\text{sinc}(2t)$. Find the probability density function of output $y(t)$.

2. (20%)

In a coherent BPSK system, the two signals are defined by $s_1(t) = A_c \cos(2\pi f_c t)$ and $s_2(t) = A_c \cos(2\pi f_c t + \frac{\pi}{4}), \quad 0 \le t \le T_b$. In the presence of additive white Gaussian noise of zero mean and power spectral density $\frac{N_0}{2}$, calculate the average probability of error.

3. (20%)

Consider the signal constellation as shown in Figure P-3. The *a priori* probabilities for $\bar{s}_1$, $\bar{s}_2$, and $\bar{s}_3$ are 0.5, 0.3, and 0.2, respectively.

(a) Find the translation vector to translate the signal constellation into a new signal constellation with minimum average energy.

(b) Calculate the average energy of the new signal constellation.

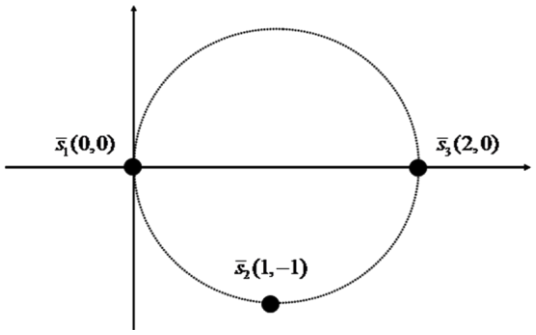

Figure P-3

4. (20%)

Figure P-4 displays the waveforms of signals $s_1(t)$ and $s_2(t)$. Using the Gram-Schmidt orthogonalization procedure, find an orthonormal basis for this set of signals.

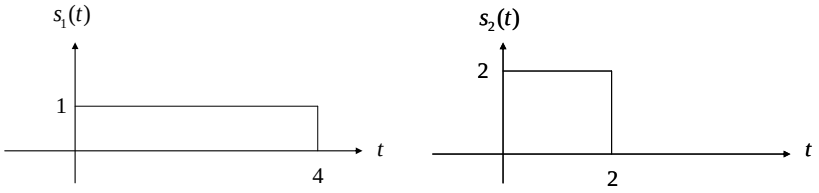

Figure P-4

5. (20%)

The trellis diagram of a (5,3) block code is shown in Figure P-5. If the received word is 01011, compute the decoded codeword by using the Viterbi decoding algorithm.

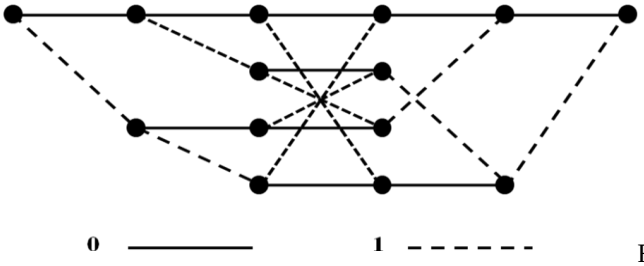

Figure P-5