

國立臺北科技大學

102 學年第二學期電機系博士班資格考試

數位通訊理論 試題

第一頁 共二頁

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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 random process with auto-correlation function $R_X(\tau)$.

Let $X_1(t) = X(t)\cos(2\pi f_c t + \Theta)$ and $X_2(t) = X(t)\sin(2\pi f_c t + \Theta)$, where the probability

density function of Θ is $f_\Theta(\theta) = \begin{cases} \frac{2}{\pi}, & -\frac{\pi}{4} \leq \theta < \frac{\pi}{4}, \\ 0, & \text{elsewhere.} \end{cases}$ If $X(t)$ and Θ are

independent, calculate the cross-correlation function of $X_1(t)$ and $X_2(t)$.

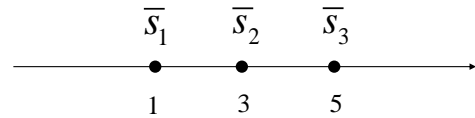
2. (20%)

Five instructions are used independently with probabilities $\{0.55, 0.21, 0.11, 0.07, 0.06\}$.

Construct a Huffman code for this instruction set.

3. (20%)

Consider the signal constellation as shown in the figure. 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.

4. (20%)

In the BPSK system, the two signals are $s_1(t) = A_c k \sin(2\pi f_c t) + A_c \sqrt{1-k^2} \cos(2\pi f_c t)$ and $s_2(t) = A_c k \sin(2\pi f_c t) - A_c \sqrt{1-k^2} \cos(2\pi f_c t)$, $0 \leq t \leq T_b$, $0 \leq k \leq 1$. 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.

5. (20%)

Consider the (4,1) code with generator matrix $[1 \ 1 \ 1 \ 1]$.

(a) Construct the syndrome table for all the single-error patterns.

(b) If (1101) is received, find the decoded codeword by using the syndrome decoding.