科目：通訊系統導論 適用：電機系(通訊工程)

編號：472

考生注意：
1.依次序作答，只要標明題號，不必抄題。
2.答案必須寫在答案卷上，否則不予計分。
3.限用藍、黑色筆作答；試題須隨卷繳回。

本試題共2頁 第1頁

1. A random process is defined as $Y(t)=X(t)+X(t-T)$, where $X(t)$ is a wide-sense stationary random process with autocorrelation function $R_X(\tau)$ and power spectral density $S_X(f)$.

(10%) (a) Show that $R_Y(\tau)=2R_X(\tau)+R_X(\tau+T)+R_X(\tau-T)$.

(10%) (b) Show that $S_Y(f)=4S_X(f)\cos^2(\pi fT)$.

2. Let X be a continuous random variable with probability density function (pdf)

$$f_X(x)=\begin{cases} kx & 0<x<1 \\ 0 & \text{otherwise} \end{cases}$$

where k is a constant.

(6%) (a) Determine the value of k and sketch $f_X(x)$.

(6%) (b) Find and sketch the corresponding cumulative distribution function (cdf) $F_X(x)$.

(8%) (c) Find the mean and variance of X.

3. Answer each of the followings:

(6%) (a) For amplitude modulation (AM), double-sideband suppressed carrier (DSB-SC) and single-sideband (SSB) signals, which one may own the lowest receiver complexity? Explain your answer.

(6%) (b) For AM, DSB-SC, and SSB signals, which one may occupy the smallest bandwidth? Explain your answer.

(4%) (c) The purpose of amplitude sensitivity k_a in AM.

(4%) (d) Carson's rule for calculating the bandwidth of frequency modulation (FM) signals.

4. For a (6, 3) systematic linear block code, the three parity-check bits c_4, c_5, and c_6 are formed from the following equations:

$$c_4 = d_1 \oplus d_3$$
$$c_5 = d_1 \oplus d_2 \oplus d_3$$
$$c_6 = d_1 \oplus d_2$$

(6%) (a) Write down the generator matrix **G**.

(8%) (b) Construct all possible code words.

(6%) (c) Suppose that the received word is 010111. Decode this received word by finding the location of the error and the transmitted data bits.

5. (20%) Show that the error probability of binary orthogonal signals $\left(\mathbf{s}_1 = [\sqrt{E_b} \quad 0] \text{ and } \mathbf{s}_2 = [0 \quad \sqrt{E_b}]\right)$ in additive white Gaussian noise (AWGN) channels is

$$P_b = Q\left(\sqrt{\frac{E_b}{N_0}}\right)$$

where $Q(x) = \frac{1}{\sqrt{2\pi}} \int_x^{\infty} e^{-t^2/2} dt, \quad x \geq 0$ and noise variance is $\frac{1}{2} N_0$.