

# 中原大學 95 學年度碩士班入學考試

3 月 18 日 16:00~17:30 電子工程系通訊組

誠實是我們珍視的美德，  
我們喜愛「拒絕作弊，堅守正直」的你！

科目：通訊系統

(共 2 頁第 1 頁)

可使用計算機，惟僅限不具可程式及多重記憶者

不可使用計算機

1. In (a)~(b), determine the null-to-null bandwidth of  $s(t)$

(a)  $s(t) = K \operatorname{rect}\left(\frac{t}{T}\right) \cos(2\pi f_c t)$  (8%)

(b)  $s(t) = \operatorname{sinc}(2Bt)$  (8%)

where  $\operatorname{rect}(t) = \begin{cases} 1, & -\frac{1}{2} < t < \frac{1}{2} \\ 0, & |t| > \frac{1}{2} \end{cases}$ ,  $\operatorname{sinc}(t) = \frac{\sin(\pi t)}{\pi t}$  and  $f_c > \frac{1}{T}$ .

2. Consider a real-valued energy signal  $g(t)$  defined over the interval  $-\infty < t < \infty$ , and let its Fourier transform be denoted by  $G(f)$ .

(a) Show that  $\int_{-\infty}^{\infty} g^2(t) dt = \int_{-\infty}^{\infty} |G(f)|^2 df$ . (8%)

(b) From the result of (a), show that  $\int_{-\infty}^{\infty} \operatorname{sinc}^2(t) dt = 1$ . (4%)

3. What is the function of an equalizer? (8%) If a communication channel with transfer function  $H_c(f)$ , what is the desired response of the equalizer? (8%)
4. A DSB-SC modulated wave can be generated by a balanced modulator. A balanced modulator consists of two standard amplitude modulators in a balanced configuration so as to suppress the carrier wave.

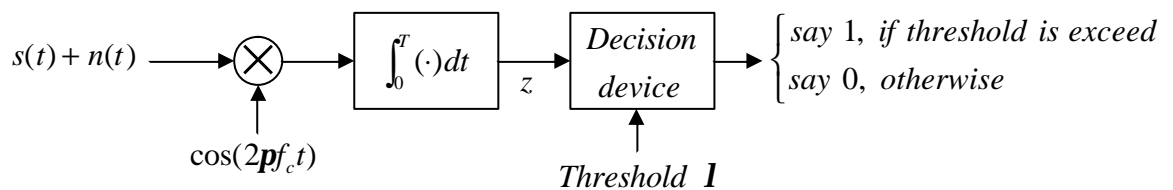
(a) Draw the block diagram for the balanced modulator. (8%)

(b) Draw the block diagram for coherent detection of DSB-SC modulated wave. (8%)

5. The BPSK signal can be expressed as

$$s(t) = \begin{cases} A \cos(2\pi f_c t), & \text{symbol 1} \\ -A \cos(2\pi f_c t), & \text{symbol 0} \end{cases}$$

The coherent detector for BPSK is shown in the following figure.



If  $n(t)$  is a Gaussian noise, then the conditional pdfs  $f(z|1)$  and  $f(z|0)$  are also Gaussian.

- (a) Find the conditional means  $E[z|1]$  and  $E[z|0]$ . (8%)
  - (b) If  $P_0$  and  $P_1$  are *a priori* probabilities, express the average probability of error  $P_E$  in terms of  $P_0, P_1, f(z|1), f(z|0)$  and  $I$ . (8%)
  - (c) Continue from (b), if the variance of  $z$  is  $\sigma^2$ , find the optimum threshold  $I$  to minimize  $P_E$ . (8%)
  - (d) Continue from (c), what is the threshold  $I$  for maximum likelihood (ML) detection. (8%)
6. Give explanations for coherent detection and noncoherent detection. Can a PSK signal be detected noncoherently? Why? (8%)