

# 大同大學 九十五 學年度研究所碩士班入學考試題

考試科目：通訊原理

所別：通訊工程研究所

第1頁 共1頁

註：本次考試不可以參考自己的書籍及筆記； 不可以使用字典； 可以使用計算器。

※每題20分

1. A quadrature implementation of a differential 8-PSK (D8PSK) modulator is given in Fig. P1.1. At each  $k$ th transmission time we send a data phasor  $\phi_k$ , which can be expressed as

$$\phi_k = \Delta\phi_k + \phi_{k-1}$$

Where the data-encoding table is also shown in Fig. P1.2.

Data encoding			
$x_k$	$y_k$	$z_k$	$\Delta\phi_k$
0	0	0	0
0	0	1	$\pi/4$
0	1	1	$2\pi/4$
0	1	0	$3\pi/4$
1	1	0	$4\pi/4$
1	1	1	$5\pi/4$
1	0	1	$6\pi/4$
1	0	0	$7\pi/4$

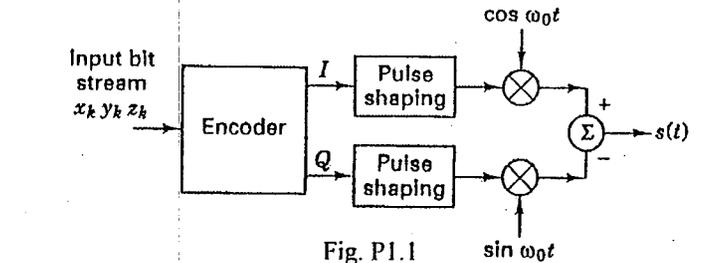
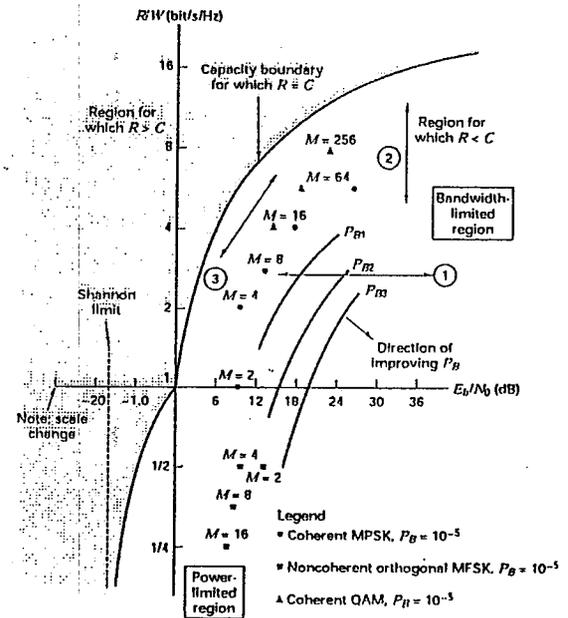


Fig. P1.2

Let the input data sequence at times  $k=1, 2, 3$  be equal to 110, 001, 110, respectively. Please formulate the output signal  $s(t)$  at the times  $k=1, 2, 3$ . Assuming that the starting phase at time  $k=0$  to be  $\phi_0=0$ .

2. The bandwidth-efficient plane is shown in right, then

- What are the spectral efficiencies (bits/s/Hz) of QPSK and 16-QAM?
- If there is an allowable DSB bandwidth of 40 MHz in the 16-QAM modem, what is the maximum allowable transmitted data rate?
- If now, we consider using bandwidth of 20 MHz at baseband to transmit the 160-Mbits/sec data rate, using PAM. What is the spectral efficiency (bits/s/Hz) needed to accomplish this system?
- How many levels of PAM would be required at (c)?



3. In an FDM (frequency division multiplexing) communication system, the transmitted baseband signal is

$$x(t) = \sum_{i=1}^N m_i(t) \cos w_i t$$

Assuming that the bandwidth of the  $i$ th message (i.e.,  $m_i(t)$ ) is denoted as  $W_i$ , then

- If the guardband is set to be  $G$  and all the messages are transmitted by double-sideband amplitude modulation. What is the bandwidth required to transmit the modulated signal?
- What is the minimum separation of carrier frequency ( $w_{i+1}-w_i$ ) to prevent the effect of bandwidth overlap?

4. The VSB (Vestigial-Sideband) filter in Fig.P4 is characterized by

$$H(f_c - f_1) = \epsilon e^{j\theta_0}$$

$$H(f_c + f_1) = (1 - \epsilon) e^{j\theta_1}$$

$$H(f_c + f_2) = e^{j\theta_2}$$

The message signal is given as  $m(t)=A\cos w_1 t+B\cos w_2 t$ , and is to be demodulated by multiplying by  $4\cos w_c t$  and lowpass filtering. That yields the demodulated output:

$y_D(t)=A\epsilon\cos(w_1 t-\theta_0)+A(1-\epsilon)\cos(w_1 t+\theta_1)+B\cos(w_2 t+\theta_2)$ . It is required that the demodulated output be distortionless. Derive the expressions for  $\theta_1$  and  $\theta_2$  as function of  $\theta_0$ .

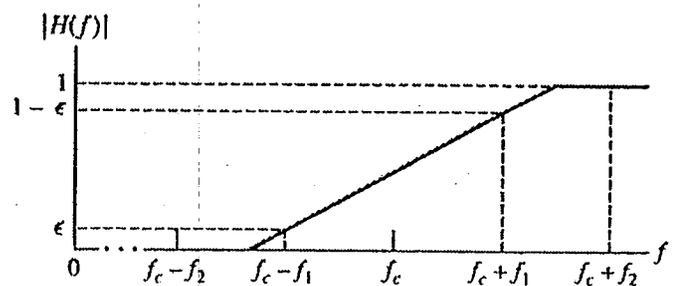


Fig.P4

5. Consider a low-pass signal with a bandwidth of 4 kHz. A linear delta modulation system, with step size  $\Delta=0.1$  V, is used to process this signal at a sampling rate ten times the Nyquist rate.

- What is the sampling rate?
- Evaluate the maximum amplitude of a test sinusoidal signal of frequency 1 kHz, which can be processed by the system without slope-overload distortion.
- Calculate the output signal-to-noise ratio.