國立臺灣科技大學
八十八學年度碩士班招生考試試題

系所別：電子工程系碩士班　　組別：乙一組　　科目：通信系統

(滿分爲 100 分)

(15分) (1) A simple model for a multipath communication channel is shown in Figure 1-1. (a) Find H (f) = Y(f)/X(f) for this channel and plot |H (f)| for β = 1 and 0.5. (b) In order to equalize the channel-induction distortion, an equalization filter is used. We use a tapped delay-line or transversal filter, as shown in Figure 1-2 to approximate the equalizer. Write down a series expression for Heq (f) = Z(f)/Y(f) for the equalizer in terms of β_i's and Δ. (c) Find the resulting equalizer Heq (f) to accommodate this channel, i.e., to determine the values of β_i's in terms of β, assuming that $\Delta = \tau_m$. (每一子題 5分)

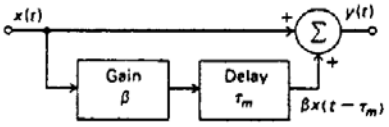

Fig. 1-1

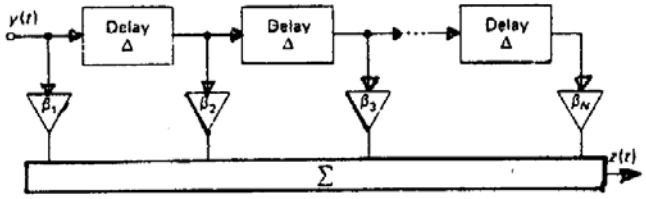

Fig. 1-2

(20分) (2) Consider the bandpass signal

$$x(t) = 2W \text{ sinc}(2Wt) \cos(2\pi f_c t)$$

(a) Obtain and sketch the frequency spectrum of $x_p(t) = x(t) + j\hat{x}(t)$. (5分)
Where $\hat{x}(t)$ is the Hilbert transform of x(t). Assume that $f_c >> 2W$.

(b) Obtain and sketch the frequency spectrum of the complex envelope, $\tilde{x}(t)$. Where the complex envelope is defined in $x(t) = \text{Re}\{\tilde{x}(t)\, e^{j2\pi f_c t}\}$. (10分)

(c) Obtain and sketch the complex envelope $\tilde{x}(t)$. (5分)

(20分) (3) A sinusoidal signal wave, $A_m \cos(2\pi f_c t)$, is to be sampled, uniformly quantized and digitalized by R-bit encoder(i.e., R-bits/sample).

(a) Find the $(SNR)_o$, the signal-to-quantization noise-ratio, of this uniform quantizer.

(b) Calculate the $(SNR)_o$ in dB for the cases of R = 6, and R = 9 respectively. (每一子題 10分)

(15分) (4) A random signal is given by the sample function, $x(t) = A \cos(2\pi f_c t + \Theta)$, where A is normally distributed with zero mean and variance of 2, Θ is uniformly distributed in $[0, 2\pi]$, A and Θ are statistically independent.

(a) Is the random signal wide-sense stationary?

(b) Find the autocorrelation function and its power spectrum density.

(c) If A is uniformly distributed in [0, 2], what are the answers in (a) and (b)?

(每一子題 5分)

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(15%) (5) Consider a phase modulation (PM) system, with the modulated wave defined by

$$s(t) = A_c \cos [2\pi f_c t + k_p m(t)]$$

where k_p is the phase sensitivity and m(t) is the message signal. The additive white Gaussian noise n(t) at the phase detector input is

$$n(t) = n_I(t) \cos (2\pi f_c t) - n_Q(t) \sin (2\pi f_c t)$$

Assuming that the carrier-to-noise ratio at the detector input is high compared with unity, determine (每一子題 5分)

(a) the output signal-to-noise ratio, assuming power spectral density in passband is $N_0/2$.
(b) the figure of merit of the system.
(c) Compare your results with FM system for the case of monotone analysis.

(15%) (6) The modulator-demodulator of a differential phase-shift keying (DPSK) are shown in figure 6-1 and figure 6-2. d(t) is the bit stream to be transmitted. T_b is the bit pulse width. $f_c T_b = n$, n is an integer. The truth table for the logic gate LG is given in table 6-1. If the bit stream is d(t) = 00101001101, (每一子題 5分)

(a) Determine b(t). Draw the logic waveforms to illustrate the response, b(t), to the input d(t).
(b) Show that the output of the demodulator receiver as figure 6-2 yields the original data, d(t).
(c) From the discussion in (a) and (b), tell what are the merits (advantages) the DPSK have.

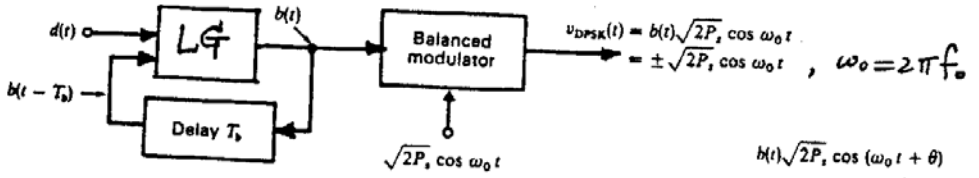

Figure 6-1

d(t) logic level	d(t) voltage	$b(t-T_b)$ logic level	$b(t-T_b)$ voltage	b(t) logic level	b(t) voltage
0	−1	0	−1	1	1
0	−1	1	1	0	−1
1	1	0	−1	0	−1
1	1	1	1	1	1

table 6-1

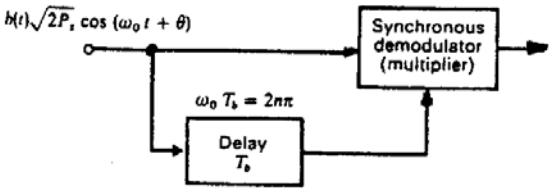

Figure 6-2