國立臺灣科技大學
八十七學年度碩士班招生考試試題

所 別：電子工程技術研究所 組別：系統組 科目：通信系統
學程別：

(滿分100分, 第5題10分, 其餘每題15分)

[1] Consider the decaying exponential pulse $g(t) = A\ \exp(-at)u(t)$.

(a) Find the energy of the signal $g(t)$.

(b) Find the percentage of the total energy of $g(t)$ contained inside the frequency band $-W \le f \le W$, where $W = a/2\pi$.

(c) Find and sketch the signal energy contained inside the frequency band $|f| \le W$ in terms of W.

[2] Three messages, m_1, m_2 and m_3 are to be time-division multiplexed. m_1 and m_2 are bandlimited to 5 kHz, and m_3 is bandlimited to 10 kHz.

(a) Design a PAM commutator switching system (with minimum number of contacts) such that each message is periodically sampled at its own Nyquist sampling rate and the samples are properly interlaced.

(b) A PCM system is used to digitalize the TDM signal obtained in (a). Each sample is quantized into 256 levels. What is the maximum bit duration that may be used.

[3] A WSS stationary message process $m(t)$ modulating a sinusoidal carrier, yields

$$z(t) = m(t)\cos(2\pi f_0 t + \theta)$$

where $E[m(t)] = 0$ and $E[m^2(t)] = M$. (a). If $\theta = 0$, find $E[z^2(t)]$. Is $z(t)$ WSS stationary? (b). If θ is an independent random variable and uniformly distributed in $[-\pi, \pi]$. Find $E[z^2(t)]$. Is $z(t)$ WSS stationary in this case ?

[4] Using the message signal, $m(t) = \dfrac{t}{1+t^2}$, sketch the modulated wave for the following modulation schemes:

(a) DSB-LC-AM with 50 % modulation.

(b) DSB-SC modulation.

[5] A signal, $x(t) = 10\cos(60\pi t)\cos^2(160\pi t)$, is sampled with sampling rate of 400 times per second.

(a) Sketch the frequency spectrum of the sampled signal.

(b) Find the range of permissible cutoff frequency of the ideal low pass filter which is used to reproduce $x(t)$.

[6] A received signal consists of an unmodulated sinusoidal wave (peak value = A, frequency = f_c) and a bandlimited white noise. This signal is applied to an ideal envelope detector. Assume the power spectral density of the noise is given by

$$S_n(f) = \begin{cases} \dfrac{N_0}{2}, & f_c - W \le |f| \le f_c + W \\ 0, & \textit{elsewhere} \end{cases}$$

find the approximate output signal-to-noise ratio, $(SNR)_0$, of the envelope detector when the channel signal-to-noise ratio, $(SNR)_c$, is high.

[7] The signal set consisting of two waveforms specified by

$$s_0(t) = A\ \cos(2\pi f_c t), \quad s_1(t) = -A\ \cos(2\pi f_c t) \quad 0 \le t \le T, \quad T = \frac{n}{f_c}$$

is used to communicate one of two equally likely messages over a channel. The channel is disturbed by additive white Gaussian noise which power spectral density is $N_0/2$. Determine the minimum attainable probability of error in terms of $Q(u)$-function. Q- function is given by

$$Q(u) = \int_u^\infty \frac{1}{\sqrt{2\pi}} e^{-x^2/2} dx$$