國立彰化師範大學 100 學年度碩士班招生考試試題

系所：電信工程學研究所　　科目：通訊原理

☆☆請在答案紙上作答☆☆　　

1. For a random process $X(t)$, the two-sided power spectral density is $G_X(f) = e^{-|f|/1000}$. Find the 30dB bandwidth. (10%)

2. An analog signal is digitized so that the ratio of the peak-signal power to the peak-quantization noise power is at least 30 dB and is transmitted over an 8-ary PAM system. The sampling rate is 30K samples/s.
   (a) How many quantization levels of the analog signal are needed for $(S/N_q)_{peak}$= 30dB? (10%)
   (b) What is the data rate in bits/s? (5%)
   (c) What is the PAM pulse or symbol transmission rate? (5%)

3. Consider the signal $s(t)$ plotted in Figure 1. Please find and draw the impulse response of the matched filter. (10%)

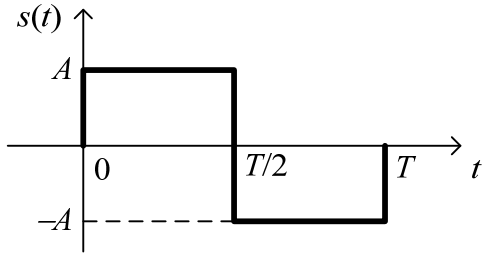

Figure 1.

4. A 16-QAM system operates over an AWGN channel with an E_b/N_0 of 13 dB. What is the bit error probability? (10%)

5. Consider a sinusoidal waveform $X(t) = A\cos(2\pi f_c t + \Phi)$, where A and f_c are constants and Φ is a random variable uniformly distributed over $[-\pi, \pi]$.
   (a) What is the probability density function of Φ? (5%)
   (b) What is the autocorrelation function of $X(t)$? (10%)
   (c) What is the power spectral density of $X(t)$? (10%)

6. Consider an FM signal $s(t) = A\cos[2\pi f_c t + \sin(2\pi f_m t)]$, where A and f_c are constants and $f_m = 10$ (Hz).
   (a) What is the modulation index of $s(t)$? (5%)
   (b) Please estimate the transmission bandwidth of $s(t)$ using Carson's rule. (10%)
   (c) Please design an FM receiver using a phase locked loop. (10%)