國立臺灣師範大學 101 學年度碩士班招生考試試題

科目：通訊原理　　適用系所：應用電子科技學系

注意：1.本試題共 2 頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則依規定扣分。

1. (共 10 分) Explain the following terms.
   (a) Intersymbol interference (2 分)
   (b) Random Variable/Random Process (2 分)
   (c) Error propagation (2 分)
   (d) Threshold effect (2 分)
   (e) The sampling theorem (2 分)

2. (10 分) Apply the Gram–Schmidt procedure to the set of four waveforms illustrated in Fig. 1 and determine the orthogonal signal sets.

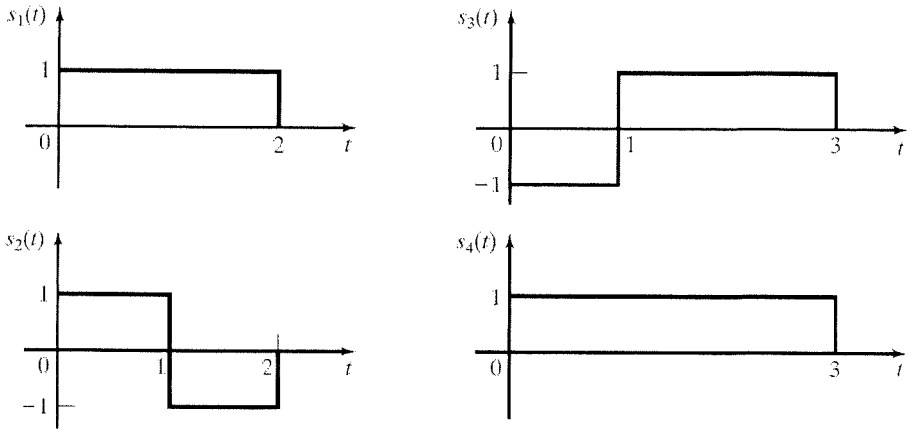

Fig. 1.

3. (共 10 分) Assume that we uniformly choose a phase Θ between $-\pi/2$ and $\pi/2$ and generate a random process $X(t)$ in the form of a sinusoid with a fixed amplitude and frequency but with a random phase Θ.
   (a) Is the random process $X(t)$ WSS (wide-sense stationary)? Why? (5 分)
   (b) Let the random process $Y(t)$ be similar to the random process $X(t)$, but assume that Θ is uniformly distributed between 0 and 2π. Is the process WSS? Why? (5 分)

4. (共 15 分)Find the power spectral densities and average power of the following signals.
   (a) $x_1(t) = 2\cos(20\pi t + \frac{\pi}{3})$ (5 分)
   (b) $x_2(t) = 3\sin(30\pi t)$ (5 分)
   (c) $x_3(t) = 5\sin(10\pi t - \frac{\pi}{6})$ (5 分)

5. (共 10 分) An FM modulator is followed by an ideal bandpass filter having a center frequency of 500Hz and a bandwidth of 70Hz. The gain of the filter is 1 in the passband. The unmodulated carrier is given by $10\cos(1000\pi t)$, and the message signal is $m(t)= 10\cos(20\pi t)$. The frequency deviation constant k_f is 8 Hz/V.
   (a) Determine the peak frequency deviation and the peak phase deviation. (5 分)
   (b) Determine the modulation index. (5 分)

6. (10 分) Determine the 8 × 8 Hadamard matrix.

7. (共 10 分) Consider the precoding procedure which aims for avoiding error propagation in duobinary encoding. The data sequence is $(x_0, x_1, x_2, x_3, x_4, x_5, x_6, x_7) = (+1, -1, +1, +1, -1, +1, -1, -1)$. Assume the initial value for the sequence (a_n), which is denoted by a_{-1}, is +1.
   (a) Find the sequence (a_k) obtained by precoding. (5 分)
   (b) Find the sequence (y_n) obtained from duobinary encoding of (a_k). (5 分)

8. (共 10 分) Consider the linear equalizer.
   (a) Explain its functionality. (5 分)
   (b) Draw the architecture of a three-tap Zero-forcing linear equalizer and express how it works. (5 分)

9. (共 15 分) Suppose that the length of the signaling interval for both 4-QASK and the one-dimensional 4-ASK, T', is twice the length of the signaling interval for binary ASK, T ($T' = 2T$).
   (a) What are the information rates of the binary ASK, 4-QASK, and one-dimensional 4-ASK signals? (5 分)
   (b) Compare the bandwidth requirements for the binary ASK, 4-QASK, and one-dimensional 4-ASK signals. (5 分)
   (c) For a given probability of bit error, compare the energy requirements for the binary ASK, 4-QASK, and one-dimensional 4-ASK signals. (5 分)