國立雲林科技大學
97學年度碩士班入學招生考試試題

系所：通訊所
科目：通信系統

1. (15%) In a DSB-SC modulation system, the carrier is $c(t) = A_c \cos(2\pi f_c t)$, the message signal is $m(t) = \text{sinc}(t) + \text{sinc}^2(t)$.

(a) (10%) Find the Fourier transformation of the modulated signal $s(t)$.

(b) (5%) Determine the bandwidth of the transmitted signal.

2. (20%) The IF frequency in an AM radio is $f_{IF} = 455\,\text{kHz}$: Assume the desired signal has a carrier frequency of 600 kHz.

(a) (8%) Find the LO frequency and the image frequency of the desired signal

(b) (12%) Draw a block diagram of a superheterodyne receiver and explain how it can remove the image signal.

3. (20%)A sinusoidal signal $m(t) = 2\cos(2\pi 10^4 t)$ is frequency modulated with carrier frequency f_c = 100 MHz. Assume the frequency sensitivity of the modulator is $k_f = 30\,\text{kHz/V}$.

(a) (8%) Use Carson's rule to find the transmission bandwidth of the FM signal.

(b) (6%) How will the transmission bandwidth change if the carrier frequency is increased?

(c) (6%) If the message signal is replaced by $m(t) = 1 + 2\cos(2\pi 10^4 t)$, find the transmission bandwidth.

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4. (20%) Consider the three functions $\phi_1(t)$, $\phi_2(t)$ and $\phi_3(t)$ shown in Figure 1.

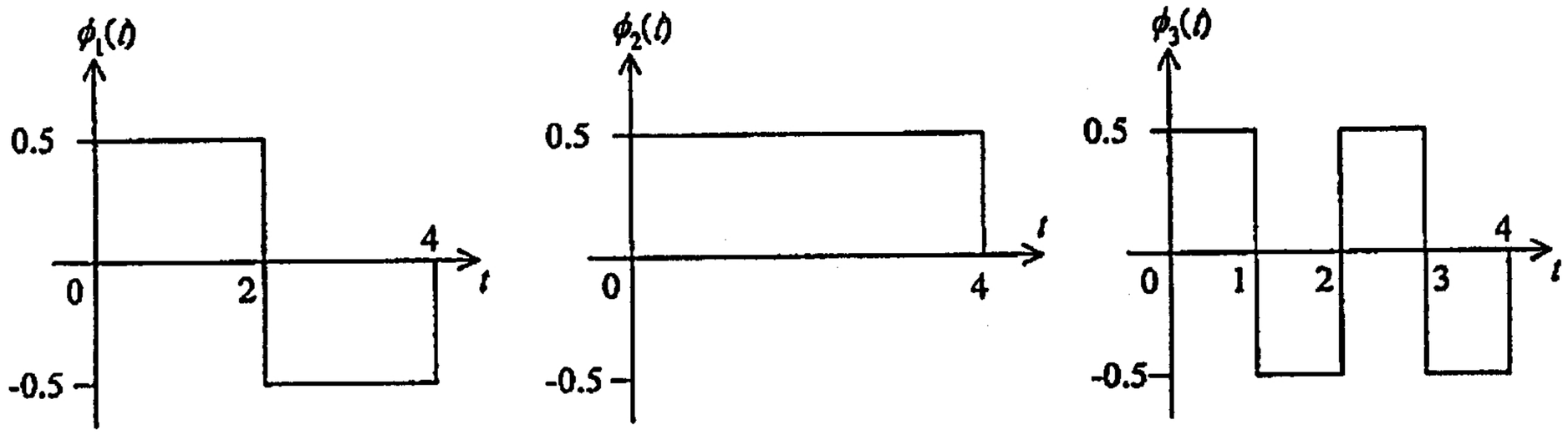

Figure 1

(a) (8%) Determine whether these three functions are orthogonal to each other over the interval [0, 4].

(b) (4%) Determine whether these three functions can form a set of orthonormal basis functions?

(c) (8%) Assume a function $x(t)$ is defined as below. Express $x(t)$ as the linear combination of $\phi_1(t)$, $\phi_2(t)$ and $\phi_3(t)$.

$$x(t)=\begin{cases}1, & 0\le t\le 1\\ 2, & 1\le t\le 2\\ 0, & 2\le t\le 3\\ 1, & 3\le t\le 4\end{cases}.$$

5. (25%) Consider a discrete memoryless source with source alphabet $S = \{ s_1, s_2, s_3, s_4, s_5, s_6, \}$ with respective probabilities { 0.3, 0.2, 0.2, 0.1, 0.1, 0.1 }.

(a) (8%) Calculate the entropy of the source.

(b) (4%) Calculate the entropy of the second-order extension of the source.

(c) (7%) Construct the Huffman code for this source.

(d) (6%) Evaluate the average codeword length and the efficiency of the Huffman code.