

中原大學 97 學年度碩士班入學考試

4 月 13 日 16:00~17:30 電子工程學系通訊組(丙組)

誠實是我們珍視的美德，
我們喜愛「拒絕作弊，堅守正直」的你！

科目：通訊系統

(共 2 頁第 1 頁)

可使用計算機，惟僅限不具可程式及多重記憶者 不可使用計算機

1. For the commercial usage, the FM system usually includes pre-emphasis and de-emphasis.
 - (a) Sketch the block diagram of the FM system with pre-emphasis and de-emphasis. (5%)
 - (b) State the functions of the pre-emphasis and de-emphasis. (5%)
 - (c) Find the noise improvement I due to pre-emphasis and de-emphasis. (10%)

Assumptions: The transfer functions of pre-emphasis and de-emphasis are

$$H_{pe}(f) = 1 + \frac{jf}{f_0}, \text{ and } H_{de}(f) = \frac{1}{1 + jf/f_0}, \text{ respectively.}$$

The power spectral of the noise $n_o(t)$ at the conventional FM receiver without pre-emphasis and de-emphasis is in the square form of the operating frequency

$$S_{N_o}(f) = \begin{cases} \frac{N_0 f^2}{A_c^2}, & |f| \leq W \\ 0, & \text{elsewhere} \end{cases},$$

in which W is the message bandwidth, N_0 is noise figure, and A_c is the carrier amplitude.

2. For the conventional AM system, the transmitted signal $m(t)$ is depicted in Fig. 1(a). After the AM modulator, the modulated signal $s(t)$ is shown in Fig. 1(b).

- (a) Find the modulation index μ of the AM system. (5%)
- (b) Find the spectrum of the modulated signal $s(t)$. (15%)
- (c) Find the power of upper side-frequency of $s(t)$. (5%)

Fig. 1(a)

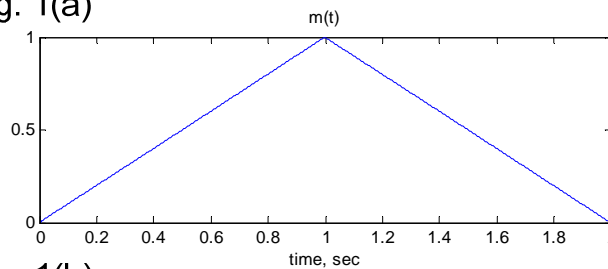
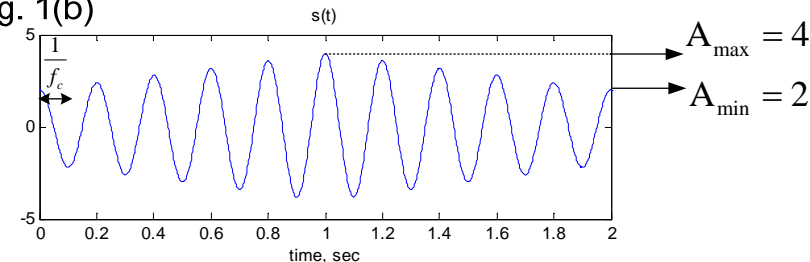


Fig. 1(b)



3. Consider three equally likely signal waveforms $\{s_i(t)\}_{i=1}^3$ are transmitted over an additive white noise channel. The three transmitted waveforms are depicted in Fig. 2, and the AWGN channel is Gaussian distributed with zero mean and variance of 0.2.

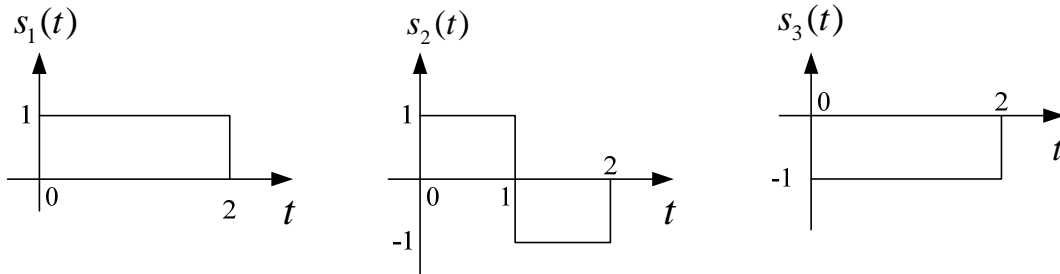


Fig. 2 Three transmitted waveforms.

- (a) Find the corresponding signal vectors \mathbf{s}_1 , \mathbf{s}_2 , and \mathbf{s}_3 to $\{s_i(t)\}_{i=1}^3$ by using the Gram-Schmidt orthogonalization procedure. (10%)
- (b) Plot the obtained the signal vectors in the signal space and determine the optimal decision boundary and decision region. (5%)
- (c) Find the error probability $P_{e,1}$ when $s_1(t)$ is transmitted. (10%)

4. Consider a PCM system with system bandwidth $B_T=16\text{M Hz}$.

- (a) Sketch the block diagram of analog-to-digital converter (ADC) of a PCM system. (5%)
- (b) Plot the associated waveform to the binary data stream “01101” in the **Manchester** code. (5%)
- (c) Determine the maximum message bandwidth W , provided that the bits rate of system is 24M bps, the message is sampling at Nyquist rate, and the PCM system uses 8-bit uniform quantizer. (5%)
- (d) What value of the maximum bit rates can be achieved if the PCM system exploits 4-PAM signaling with ideal Nyquist filter of rolloff factor $\alpha=0$. (5%)

5. Assume a binary PAM signal with rectangular transmitter pulse shaping conveys over the ideal band-limited channel. Can the corresponding received signal be free from the intersymbol interference effect? Give your explanation. (10%)