

本試題是否可以使用計算機：☐可使用，☒不可使用（請命題老師勾選）

考試日期：0301，節次：2

注意：請將 Part 1(選擇題)及 Part 2(填充題)之答案依題序在答案卷第一頁上作答，

務必標明題號，可自行製作適當表格填寫。

Part 1: 選擇題 (計 4 題，每題 5 分，複選，答錯不倒扣。每題至少有一答案，沒寫不給分。)

1. For AM modulation, if the modulation index is increased, then: (a) the bandwidth is increased; (b) the transmitted power is increased; (c) the power efficiency is increased; (d) the post-detection SNR is decreased; (e) the post-detection SNR is increased.
2. For FM modulation, if the modulation index is increased, then: (a) the bandwidth is increased; (b) the transmitted power is increased; (c) the power efficiency is increased; (d) the post-detection SNR is decreased; (e) the post-detection SNR is increased.
3. A signal $x(t)$ sampled by 12kHz and quantized with 8-bit PCM can achieve 20 dB signal-to-quantization noise ratio (SQNR). If we want to increase the SQNR to 40 dB, we may adopt: (a) 24kHz sampling rate; (b) 120kHz sampling rate; (c) 12-bit PCM; (d) an amplifier with amplitude gain = 100 before the quantization; (e) none of above.
4. If a filter is characterized by the input-output relationship as an ideal finite-time integrator, then this filter is a (a) highpass filter; (b) bandpass filter; (c) lowpass filter; (d) bandrejection filter; (e) linear system.

Part 2: 填充題 (計 12 格，每格 5 分)

1. What are the three key components of a typical phase-locked loop (PLL)? (1)
2. An information source has its output from alphabet set $\{W, X, Y, Z\}$ with probabilities $P_r(W) = 1/4$, $P_r(X) = 1/8$, $P_r(Y) = 1/8$, and $P_r(Z) = 1/2$.
 - (a) Determine the entropy of this source. (2)
 - (b) Design a Huffman code for this information source. What are the average codeword length L and the coding efficiency η ? (3)
3. To transmit a data source of rate = 2.4Mbps by 16-QAM modulation through a raised cosine filter with roll-off factor = 0.5, what is the required bandwidth? (4)
4. A white, Gaussian signal with two-sided power spectral density (PSD) of 13dBm/Hz passes through a filter with impulse response $h(t) = 100\text{sinc}(1000t)$. Determine the followings:
 - (a) The two-sided power spectral density (PSD) of the output. (5)
 - (b) The power (in dBW) of the output. (6)
 - (c) The autocorrelation function of the output. (7)
 - (d) The probability density function (pdf) of the output's amplitude at an arbitrary time t_0 . (8)

(背面仍有題目,請繼續作答)

5. The parity-check matrix of a systematic linear (n, k) block code is

$$\mathbf{H} = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 1 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 1 & 1 & 1 \end{bmatrix},$$

where $\mathbf{u} \cdot [\mathbf{H}]^T = 0$, \mathbf{u} is any code vector.

(a) Determine (n, k) of this code. (9)

(b) If the message vector $\mathbf{m} = (1001)$. What is the corresponding code vector \mathbf{u} ? (10)

(c) Determine (d_{\min}, e, t) of this code, where e is the error-detecting capability and t is the error-correcting capability. (11)

(d) If the received vector $\mathbf{r} = (10101101)$, what is the decoded message \mathbf{m} ? (12)

Part 3: (計 2 題，每題 10 分)

1. For an equally likely binary data source with 10-kbps transmission rate, a modulator transmits bit 0 by $S_0(t)$ and transmits bit 1 by $S_1(t)$ (as shown in Fig. 1) through an AWGN channel with 30dB power loss and one-sided noise PSD = -47dBm/Hz, depict the optimal receiver and determine the impulse response of the receiver's filter as well as the value of optimal threshold. Also determine the bit-error-rate of this system in Q-function ($Q(u) = \int_u^\infty \frac{1}{\sqrt{2\pi}} e^{-x^2/2} dx$).

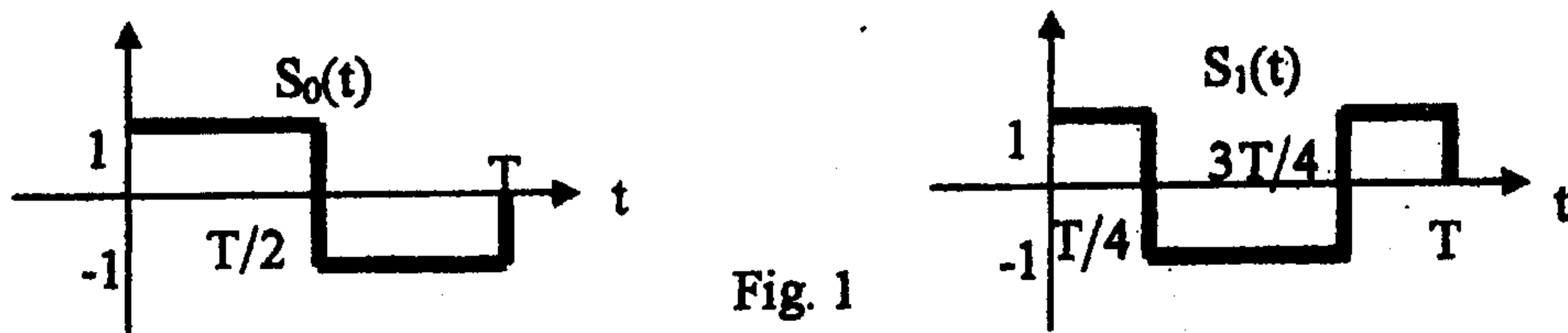


Fig. 1

2. Show the descending order of the minimum bit-error-rate P_b for the following modulation schemes to send messages through the AWGN channel with $E_b/N_0 = 10\text{dB}$.
- (a) BPSK; (b) QPSK; (c) OQPSK; (d) 16PSK;
 (e) 8FSK; (f) BFSK; (g) MSK; (h) 16QAM.