

※ 考生請注意：本試題可使用計算機，並限「考選部核定之國家考試電子計算器」機型

**注意: Part 1 (填充題) 不必在答案卷上填寫計算過程，僅需將答案依題序在答案卷「第一頁」上明確填寫，務必標明格號，可自行製作適當表格填寫。**

**Part 1: 填充題 (35 分，7 格，每格 5 分)**

1. The normalized signal  $m_n(t)$  ( $m_n(t) \leq 1$ ) has a single sided bandwidth of 4 kHz and its power is 0.4 W. The carrier  $A \cos 2\pi f_0 t$  has a power of 50W.

(a) If  $m_n(t)$  modulates the carrier using SSB modulation, the bandwidth of the modulated signal  $c(t)$  is (1) and the power is (2). Note that

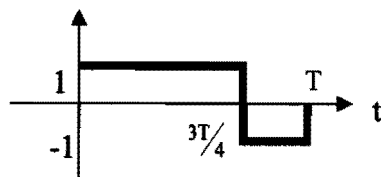
$$c(t) = A m_n(t) \cos 2\pi f_0 t \pm A \widehat{m}_n(t) \sin 2\pi f_0 t, \text{ where } \widehat{m}_n(t) \text{ is the Hilbert transform of } m_n(t).$$

(b) If the modulation scheme is AM with modulation index  $a = 0.5$ , the bandwidth of the modulated signal  $c(t)$  is (3), the power is (4), and the power efficiency is (5). Note that  $c(t) = A[1 + a \cdot m_n(t)] \cos 2\pi f_0 t$ .

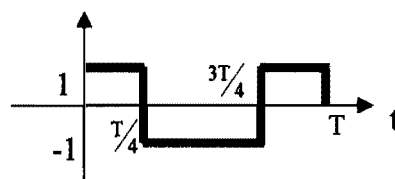
(c) If the modulation scheme is FM with frequency-deviation constant (or frequency sensitivity)  $k_f = 24000$ , the bandwidth of the modulated signal  $c(t)$  is (6) and the power is (7).

**Part 2: (65 分)**

1. In an AWGN channel with power-spectral density of  $N_0/2$ , two equally likely messages are transmitted by the following signals  $S_0(t)$  and  $S_1(t)$ .



$S_0(t)$



$S_1(t)$

- (a) Depict an optimal receiver and determine the threshold value for the receiver you design. (10%)
- (b) With the optimal receiver, determine the bit-error-rate (BER) in terms of T and  $N_0$ . (5%)
- (c) It is known that  $E_b/N_0 = 10.5\text{dB}$  is required to get  $\text{BER} = 10^{-6}$  for BPSK signals, what is the required  $E_b/N_0$  (in dB) for this system to get  $\text{BER} = 10^{-6}$ ? (5%)

(背面仍有題目,請繼續作答)

※ 考生請注意：本試題可使用計算機，並限「考選部核定之國家考試電子計算器」機型

2. The mapping between messages and codewords of an (7, 3) block code is given as:

Messages ( <u>m</u> )	Codewords ( <u>u</u> )	Messages ( <u>m</u> )	Codewords ( <u>u</u> )
0 0 0	0 0 0 0 0 0 0	0 0 1	1 1 0 1 0 0 1
1 0 0	1 1 1 0 1 0 0	1 0 1	0 0 1 1 1 0 1
0 1 0	0 1 1 1 0 1 0	0 1 1	1 0 1 0 0 1 1
1 1 0	1 0 0 1 1 1 0	1 1 1	0 1 0 0 1 1 1

- (a) Is this code a linear systematic code? If "yes", show the generator matrix  $G$ , where  $\underline{u} = \underline{m} G$ , and the parity-check matrix  $H$ . (10%)
- (b) Determine  $d_{\min}$ , error-detecting capability, and error-correcting capability of this code. (9%)
- (c) If the received vector  $\underline{r} = (0 0 1 1 1 1 1)$ , determine the syndrome and the decoded message. (6%)
- (d) A 3-bit message block is sent through an AWGN channel by using BFSK modulation with non-coherent detection. The received  $E_b/N_0$  is 7 dB. Determine and compare the successful reception probabilities of the whole block for two cases: one is that the message block is encoded by this (7, 3) code and the other is that it is sent without channel coding. (15%)  
(Hint: The bit-error-rate of BFSK modulation with non-coherent detection is  $P_b = 1/2 \cdot \exp(-E_b/2N_0)$ .)

3. Explain the meaning of the Entropy of a message. Also give a simple example to show how to calculate the Entropy of a message. (5%)