

系所組別： 電腦與通信工程研究所乙組

考試科目： 通信系統

考試日期：0307，節次：2

※ 考生請注意：本試題 可 不可 使用計算機

**注意：Part 1(選擇題)及 Part 2(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，務必標明題號，可自行製作適當表格填寫。**

**Part 1: 選擇題 (25 分，每題 5 分，複選，答錯不倒扣。每題至少有一答案，沒寫不給分。)**

- If  $y(t)$  denotes the system output and  $x(t)$  denotes the system input, which systems are linear systems?: (a)  $y(t)=15x(t)+122$ ; (b)  $y(t)=|x(t)|$ ; (c)  $y(t)=x^2(t)$ ; (d)  $y(t)=5x(t)-2dx(t)/dt$ ; (e)  $y(t)=15x(t)\cos 100t+10$ .
- A speaker communicates with a listener through an FM transmission system. When the speaker raises his voice then (a) the power of the FM wave will be increased; (b) the power of the FM wave will be decreased; (c) the bandwidth of the FM wave will be increased; (d) the bandwidth of the FM wave will be decreased; (e) the received channel's SNR will be increased.
- About the pulse-modulation schemes, PAM, PPM, and PWM, which statements are correct? (a) PAM has better noise immunity. (b) PPM can be produced from differentiating a PWM signal. (c) PPM and PWM signals require larger bandwidth. (d) PWM and PAM have constant amplitude. (e) The width of PPM pulse is proportional to the amplitude of the information signal.
- For a given analog bandpass signal, whose bandwidth is ranged between 3000Hz and 4000Hz, to avoid the frequency overlapping produced by the sampler, the sampling frequency can be (a) 2000 Hz; (b) 3000 Hz; (c) 4000Hz; (d) 1000Hz; (e) 8000Hz.
- S and N are uncorrelated joint Gaussian random variables.  $\Phi_S$  and  $\Phi_N$  denote the respective characteristic functions. Which statements are true? (a) S and N are independent. (b) S and N are orthogonal. (c) S+N is also Gaussian. (d) S+N has a characteristic function of  $\Phi_S+\Phi_N$ . (e) S+N has a characteristic function of  $\Phi_S\Phi_N$ .

**Part 2: 填充題 (50 分，每格 5 分)**

- The pdf of the amplitude of a lowpass random signal  $x(t)$  (bandwidth = 20 kHz) at any time  $t_0$  is uniformly distributed over (-16, 16). This signal is sampled at a rate higher than the Nyquist rate to provide a guard-band of 5KHz, digitized with a uniform 64-level quantizer, and encoded by a natural PCM coder.
  - The lowest bit rate at PCM output is (1), and the maximum signal to quantization noise ratio is (2) (in dB)?
  - With the same quantizer, if the amplitude's pdf of  $x(t)$  at any time  $t_0$  is reduced to be uniformly distributed over (-8, 8), the signal to quantization noise ratio will become (3) (in dB)?
  - If the PCM output is baseband modulated by a 8-level polar NRZ signals, the one-sided mainlobe bandwidth will be (4).

(背面仍有題目,請繼續作答)

系所組別： 電腦與通信工程研究所乙組

考試科目： 通信系統

考試日期： 0307，節次： 2

※ 考生請注意：本試題 可 不可 使用計算機

2. An information source has its output from alphabet set  $\{X, Y, Z\}$  with probabilities  $P_r(X) = 0.25$ ,  $P_r(Y) = 0.02$ , and  $P_r(Z) = 0.73$ .
- (a) The entropy of this source is (5).
- (b) Design a Huffman code for this information source. What are the average codeword length  $L$  and the coding efficiency  $\eta$ ? (6)
- (c) Give a way to improve the coding efficiency? (7)
3. A digital communication system consists of a transmission line with 4 regenerative repeaters (excluding the last receiver). The communication environment and design of all receivers are identical. The channel has an ideal frequency response over  $320\text{MHz} \leq f \leq 325\text{MHz}$ . The modulation scheme is OQPSK with coherent detection and the channel noise is AWGN with  $N_0 = 10^{-10}$  W/Hz.
- (a) The highest bit rate (bps) that can be transmitted without ISI is (8).
- (b) If the bit-error-rate of the whole system  $\leq 5 \cdot 10^{-5}$  is required, the minimum received  $E_b/N_0$  at each receiver is (9). In this case, the minimum transmitted power (in dBm) at each repeater for the system of (a) is (10) if the channel attenuation between two adjacent repeaters is 30 dB.  
(Note: It is required  $E_b/N_0 = 12.6$  dB for BFSK signal with coherent detection and  $P_b = 10^{-5}$ .)

**Part 3: (25 分)**

1. The generator polynomial of a (15, 7) linear cyclic code is  $g(x) = 1+x^4+x^6+x^7+x^8$ .
- (a) Determine the output (in polynomial form) of the encoder if the input message polynomial  $m(x) = 1+x^2+x^5$ . (5%)
- (b) If the received polynomial  $r(x) = 1+x^4+x^8+x^{12}$  (i.e.,  $\mathbf{r} = (100010001000100)$ ), what is the decision of the error-detector at the receiver (error or no error)? Why? (5%)
2. Explain briefly the following terminologies:
- (a) Carson's rule for FM signals; (5%)
- (b) AWGN; (5%)
- (c) Gray code (also show the label of 8PSK with Gray code). (5%)