

# 元智大學 103 學年度研究所 碩士班 招生試題卷

系(所)別： 通訊工程學系碩  
士班

組別： 通訊組

科目： 通訊系統

用紙第 / 頁共 / 頁

●不可使用電子計算機

1. (20%) Suppose a white noise  $w(t)$  has a PSD of  $N_0/2 = 0.5 \times 10^{-9}$  Watts/Hz, and passes through an ideal BPF with center frequency of 1 GHz and bandwidth of 10 MHz. Let  $N(t)$  be the BPF output.
  - (a) Give the expression of  $N(t)$  in terms of its I/Q components  $N_I(t)$  and  $N_Q(t)$ , and sketch the block diagram of the I/Q down converter which converts  $N(t)$  to  $\{N_I(t), N_Q(t)\}$ . (10%)
  - (b) Find the PSD, power, and the first-order PDF of  $N_I(t)$ . (10%)
2. (20%)
  - (a) Sketch a signal constellation diagram for a gray-coded 16-QAM signal. (10%)
  - (b) State the major channel impairments (or effects) of a wireless channel. (10%)
3. (60%) Briefly answer the following problems:
  - (a) If a signal  $x(t) = 10 \times \text{sinc}^2(1000t)$  is sampled at 1500 samples/sec, can it be perfectly reconstructed from its discrete-time samples? Use the Nyquist sampling theorem to explain your answer. (10%)
  - (b) If a communication channel with input  $x(t)$  and output  $y(t)$  follows the I/O relation:  $y(t) = x(t) + 0.3 \cdot x(t-0.5)$ , find the channel impulse response  $h(t)$  and frequency response  $H(f)$ . (10%)
  - (c) Consider the STFM signal  $s(t) = 2 \times \cos(2\pi f_c t + 4 \sin(2\pi f_m t))$ , where  $f_c = 100$  MHz, and  $f_m = 5$  kHz. Find the FM modulation index  $\beta$  and transmission bandwidth  $B_T$  of  $s(t)$ . (10%)
  - (d) A PCM system uses a 1024-level uniform quantizer. The bit rate of the system is equal to 20 Mbps. To transmit a full-loaded sinusoidal message signal  $m(t)$ , find the maximum allowable sinusoidal frequency and the resultant output SNR in dB. (10%)
  - (e) A communication system transmits a polar NRZ signal with signal power  $P = 1$  W and data rate  $R_b = 1$  Mbps through an AWGN channel with  $N_0/2 = 0.5 \times 10^{-9}$  Watts/Hz. Design and sketch the block diagram of the optimal receiver, and find the conditional bit error probability  $P_e(1)$  given a bit '1' is transmitted. (10%)
  - (f) A passband QPSK transmitter has the following specifications: bit rate  $R_b = 4$  Mbps, carrier frequency  $f_c = 100$  MHz, and raised cosine baseband pulse shaping with 50% rolloff. Sketch the transmitted signal spectrum  $S_x(f)$  and determine the signal bandwidth  $B_T$ . (10%)

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