國立中央大學八十九學年度碩士班研究生入學試題

113 所别:

电模工程学系

9組 科目:

通讯系统

共 2 頁 第 1]

注意:本試題共6題,每題20分,任選5題。滿分100分。

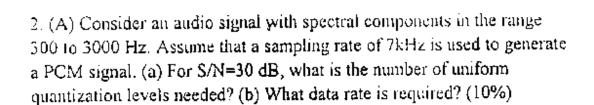
(20) 1. Given the signals $x_1(t)$ and $x_2(t)$ as follows.

(5) (a) Rewrite
$$x_1(t) = \sum_{n=-\infty}^{\infty} \prod \left(\frac{t - T_0}{T_0} \right) \delta(t - nT_0)$$
 in the simplest form.

(5) (b) Find $X_1(f)$, the Fourier transform of $x_1(t)$.

(5) (c) Rewrite
$$x_1(t) = \sum_{n=-\infty}^{\infty} \left[\prod \left(\frac{t}{T_0} \right) * \delta(t - nT_0) \right]$$
 in the simplest form, where * represents the convolution operation.

(5) (d) Find $X_2(f)$, the Fourier transform of $x_2(t)$.



(B) Ten analog signals that are bandlimited to frequencies below 16 kHz are samples at the Nyquist rate. The PCM digitizing error is below 0.2%. The signals are carried by a TDM channel. What is the data rate required for the channel? (10%)

(20%) 3. $G_1, G_2, X_1, X_2, X_3, X_4$ are independent Gaussian random variables with zero means, $E[G_1] = E[G_2] = E[X_1] = E[X_1] = E[X_3] = E[X_4] = 0$. Their variances are given by var $G_1 = \text{var } G_2 = \sigma^2$ and var $X_1 = \text{var } X_2 = \text{var } X_3 = \text{var } X_4 = N_0$, where N_0 is a constant. Let $R_1 = \sqrt{(G_1 + X_1)^2 + (G_2 + X_2)^2}$ and $R_2 = \sqrt{X_2^2 + X_4^2}$. (10%) (a). Find the probability density function $f_{R_1}(r_1)$ of R_1 .

(10%) (b). Find the probability that $R_1 < R_2$.

立中央大學八十九學年度碩士班研究生ノ

所別: 電機工程學系 丁組 科目:

通訊系統

共.

20% 4. Consider 16-ary QAM with signals given as

$$s_i(t) = \sqrt{\frac{2E_s}{T_s}} \left[a_i \cos w_t t + b_i \sin w_t t \right] \quad 0 \le t \le T_s \,,$$

where $a_i, b_i \in \{\pm 1, \pm 3\}$ with equal probability. Under the assumption of the AWGN channel with double-sided power spectral density $N_0/2$.

- 5% (a) Devise an optimal coherent detector for 16-QAM;
- 5% (b) Show the signal constellation and the optimal decision regions;
- 10% (c) Compute the detected error probability in term of E_s / N_0 .

5.(20%)Consider a systematic block code whose parity-check equations are

$$c_1 = m_1 + m_2 + m_3$$

$$c_2 = m_2 + m_3 + m_4$$

$$c_3 = m_1 + m_2 + m_4$$

$$c_4 = m_1 + m_3 + m_4$$

where m_1 are message digits and c_1 are check digits.

- (A)Find the generator matrix
- (B) Find the parity-check matrix
- (C)Encode the message (1101)
- (D)ls the vector 1101001 a codeword?

6 (20%) For a relay-satellite-to-user link:

- (a). Relay satellite input power: 10 W
- (b). Relay satellite antenna gain: 38 dB
- (c) Transmit frequency: 10 GHz
- (d). Receiver noise temperature of user (antenna included): 1000K
- (e). User satellite antenna gain: 15 dB
- (f). Total system losses: 3 dB
- (g). System bandwidth: 3000 Hz
- (h). Relay-user separation: 41000 km

Knowing that $10\log_{10}(kT_0) = -174$ dBm/Hz, where k is Boltzmann's constant and T_0 is room temperature 290 K; find the signal-to-noise power ratio in a 3000 Hz bandwidth at user satellite receiver output.