

【基本通訊概論】試卷

考試地點：通訊館一樓 E1-109 室

考試時間：100 分鐘

試題總分：100 分

1. [10%] (a) Which of the following schemes are analog modulation schemes (a) FM (b) FSK (c) AM (d) BPSK (e) DPSK.
 (b) Which of the following schemes are digital modulation schemes (a) FM (b) FSK (c) AM (d) BPSK (e) DPSK.

2. [10%] Two random variables X and Y have means and variances given below:

$$m_x = 2, \sigma_x^2 = 4, m_y = 1, \sigma_y^2 = 9.$$

A new random variable Z is defined as $Z=3X-4Y$. Determine the mean and variance of Z for the following cases of correlation between the random variable X and Y: (a) $\rho_{xy} = 0$ (b) $\rho_{xy} = 1$.

3. [10%] Three fair coins are tossed simultaneously. A random variable X is defined as the total number of heads up on the coins.
 (a) What is the probability of $X=0$?
 (b) What is the probability of $X=2$?
 (c) Plot the cumulative distribution function corresponding to this random variable.

4. [10 %] Sketch the double sided spectra of $x(t) = 2 \cos(10\pi t - \frac{1}{6}\pi)$.

5. [15%] (a) Please describe what the sampling theory is. (b) Consider the analog signal $x_a(t) = 3 \sin(20\pi t) + 10 \sin(400\pi t) - \cos(100\pi t) - 2 \sin(700\pi t)$. Determine the Nyquist sampling rate for $x_a(t)$.

6. [15%] Consider the random process with sample function:

$$x(t) = A \cos(2\pi f_c t + \theta)$$

where A and f_c are constant and θ is a random variable that is uniformly distributed over the

interval $[-\pi, \pi]$, that is, $f_\theta(\theta) = \begin{cases} 1/2\pi & -\pi \leq \theta \leq \pi \\ 0 & \text{elsewhere} \end{cases}$. Please calculate (a) the mean of $x(t)$. (b) DC power

of $x(t)$. (c) total power of $x(t)$.

7. [20%] Consider the pulse signal $s(t) = \begin{cases} A, & 0 \leq t \leq T \\ 0, & \text{otherwise} \end{cases}$. (a) Please find the match filter to this signal. (b)

If the transmitted signal consists of a sequence of constant amplitude pulse of either A or $-A$ units in amplitude and T seconds in duration. Please draw a receiver structure to decide whether the transmitted signal was A or $-A$ during each bit period in additive white Gaussian noise.

8. [10%] In a DSB system, the bandwidth of the bandpass predetection filter is B_T and the bandwidth of the lowpass postdetection filter is B_D . The received signal and noise are given by $x(t) = Am(t)\cos(2\pi f_c t) + n(t)$. A and f_c are constant. $m(t)$ is the message. The noise $n(t)$ has the double sided power spectral density $\frac{N_0}{2}$ W/Hz. Please write the predetection SNR.