(20%) 1. Twelve different message signals, each with a bandwidth of 10kHz, are to be multiplexed and transmitted. Determine the minimum bandwidth required for each method if the myltiplexing or modulation method used is (a) FDM (b) SSB (c) PAM (d) TDM and explain the reason.

(20%) 2. Let $\bar{x}$ and σ^2 be the expected value and variance of the random variable X, repectively. Regardless of the distribution of X, what is the probability that X deviates from $\bar{x}$ by more than $\pm 3\sigma$?

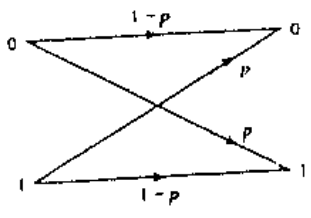
(20%) 3. In each of the following cases, determine whether the signal x(t) after sampling can be fully reconstructed with ideal filters. Note that the filter types are not limited to low-pass filters. Please also draw the spectrums and give brief reasons to support your answers.

(a) $x(t) = \cos 2\pi(3f_o)t$ is sampled at $8f_o$.
(b) $x(t) = \cos 2\pi(5f_o)t$ is sampled at $8f_o$.
(c) $x(t) = \cos 2\pi(3f_o)t$ and $y(t) = \cos 2\pi(5f_o)t$ are both sampled at $8f_o$.
(d) $x(t) = \cos 2\pi(3f_o)t$ and $y(t) = \cos 2\pi(7f_o)t$ are both sampled at $8f_o$.

(20%) 4. For the BPSK modulation, the modulator generates one of two signals, $s_0(t)$ for data "0" or $s_1(t)$ for data "1" where

$$\begin{cases} s_0(t) = \sqrt{\dfrac{2E}{T}}\sin(2\pi f_0 t + \dfrac{\pi}{2}), & 0 \le t \le T \\ s_1(t) = \sqrt{\dfrac{2E}{T}}\sin(2\pi f_0 t - \dfrac{\pi}{2}), & 0 \le t \le T \end{cases}$$

Under the assumptions of an additive white Gaussian noise (AWGN) channel with one-sided power spectral density N_0 and coherent detection, the sampled output given by $\rho = \int_0^T r(t)\sqrt{\dfrac{2E}{T}}\sin(2\pi f_0 t + \dfrac{\pi}{2})\,dt$ is quantized to binary levels with $\rho \le 0 \rightarrow$ *data* "0" *and* $\rho > 0 \rightarrow$ *data* "1" (i.e., use a hard decision) where *r(t)* is the received signal. This channel can be modeled as the binary symmetric channel (BSC) as depicted below, where p is called the transition error probability of the channel. Please find p.



注意：背面有試題

(20) 5. A (7.4) systematic block code has parity-check equation

$$C_1 = m_1 + m_2 + m_3$$
$$C_2 = m_2 + m_3 + m_4$$
$$C_3 = m_1 + m_2 + m_4$$

Where m_i are message digits and C_i are check digits.

(A) Find the generator matrix.

(B) Find the parity-check matrix

(C) Encode the message 1101

(D) Decode the sequences 1100101 and find the syndrome.