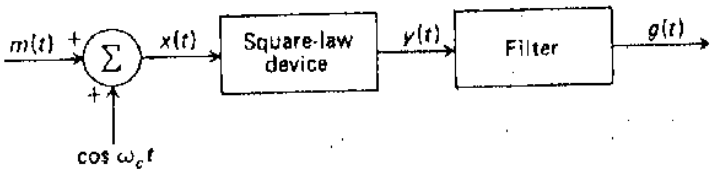
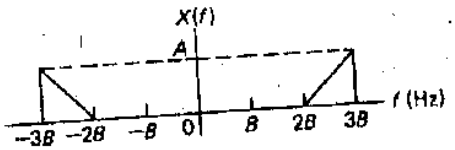
1. Consider the following system. Assume that the average value of $m(t)$ is zero and that the maximum value of $|m(t)|$ is M. Also assume that the square-law device is defined by

$$y(t) = 4x(t) + 2x^2(t)$$

(a) Write the equation for $y(t)$.
(b) Describe the filter that yields an AM (amplitude modulated) signal for $g(t)$. Give the necessary filter type and the frequencies of interest.
(c) What value of M yields a modulation index of 0.8? (15%)



2. Given the following bandpass signal spectrum, sketch spectra for the following sampling rates and indicate which ones are suitable. (15%)
(a) 2.5B (b) 6B



10% 3. Let X be a random variable with probability density function (pdf) $f_x(x) = \alpha e^{-\alpha x} u(x)$. Compute the pdf of $Y = 2X + 3$.

15% 4. Show that side information never increases average uncertainty. That is, show that $H(X|Y) \le H(X)$, where both $H(X)$ and $H(X|Y)$ are defined as

$$H(X) = -\sum_{j=1}^{n} p(x_j)\log_2 p(x_j) \quad \text{and} \quad H(X|Y) = -\sum_{j=1}^{n}\sum_{j=1}^{m} p(x_j, y_j)\log_2 p(x_j|y_j),$$

respectively, also $\sum_{j=1}^{n} p(x_j) = 1$ and $\sum_{j=1}^{m} p(y_j) = 1$.

15% 5. Consider a systematic (8,4) code whose parity-check equations are

$$v_0 = u_1 + u_2 + u_3$$
$$v_1 = u_0 + u_1 + u_2$$
$$v_2 = u_0 + u_1 + u_3$$
$$v_3 = u_0 + u_2 + u_3$$

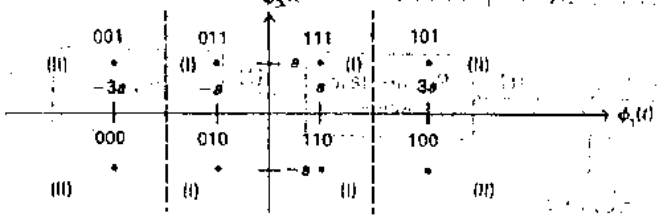
where u_0, u_1, u_2, and u_3 are message digits and v_0, v_1, v_2, and v_3 are parity-check digits. Find the generator and parity-check matrices for this code. Show that the minimum Hamming distance of this code is 4.

注意：背面有試題

6、Consider the two 8-point QAM signal constellations in Fig P6. The minimum distance between adjacent points is 2A.

(a) Determine the average transmitted power for each constellation, assuming that the signal points are equally probable. Which constellation is more power-efficient ?

(b)Find the average error probabilities for constellation, which constellation is more reliable. (15 %)



7、Given the following channel pulse-response samples :

Pc(-3T)= − 0.001 Pc(-2T)= − 0.01 Pc(-T)= 0.1 Pc(0) = 1.0

Pc(T)= 0.2 Pc(2T)= − 0.02 Pc(3T)= 0.001

(a) Find the tap coefficients for a three-tap zero-forcing equalizer.

(b) Find the output samples for mT = − 2T, − T, 0, T, and 2T. (15 %)