1. A low pass signal x(t) of bandwidth W is applied to the system shown in Figure 1. The block marked by H represents Hilbert transform and it is assumed that $f_0 >> W$. Express the signals $x_i(t)$ and $X_i(f)$ by x(t) and X(f), the Fourier transform of x(t), for $2 \le i \le 4$, respectively. (15%)

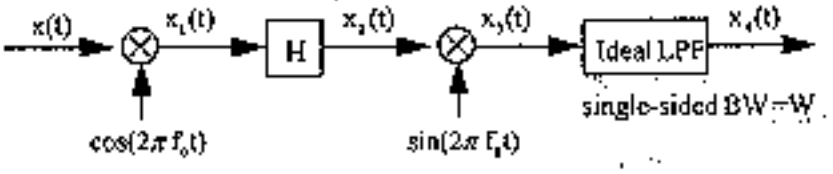


Figure 1

2. A certain communication channel is characterized by 80dB attenuation and additive noise with PSD as shown in Figure 2. The bandwidth of a message signal is 10 kHz and its amplitude is uniformly distributed in the interval [-1,1]. If we require that the SNR after demodulation be 20dB, in each of the following cases find the necessary transmitted power. (Assume the carrier frequency is 1MHz.)
   (a) Conventional AM with a modulation index of 0.1; (5%)
   (b) DSB-SC modulation; (5%)
   (c) SSB modulation. (5%)

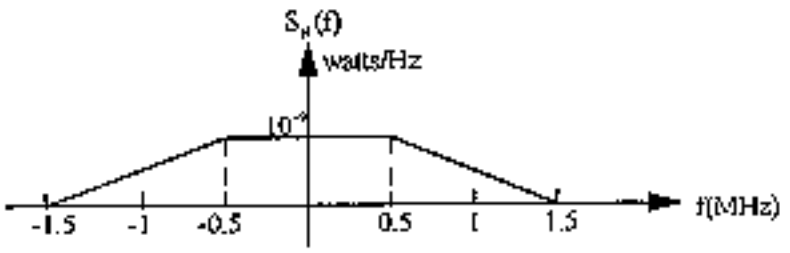


Figure 2

3. An angle-modulated signal has the form $s(t) = 100\cos[2\pi f_c t + 4\sin 2\pi f_m t]$, where $f_c = 100$MHz and $f_m = 3$kHz.
   (a) Determine the average transmitted power. (5%)
   (b) Determine the peak-phase deviation. (5%)
   (c) Determine the peak-frequency deviation. (5%)
   (d) If s(t) is an FM signal, determine the modulation index $\beta$ and the transmitted signal bandwidth by the Carson's rule. (5%)

(背面仍有題目,請繼續作答)

4. The output signal-to-noise ratio (SNR) of a uniform quantizer can be expressed as SNR(dB) = $a_0 + a_1 R_b$, where $R_b$ is the number of bits used per sample, $a_0$ and $a_1$ are constants.
   (a) Calculate $a_1$. (5%)
   (b) Calculate $a_0$ for a single-tone sinusoidal input signal. (5%)
   (c) Assume the bandwidth of the input signal is W. Show that the output data rate $R_b$ (bits/sec) of the quantizer can be expressed by $R_b = b_1 W \cdot \log(b_2 \cdot SNR)$, $b_1$ and $b_2$ are constants. (5%)

5. (a) Plot the transfer function of the Duobinary equivalent correlative filter. Indicate the signaling rate R in your figure. (5%)
   (b) How can you prevent error propagation in the Duobinary signaling scheme in (a)? (5%)
   (c) What is the advantage of the Duobinary signaling over the ideal Nyquist pulse ? Why? (5%)
   (d) What is the disadvantage of the Duobinary signaling over the ideal Nyquist pulse? Why? (5%)

6. The bit error rate for a digital modulation scheme in an AWGN channel is expressed as a function of $E_b/N_0$ (dB), where $E_b$ is the energy per bit and $N_0$ is the noise power spectral density. We call this function the performance curve.
   (a) Plot the performance curves of coherent BPSK, coherent QPSK, coherent FSK, noncoherent FSK, DPSK in the same figure. Indicate clearly the relative positions between the above curves. (8%)
   (b) Explain the reasons that cause the relative positions in (a). (7%)