(100) 輔仁大學碩士班招生考試試題	考試日期：100 年 3 月 18 日第 3 節
	本試題共 2 頁（本頁為第 1 頁）

科目：通訊工程(含類比和數位通訊)　系所組：電子所甲組

1. A complex signal $x(t)$ has the spectrum $X(f)$ given in Fig. 1. Plot the Fourier transform (amplitude and phase spectra) for the following signal. **(25%)**

   a) $x(t-0.25)$. (5%)

   b) $x(t)\exp(j20\pi t)$. (4%)

   c) $X(t)$. (5%)

   d) $Re[x(t)\exp(j20\pi t)$. (6%)

   e) $x(t) \otimes x^*(-t)$, where $\otimes$ denotes the convolution operation. (5%)

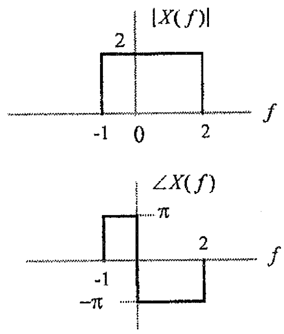

Fig.1

2. The power spectral density of a random process $X(t)$ is shown in Fig. 2. It consists of a delta function at frequency $f = 0$ and a triangular component. **(20%)**

   a) Determine and sketch the autocorrelation function $R_X(\tau)$ of $X(t)$. (5%)

   b) What is the DC power contained in $X(t)$. (4%)

   c) What is the AC power contained in $X(t)$. (5%)

   d) What sampling rates f_s will give uncorrelated samples of $X(t)$? [hint: $C_X(\tau) = 0$ at $f = f_s$.] Are the samples statistically independent? (6%)

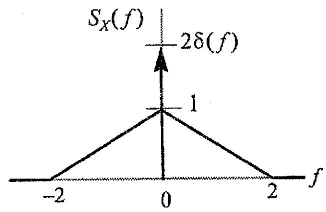

Fig. 2

3. Consider the AM signal $s(t) = 2[1+\mu\cos(6\pi t+\pi/4)]\cos(100\pi t)$. The AM signal $s(t)$ is applied to an ideal envelope detector, producting the output $v(t)$. **(12%)**

   a) Assume that the modulation factor is $\mu = 0.5$. Determine and plot $v(t)$. (6%)

   b) Assume that the modulation factor is $\mu = 2$. Determine and plot $v(t)$. (6%)

4. A double-sideband modulation (DSB) is transmitted over a noisy channel, with the power spectral density of noise being as shown in Fig. 3. The message bandwidth is 10kHz and the carrier frequency is 100 kHz. Assuming that the average power of the modulated wave is 10 watts, determine the output signal-to-noise ratio (dB) of the receiver. **(10%)**

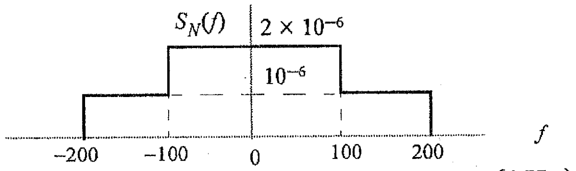

Fig. 3

※ 注意：1. 考生須在「彌封答案卷」上作答。
2. 本試題紙空白部分可當考稿紙使用。
3. 考生於作答時可否使用計算機、法典、字典或其他資料或工具，以簡章之規定為準。

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5. A continuous-time signal is sampled and then transmitted as a PCM signal with $T = 0.5$ second. The noise power spectrum density has the level of $N_0/2 = 2 \times 10^{-1}(W/Hz)$. The pulse signal $g(t)$ has the Fourier transform $G(f)$ given in Fig. 4. A matched filter is used as the receiver filter. **(33%)**

a) Find and plot the impulse response of the matched filter. (4%)

b) Find and plot the pulse signal at the output of the matched filter. (4%)

c) Determine the noise power at the output of the matched filter. (5%)

d) Calculate the peak pulse signal-to-noise ratio. (5%)

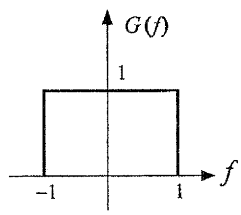

Fig. 4

e) Assume the use of Bipolar NRZ signaling (Binary PAM), find the average error rate and the bit energy [Note: Do not use the formula developed for integrate-and-dump circuit). (7%)

f) Consider 4–PAM, find the average symbol error rate and the symbol energy. (8%)

Table The Error Function[a]

u	erf(u)	u	erf(u)
0.00	0.00000	1.10	0.88021
0.05	0.05637	1.15	0.89612
0.10	0.11246	1.20	0.91031
0.15	0.16800	1.25	0.92290
0.20	0.22270	1.30	0.93401
0.25	0.27633	1.35	0.94376
0.30	0.32863	1.40	0.95229
0.35	0.37938	1.45	0.95970
0.40	0.42839	1.50	0.96611
0.45	0.47548	1.55	0.97162
0.50	0.52050	1.60	0.97635
0.55	0.56332	1.65	0.98038
0.60	0.60386	1.70	0.98379
0.65	0.64203	1.75	0.98667
0.70	0.67780	1.80	0.98909
0.75	0.71116	1.85	0.99111
0.80	0.74210	1.90	0.99279
0.85	0.77067	1.95	0.99418
0.90	0.79691	2.00	0.99532
0.95	0.82089	2.50	0.99959
1.00	0.84270	3.00	0.99998
1.05	0.86244	3.30	0.999998

[a] The error function is tabulated extensively in several references; see for example, Abramowitz and Stegun (1965, pp. 297–316).

error function $\text{erfc}(u) = 1 - \text{erf}(u)$

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