注意事項：

一、本試題共有 8 題。每題均須作答，總分一分的。
二、請於答案卷中作答，否則不予計分。
三、答案卷上請用藍色或黑色筆縫寫，不得使用鉛筆。
四、作答時請先標明題號橫式書寫。

1. Measurements on an amplifier indicate a gain of 30dB. (10 分)
   (a) If the input voltage is 1 volt, calculate the output voltage.
   (b) If the output voltage is 10 W, calculate the input power.

2. Measurements on an amplifier indicate a gain of 18dB. (10 分)
   (a) If the input power is 0.1 W, please express it in dBm.
   (b) Find the output power in dBm

3. A waveform \( m(t) \) has a Fourier Transform \( M(f) \) as shown. (10 分)
   (a) Find the energy content of the waveform.
   (b) Calculate the frequency \( f_i \) such that one quarter of the energy is in the
       frequency range \(-f_i\) to \( f_i\).

   Hint: \[
   E = \int_{-\infty}^{\infty} |M(f)|^2 df
   \]

4. A DSB AM modulator is a multiplier with two input signals – baseband signal
   \( m(t) \) and carrier signal \( v_c(t) \), \( v_a(t) = m(t)v_c(t) \). Assuming \( m(t) \) has a spectrum
   which is a constant and unit amplitude extending from \( f = -f_m \) to \( f = +f_m \).
   (10 分)
(a) For \( v_c(t) = \cos 2\pi f_c t \), sketch the spectra of \( m(t) \) and \( v_o(t) \).

(b) If the carrier signal is distorted and is given by \( v_c(t) = \cos 2\pi f_c t + \cos^2 2\pi f_c t \), sketch the spectrum of \( v_o(t) \).

Assuming \( f_c \gg f_m \).

5. For a lowpassed baseband signal \( m(t) \) with the highest frequency \( W \), to be sampled with sampling rate \( f_s \). (10 分)

(a) Please explain what the “sampling theorem” is.

(b) Sketch the spectra for the conditions of satisfying and not satisfying the “sampling theorem”.

6. In an Armstrong FM modulator, the \( f_{c1} \) is 300kHz. The frequency deviation is \( f_\Delta = 20 \text{ Hz} \) at the input. At the output of the modulator the carrier frequency is to be 64 MHz and frequency deviation \( f_\Delta = 30.72 \text{ kHz} \). One mixer with oscillator frequency \( f_{LO} = 12.4 \text{ MHz} \) is used. Find \( m \) and \( n \) of the two multipliers to accomplish this end (Assuming \( m>n \)). (10 分)

7. A sinusoidal signal \( x(t)=8\cos(20\pi t) \) is being sampling with \( F_c=50\text{Hz} \), and undergone the PCM coding with 4 bits, (a) write down the expression of \( x[n] \) (5 分), (b) find the binary bit streams \( S \) of \( x[n] \) at first 3 samples (7 分), (c) and the corresponding DPCM code (8 分). (you can specify your own DPCM law to derive your answer).

8. Two symbols \( A_0 \) and \( A_1 \), which the subscript is represented as logical ‘0’ and ‘1’ respectively, are transmitted over a channel. Let \( P(A) \) denotes the occurrence probability at transmitter while \( P(B) \) denotes the probability of detected symbol at the receiver, find out (a) \( P(B_0|A_1) \) (4 分), and (b) \( P(A_1|B_0) \) (6 分), (c) if \( P(A_0)=0.3 \), \( P(B_0|A_0)=0.7 \), and \( P(B_1|A_1)=0.8 \). If ‘0’ and ‘1’ are sent by 0V and +5V voltage, and at the receiver the received voltage are identical Gaussian distributions shown in Fig. 1, which the area under the curve within \( \mu \pm k\sigma \) are listed in Table 1, try to find out the BER \( P_e \) (10 分).
### Table 1

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<th>0.5</th>
<th>1.0</th>
<th>1.5</th>
<th>2.0</th>
<th>2.5</th>
<th>3.0</th>
<th>3.5</th>
<th>4.0</th>
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<td>0.988</td>
<td>0.997</td>
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Fig. 1