大同大學 九十二 學年度研究所碩士班入學考試題

考試科目：**通訊原理**　　所別：**通訊工程研究所**　　第1頁 共1頁

註:本次考試不可以參考自己的書籍及筆記； 不可以使用字典； 可以使用計算器。

※每題20分

1. Consider an *RC* low-pass filter with transfer function $H(w)$.
   (a) Give $H(w)$. (4%)
   (b) Give the power transfer function of the filter (The power transfer function is defined as the ratio of output power spectral density to the input power spectral density). (4%)
   (c) What are the amplitude and phase responses of $H(w)$? (4%)
   (d) What are the group delay and phase delay. Is the network distortionless? Why? (4%)
   (e) Consider a white-noise process $w(t)$ of zero mean and power spectral density $N_o/2$ applied to the low-pass filter, what is the power spectral density appearing at the filter output ? (4%)

2. An FM signal is given by
$$s(t)=\cos\left[w_c t+\sum_{n=1}^{K}\beta_n\cos(nw_o t+\theta_n)\right]$$
   (a) If θ_n is constant, then calculate the instantaneous frequency of $s(t)$. (5%)
   (b) If θ_n=0 and K=1, find the maximum frequency deviation. (5%)
   (c) If each θ_n is an independent random variable, uniformly distribution between $-\pi$ and π, find the rms (root-mean-square) frequency deviation. (5%)
   (d) Under the condition of (c), find the rms phase deviation. (5%)
   [Hint: The rms value of a random variable x is given by $x_{rms}=\{E(x^2)\}^{1/2}$]

3. (a) A source with bandwidth 2000 Hz is sampled at the Nyquist rate. Assuming that the resulting sequence can be approximately modeled by a discrete memoryless source with five alphabets and with corresponding probabilities {1/2, 1/4, 1/8, 1/16, 1/16}, determine the rate of the source in bits/sec.(10%)
   (b) The input to a delta modulator is $m(t)=kt$. It is known that slope overload occurs when k exceeds a specified value. What is the value of k? Give it in terms of the step size S and the sampling frequency f_s.(5%)
   (c) An 8-ary communication system transmits at a rate of 1000 symbols per second. What is the equivalent bit rate in bits per second?(5%)

4. The signal component of a coherent PSK system is defined by
$$s(t)=Ak\sin(2\pi f_c t)\pm A\sqrt{1-k^2}\cos(2\pi f_c t)$$
   where $0\le t\le T_b$, and the plus sign corresponds to symbol 1 and the minus sign corresponds to symbol 0.
   (a) Draw a signal-space diagram for the scheme described here. (10%)
   (b) Suppose that 10 percent of the transmitted signal power is allocated to the carrier component. Determine the E_b/N_o required to realize a probability of error equal to 10^{-4}. (10%)
   Hint: In the presence of additive white Gaussian noise of zero mean and power spectral density $N_o/2$, the average probability of error is
$$P_e\approx\frac{1}{2}\frac{\exp(-u^2)}{\sqrt{\pi}\,u},\qquad u^2=\frac{E_b}{N_o}(1-k^2)$$

5. (a) Show that the two signal constellations shown in Fig.P5 have the same average probability of symbol error.(10%)
   (b) Which of these two constellations has minimum average energy?(5%)
   (c) How to rearrange the constellation that has the larger average energy to a new constellation that differs from another one but still has minimum average energy?(5%)

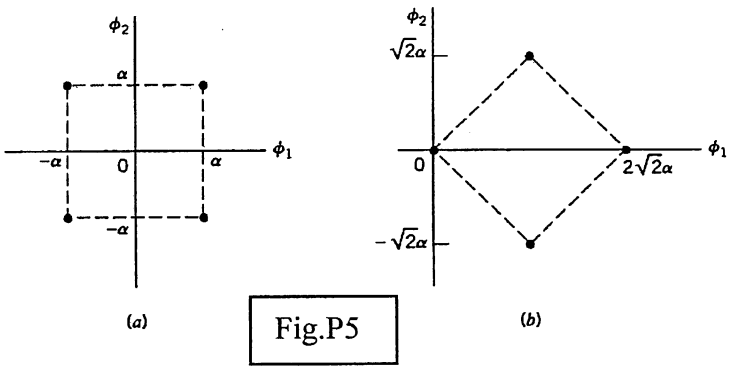

Fig.P5