國立暨南國際大學九十五學年度碩士班研究生入學考試試題　第 2 節

科目：通訊系統導論　適用：通訊所

編號：452

考生注意：
1.依次序作答，只要標明題號，不必抄題。
2.答案必須寫在答案卷上，否則不予計分。
3.限用藍、黑色筆作答；試題須隨卷繳回。

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1. (1) (10%) Why do we need modulation for communication?

   (2) (10%) Explain how to use a PM modulator to form an FM modulator. Also, explain how to use an FM modulator to form a PM modulator.

2. Let $\{A_k\}_{k=-\infty}^{\infty}$ be a sequence of random variables with $E[A_k] = m$ and $E[A_k A_j] = R_A(k-j)$. We further assume that $R_A(k-j) = R_A(j-k)$. Let $p(t)$ be any deterministic signal whose Fourier transform is $P(f)$, and define the random process $X(t) = \sum_{k=-\infty}^{+\infty} A_k p(t-kT)$, where T is a constant.

   (1) (5%) Find $R_X(t+\tau, t)$.

   (2) (15%) Derive the power-spectral density of $X(t)$.

3. Let X and Y denote two jointly distributed discrete valued random variables.

   (1) (5%) Show that $H(X) = -\sum_{x,y} P(x,y) \log p(x)$ and
   $$H(Y) = -\sum_{x,y} P(x,y) \log p(y)$$

   (2) (15%) Use the above result to show that
   $$H(X,Y) \le H(X) + H(Y)$$
   When does the equality hold?

4. Given the signal $s(t)$ transmitted over the interval $0 \le t \le T$ and corrupted by AWGN.

   (1) (5%) Determine the impulse response of its matched filter.

   (2) (15%) Prove that the output SNR can be maximized by this filter.

5. Binary antipodal signals are used to transmit information over an AWGN channel. The prior probabilities for the two input symbols (bits) are 1/3 and 2/3.

   (1) (10%) Determine the optimum maximum-likelihood decision rule for the detector.

   (2) (10%) Determine the average probability of error as a function of E_b / N_0.