(102)輔仁大學碩士班招生考試試題	考試日期：102 年 3 月 8 日第 2 節
	本試題共 1 頁 (本頁為第 1 頁)

科目：通訊系統　　系所組：電機工程學系甲組

1. Consider an impulse train function $x(t)=\sum_{n=-\infty}^{\infty}\delta(t-0.5n)$. $y(t)$ is a function of the impulse train as given by $y(t)=-x(0.5t+0.05)+1$. An ideal bandpass filter $h(t)$ with frequency response in Hz is given by $H(f)=\begin{cases}1, & 4.5<|f|<5.5\\ 0, & otherwise\end{cases}$.
   (1) Find the exponential Fourier series of $y(t)$. (10%)
   (2) Find the Fourier transform of $y(t)$. (10%)
   (3) Pass $y(t)$ through the ideal bandpass filter $h(t)$. The filter output is assumed to be $z(t)$. Find the Hilbert transform of $z(t)$. (10%)

2. A frequency modulation (FM) signal is expressed as $x(t)=\cos(2000\pi t+20\pi\sin(20\pi t))$.
   (1) Find the peak frequency deviation in Hz. (5%)
   (2) Determine the Carson's bandwidth in Hz. (5%)
   (3) Find the average power of $x(t)$. (5%)
   (4) Can we regard $x(t)$ as a narrowband FM signal? Please explain your answer. (5%)

3. Let a random process be given as $z(t)=x(t)y(t)$ where $x(t)$ is a stationary random process with autocorrelation function $R_x(\tau)=e^{-|\tau|}$ and $y(t)=10\cos(200\pi t+\theta)$ with θ uniformly distributed over the interval [0, 2π]. $x(t)$ and $y(t)$ are statistically independent.
   (1) Find the autocorrelation function of $z(t)$. (5%)
   (2) Find the power spectral density of $z(t)$. (5%)
   (3) Find the DC power in $z(t)$. (5%)
   (4) Find the AC power in $z(t)$. (5%)

4. For a 2-level transmission system, the value of the transmitted data x is randomly picked from the set {1,-1}. The received data y is corrupted by an additive noise n with probability density function $f(n)=\begin{cases}(n+a)/a^2, & -a\le n<0\\ (a-n)/a^2, & 0\le n<a\\ 0, & otherwise\end{cases}$. Thus, we can have the form of $y=x+n$. Assume a maximum a posteriori detector is employed. Find the probability of error. (10%)

5. For a 2-level transmission system, the value of the transmitted data x is either 1 or 4. The probability for $x=1$ is p while for $x=4$ is $1-p$. The data x is sent over a channel with an additive white Gausian noise n with zero mean and unit variance. Then, the received data can be expressed as $y=x+n$. Assume a maximum a posteriori (MAP) detector is employed. When $y<2$, the MAP detector output is 1. While $y>2$, the MAP detector output is 4.
   (1) Determine p. (10%)
   (2) Find the probability of error in terms of Q function. (10%)

   [PS: $Q(x)=\frac{1}{\sqrt{2\pi}}\int_x^{\infty}e^{-\frac{u^2}{2}}du$]

※ 注意：1.考生須在「彌封答案券」上作答。
2. 本試題紙空白部分可當稿紙使用。
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。