國立臺北科技大學九十五學年度碩士班招生考試

系所組別：1820 資訊工程系碩士班乙組

第二節 通訊概論 試題

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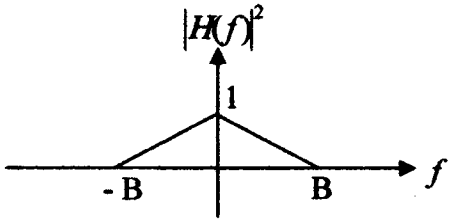
注意事項：

1.本試題共 6 題，配分共 100 分。
2.請標明大題、子題編號作答，不必抄題。
3.全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Answer the following questions:
   (a) Write and explain the *strong DiriChlet Condition* for the existence of the Fourier Series. (4%)
   (b) Explain the physical meaning of the *impulse response* of a system. (4%)
   (c) Noise equivalent bandwidth. (4%)
   (d) Noise quieting effect in FM system. (4%)
   (e) Bandwidth efficiency (Give its definition and physical meaning.) (4%)

2. A linear system has a power transfer function $|H(f)|^2$ as shown in the Figure below.



The input *x(t)* is a Gaussian random process with a power spectral density given by

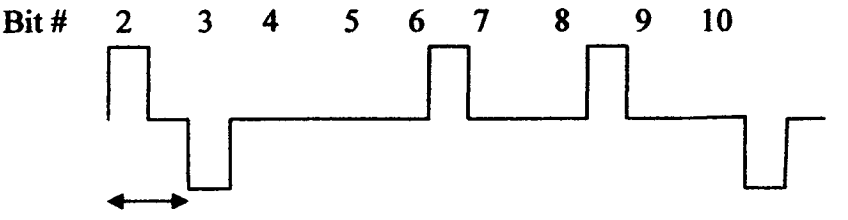
$$S_{xx}(f)=\begin{cases}\frac{1}{2}N_0, & |f|\le 2B\\ 0, & otherwise\end{cases}$$

   (a) Find the autocorrelation function for the output *y(t)*. (7%)
   (b) Find the probability density function for the output *y(t)*. (7%)
   (c) When are the two random variables $y_1 = y(t_1)$ and $y_2 = y(t_2)$ independent? (6%)

3. (a) A channel bandwidth of 150kHz is available. It is desired to transmit through it at a data rate of 500kbps. What is required value of *M* for *M-ary* PSK? (6%)

(b) Compare and discuss the relative advantages and disadvantages of the modulation schemes for *M-ary* PSK, *M-ary* DPSK, and *M-ary* QAM. (9%)

4. Assuming that a data sequence was encoded by BPRZ-AMI (Bipolar Return-to-Zero Alternate Mark Inversion) encoding and passed through a noisy channel.



Bit interval = 0.1 μS

(a) The received waveform is shown in above. Assume the first bit (bit #2) is correct. What should be the binary value of the preceding bit (i.e., the bit #1) of bit #2? Give a reason for your answer. (4%)

(b) Is there any bit in error? If so, please locate the erred-bit position and explain your answer briefly. (4%)

(c) What should be the correct binary data sequence? (4%)

(d) What will be the data rate of the encoded waveform? (2%)

(e) What is the minimum bandwidth required to transmit this encoded signal? (4%)

5. A linear system can be described by the differential equation $g(t)+\frac{d^4g(t)}{dt^4}=\frac{d^2f(t)}{dt^2}$, where *f(t)* is the input to and *g(t)* is the output out of the system.

(a) Is this linear system a time-variant one? (7%)

(b) Determine the frequency transfer function, $H(\omega)$ or $H(f)$, of the system. (7%)

6. Assume that the transfer functions of the preemphasis and deemphasis filters of an FM system are $H_{pe}(f)=k(1+\frac{jf}{f_0})$ and $H_{de}(f)=\frac{1}{k}\left(\frac{1}{1+\frac{jf}{f_0}}\right)$. The scaling factor k is to be chosen so that the average power of the emphasized signal is the same as that of the original signal, *m(t)*. Find the value of k that satisfies this requirement for the case when the power spectral density of the signal *m(t)* is

$$S_M(f)=\begin{cases}\dfrac{S_0}{1+(f/f_0)^2}, & -W\le f\le W\\ 0, & \textit{elsewhere}\end{cases}$$

Given that $\int\frac{du}{u^2+a^2}=\frac{1}{a}\tan^{-1}\frac{u}{a}$. (13%)