國立中山大學106學年度碩士暨碩士專班招生考試試題

科目名稱：通訊理論【通訊所碩士班甲組】　　題號：437002

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（混合題）　共3頁第1頁

(50 %) Multiple Choice. Please mark the answers on your computer scoring answer sheet.

1. (　) (5%) True or false. The signal $x(t)=\text{sinc}(t)$ is a power-type signal.

   A. True.　　B. False.

2. (　) (5%) True or false. If $Y=3X+2$, then $H(Y|X)=0$. Here, $H(Y|X)$ is the conditional entropy of random variable Y given the random variable X.

   A. True.　　B. False.

3. (　) (5%) True or false. A time-domain signal has a frequency domain representation that can be obtained using Fourier transform.

   A. True.　　B. False.

4. (　) (5%) True or false. Frequency modulation is a nonlinear modulation while phase modulation is linear.

   A. True.　　B. False.

5. (　) (5%) True or false. The matched filter can maximize the signal-to-noise ratio (SNR) of the sampled signals even in COLOR noise environment.

   A. True.　　B. False.

6. (　) (5%) True or false. Fig. 1 can be a regular autocorrelation function.

   A. True.　　B. False.

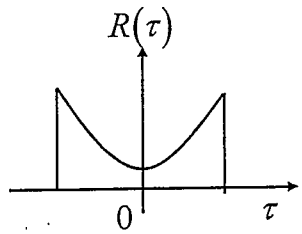

Fig 1.

7. (　) (5%) True or false. Consider a linear-time invariant system. If the input signal in time-domain $x(t)=e^{3t}$ and system impulse response $h(t)=5\delta(t)$, then the output signal does not exist since the Fourier transform of $x(t)$ does not converge.

   A. True.　　B. False.

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8. (　) (5%) True or false. A conventional AM signal $u(t)$ contains a large carrier component in addition to the AM modulated signal, i.e., $u(t)=A_c\left(1+m(t)\right)\cos\left(2\pi f_c t+\phi_c\right)$. The message $m(t)$ can be completely recovered by a envelop detector as $m(t)$ is constrained to $|m(t)|\geq 1$.

A. True.　　B. False.

9. (　) (5%) True or false. A white noise process with power spectrum $N_0/2$ passes the filter with frequency response in Fig. 2. Then, the power of the filter output is $N_0/3$.

A. True.　　B. False.

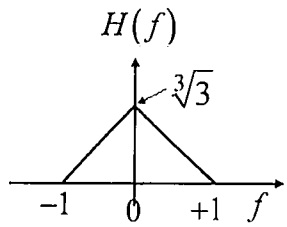

Fig. 2

10. (　) (5%) True or false. For a real signal $x(t)$, its Fourier transform is also real.

A. True.　　B. False.

11. (15%) For a binary PAM system, the received signal is expressed as $r=\pm\sqrt{E_b}+N$, where N is a zero-mean Gaussian random variable with variance σ_n^2. Assume the two signals are transmitted with unequal probability $P\left(a_m=\sqrt{E_b}\right)=1/3$ and $P\left(a_m=-\sqrt{E_b}\right)=2/3$.

(a). (10%) Decide the optimum threshold at the detector.

(b). (5%) Compute the average probability of error in terms of Q-function.

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

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12. (35%) The system in Fig. 3(a) shows that a low pass signals $x(t)$ with a bandwidth of w is sampled at the Nyquist rate. The sampled signal is expressed as $x_p(t)=\sum_{n=-\infty}^{\infty}(-1)^n x(nT_s)\delta(t-nT_s)$, where T_s is the sampling period. Assume the Fourier transform of $x(t)$ be $X(f)$ given in Fig. 3(b). Answer the following questions.

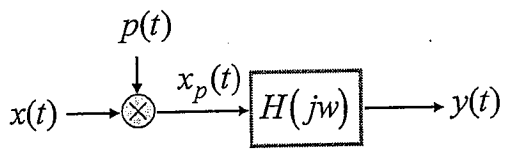
(a). (10%) Find the Fourier transform of $x_p(t)$.

(b). (5%) Can we reconstruct $x(t)$ from $x_p(t)$ with a linear time-invariant system? Please justify your answer.

(c). (5%) Can we reconstruct $x(t)$ from $x_p(t)$ with a time-varying system? Please justify your answer.

(d). (10%) Assume $h(t)$ be a bandpass filter with frequency response shown in Fig. 3(c). Plot the frequency response of $y(t)$.

(e). (5%) How can you reconstruct $x(t)$ from $y(t)$?



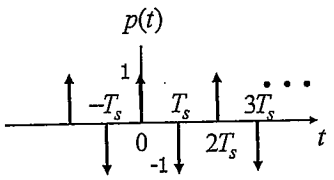


Fig. 3(a)

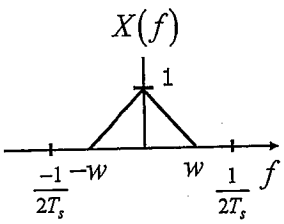


Fig. 3(b)

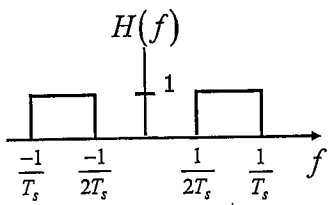


Fig. 3(c)