

國立臺北科技大學

九十三年學年度資訊工程系碩士班入學考試

通訊概論試題

填准考證號碼

第一頁 共一頁

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注意事項：

1. 本試題共六題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. (15%) Find the impulse response, $h[n]$, of the discrete time causal LTI system described by the following difference equation.

$$y[n] - \frac{1}{3}y[n-2] = x[n]$$

2. (15%) First determine the fundamental frequency, ω_0 , of the following continuous time periodic signal $x(t) = 1 + 2\cos(2\pi t) + \sin(2\pi t) + 3\cos(4\pi t + \frac{\pi}{4}) + 2e^{j6\pi t}$, then derive all

of its Fourier series coefficients, a_k , when $x(t)$ is expanded as $x(t) = \sum_{k=-\infty}^{\infty} a_k e^{jk\omega_0 t}$.

3. (15%) Consider the input signal $x(t) = 2\cos(2\pi t) + 3\sin(6\pi t) + 4e^{j8\pi t}$, and the LTI system with impulse response $h(t) = \frac{\sin(4\pi t)}{\pi}$. Derive the output signal $y(t)$.

4. (15%) An input signal $x(t) = \Pi(t - \frac{1}{2}) + \Pi(t - \frac{5}{2})$ with signal duration $T=3$ is sent to the matched filter with the impulse response $h(t)$. It is noted that $\Pi(t)$ is a rectangular

$$\text{function with } \Pi(t) = \begin{cases} 1, & |t| \leq \frac{1}{2} \\ 0, & |t| > \frac{1}{2} \end{cases}$$

Then (a) Sketch $h(t)$.

(b) Sketch the output signal $y(t)$ of the matched filter.

5. (20%) A random process is defined by $X(t) = A \cos(2\pi ft) + B \sin(2\pi ft)$. Note that A and B are two zero-mean independent Gaussian random variables with variances σ_A and σ_B , respectively. It is assumed that $\sigma_A \neq \sigma_B$

(a) Find the mean of $X(t)$.

(b) Find the autocorrelation function of $X(t)$.

(c) Is $X(t)$ stationary?

6. (20%) Consider a TDM multiplexing system where 10 stations are sharing a common multiplexer. Each station is driven by a packet voice source. The latter operates at a voice encoding rate of 32Kbps, and generates 1 voice packet every 16 msec. An overhead of 64 bits is added to each packet. Each station (voice source) is assigned a single voice packet during each frame.

(a) Calculate the minimum data rate (R) in the output channel of the multiplexer required to support these voice sources.

(b) Assume the bit-error-rate (BER) in the output channel of the multiplexer is 0.0001. Then calculate the probability that 2 consecutive voice packets belonging to a single source will be received in errors.