

國立臺灣科技大學

八十九學年度碩士班招生考試試題

系所組別：電機工程系乙一組

科目：信號與系統

1. Compute the inverse Fourier transform of the following frequency functions. (20%)

(a) $X(\omega) = p_2(\omega) \sin(\pi\omega)$ where $F\{p_\tau(t)\} = \tau \operatorname{sinc}(\tau\omega/2\pi)$

(b) $X(\omega) = \cos^2(2\omega) / j\omega$

2. For the discrete-time signal $x[n] = \sum_{k=-\infty}^{\infty} p[n-10k]$, where $p[n] = \begin{cases} 1, & |n| \leq 2 \\ 0, & \text{otherwise} \end{cases}$ (20%)

(a) Find the discrete-time Fourier series of $x[n]$.

(b) Find the discrete-time Fourier transform of $p[n]$. (Express your answer in closed form)

3. A Hilbert Transformer is a linear time-invariant continuous-time system with impulse response $h(t) = 1/t$, $-\infty < t < \infty$. Using the Fourier transform approach, determine the output response resulting from the input $x(t) = A \cos\omega_0 t$, $-\infty < t < \infty$. Where ω_0 is an arbitrary strictly positive real number. [Hint : $F\{u(t) - 0.5\} = 1/j\omega$] (10%)



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(4) It is known that a system may or may not be:

(a) memoryless (b) time invariant (c) linear (d) causal (e) stable

Determine which of these properties hold and which do not hold for each of the following system. *Justify your answers or no partial credit will be given.*

(A) $y(t) = x(t-2) + x(2-t)$

(B) $y(t) = [\cos(3t)]x(t)$

(C) $y(t) = \begin{cases} 0 & x(t) < 0 \\ x(t) + x(t-2) & x(t) \geq 0 \end{cases} \quad (20\%)$

(5) Consider a discrete-time LTI system with unit sample response

$$h[n] = (n+1)\alpha^n u[n]$$

where $|\alpha| < 1$. Show that the step response of this system is

$$s[n] = \left[\frac{1}{(\alpha-1)^2} - \frac{\alpha}{(\alpha-1)^2} \alpha^n + \frac{\alpha}{(\alpha+1)} (n+1)\alpha^n \right] u[n] \quad (15\%)$$

(6) Let

$$g(t) = x(t) + \alpha x(-t)$$

Where

$$x(t) = \beta e^{-t} u(t)$$

And the Laplace transform of $g(t)$ is

$$G(s) = \frac{s}{s^2 - 1} \quad -1 < \text{Re}\{s\} < 1$$

Determine the values of the constants α and β . (15%)

