國立臺灣科技大學

九十四學年度碩士班招生考試試題

系所組別：電機工程系碩士班乙一組

科　　目：信號與系統

總分 100 分，請依序作答。

1. Determine whether the following systems are linear or nonlinear, are time invariant or time varying. Justify your answers. In the following parts, $x(t)$ (or $x[n]$) is an arbitrary input and $y(t)$ (or $y[n]$) is the zero-state response to $x(t)$ (or $x[n]$).

   (a) $y(t) = \int_{t-1}^{t} x(\lambda)\, d\lambda$ (10%)

   (b) $y[n] = \sum_{i=-\infty}^{n} (0.2)^n x[i]$ (10%)

2. Given two real numbers a and b, for the difference equation

$$y[n+1] - b \times y[n] = a \qquad n \geq 0$$

   (a) Derive an analytical expression for the solution $y[n]$ assuming an arbitrary initial condition $y[0]$. (5%)

   (b) Under what conditions does $y[n]$ converge to $a/(1-b)$ as $n \to \infty$? (5%)

   (c) Compute $y[10]$ when $y[0] = 5$, $a = 9$, and $b = 0.1$. (5%)

3. A linear time-invariant discrete-time system has the unit-pulse response

$$h[n] = e^{-n} \qquad \text{for } n \geq 0$$

   (a) Compute the unit-step response $g[n]$ for $n \geq 0$. (Express your answer in closed form) (10%)

   (b) Compute the output response $y[n]$ for $n \geq 0$ when the input is $x[n] = u[n] - u[n-3]$ with zero initial energy in the system prior to the application of the input. (Where $u[n]$ is the unit-step function) (5%)

126

國立臺灣科技大學
九十四學年度碩士班招生考試試題
系所組別：電機工程系碩士班乙一組
科　　目：信號與系統

4. For $H(z)=\dfrac{Y(z)}{X(z)}=\dfrac{1-\frac{1}{3}z^{-1}}{(1-z^{-1})(1+2z^{-1})}$, $|z|>2$

(a) Use partial-fraction expansion and the fact that $a^n u[n]\overset{z}{\leftrightarrow}\dfrac{1}{1-az^{-1}}$, $|z|>|a|$. Find the inversion z-transform of $H(z)$. (15%)

(b) Determine a difference equation relating $x[n]$ and $y[n]$. (5%)

(c) Use the result of partial-fraction expansion in (a), draw a block diagram representation for $H(z)$ in parallel form. (5%)

5. Find the inverse Laplace tranform of the function

$$\frac{s-3}{s^2+10s+9}e^{-12s} \qquad \mathrm{Re}\{s\}>-1 \qquad (10\%)$$

6. Consider an LTI system whose response to the input

$x(t)=te^{-t}u(t)$

is

$y(t)=[2e^{-t}-2e^{-4t}]u(t)$

(a) Find the frequency response of the system $H(j\omega)$. (10%)

(b) Determine the system's impulse response $h(t)$. (5%)

1>1