國立臺灣科技大學
九十三學年度碩士班考試試題

系所組別：電機工程系乙一組
科　　目：信號與系統

總分 100 分，請依序作答。

1. Please verify whether the system $y[n] = 2x[n] + 3$ is a linear system or not. (10%)

2. Find the Laplace transform for $x(t) = e^{-b|t|}$. (10%)

3. Please find the Fourier series coefficients for the signal

$$x[n] = 1 + \sin(\frac{2n\pi}{N}) + 3\cos(\frac{2n\pi}{N}) + \cos(\frac{4n\pi}{N} + \frac{\pi}{2}).$$ (15%)

4. Consider a z-transform as $X(z) = \log(1 + az^{-1})$. Please find $x[n]$ for $n = 0, 1, 2, 3, \ldots$. (15%)

5. Consider the discrete-time system given by the input/output difference equation

$$y[n] + 0.9y[n-1] = 1.9x[n]$$ (20%)

(a) Determine the unit-pulse response h[n]. (Express your answer in closed form)

(b) Compute the output response y[n] when the input $x[n] = 2\delta[n] - \delta[n-1]$. (Where $\delta[n]$ is the unit-pulse function)

(c) Find the frequency response function $H(\Omega)$.

(d) Plot the magnitude function $|H(\Omega)|$ for $-\pi \le \Omega \le \pi$.

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6. A linear time-invariant continuous-time system has impulse response

$$h(t) = 4e^{-2t} + \cos(t), \quad t \geq 0 \qquad (15\%)$$

(a) Find the transfer function H(s).

(b) Compute the step response g(t) for all $t \geq 0$.

(c) Compute the output response y(t) for all $t \geq 0$ when the input is $u(t) - u(t-1)$ with no initial energy in the system at time $t = 0$. (Where u(t) is the unit-step function)

7. An ideal linear-phase low-pass filter has the frequency response transfer function

$$H(\omega) = \begin{cases} e^{-j\omega}, & |\omega| < 2 \\ 0, & \text{all other } \omega \end{cases}$$

, and that the input $x(t) = 2\text{sinc}(t/\pi)\cos(2t)$. (15%)

Hint: $F\{\tau\ \text{sinc}(\tau t/2\pi)\} = 2\pi p_\tau(\omega)$, where $p_\tau(\omega) = \begin{cases} 1, & |\omega| < \tau/2 \\ 0, & \text{all other } \omega \end{cases}$

(a) Plot the magnitude function for the input signal $X(\omega)$.

(b) Plot the magnitude of the output response function $Y(\omega)$.

(c) Compute the filter's output response y(t).