國立臺灣科技大學
九十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. Consider a linear system with the following response $\delta(t-\tau)$ (18%; 6% each):

$$h_\tau(t) = u(t-\tau) - u(t-2\tau)$$

(i) Is this system time-invariant? Why?
(ii) Is it causal? Why?
(iii) Determine the response of this system to the following input:

$$x_1(t) = e^{-t}u(t)$$

2. Consider an LTI system with impulse response

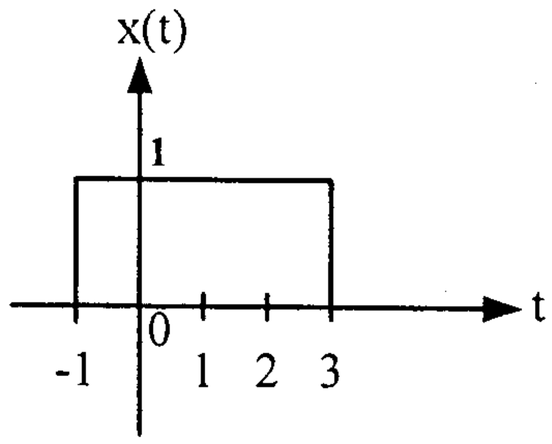
$$h(t) = e^{-2t}u(t)$$

Find the Fourier series representation of the output y(t) for each of the following inputs (12%, 6% each):

(i) $x(t) = \sin 4\pi t + \cos(6\pi t + \pi/4)$

(ii) $x(t) = \sum_{n=-\infty}^{+\infty} \delta(t-n)$

3. Let $X(\omega)$ denote the Fourier transform of the signal x(t)depicted below: (20%; 5% each)



(i) Find $X(0)$

(ii) Find $\int_{-\infty}^{\infty} X(\omega)d\omega$

(iii) Find $\int_{-\infty}^{\infty} X(\omega)\frac{2\sin\omega}{\omega}e^{j2\omega}d\omega$

(iv) Evaluate $\int_{-\infty}^{\infty} |X(\omega)|^2 d\omega$

You should perform all of these calculations without explicitly evaluating $X(\omega)$.

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4. A linear time-invariant continuous-time system has the frequency response function H(ω). It is known that the input $x(t) = 2 + 4\cos(3\pi t) + \sin(6\pi t - \pi/4)$ produces the response $y(t) = 1 + 3\cos(6\pi t)$. (20%)

(a) For what values of ω is it possible to determine H(ω)?

(b) Compute H(ω) for each of the values of ω determined in part (a).

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

$$y[n] - 0.4\, y[n-1] = x[n] \qquad (20\%)$$

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

(b) Find the unit-step response g[n]. (Express your answer in closed form)

6. Determine the Nyquist sampling frequency (rad/sec) for the continuous-time signal

$$x(t) = 4\,\mathrm{sinc}(t/\pi)\cos(3t). \qquad (10\%)$$

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