國立台灣科技大學九十八學年度碩士班招生試題

系所組別： 電機工程系碩士班丙組

科　　目： 信號與系統

總分 100 分，請依序作答

(1) Prove the following right-shift properties of one-sided z-transform given by the following formula, suppose that $x[n] \to X(z)$

$$X(z) = \sum_{n=0}^{\infty} x[n] z^{-n}$$

(a) (5%) $x[n-1] \to z^{-1}X(z) + x[-1]$

(b) (5%) $x[n-2] \to z^{-2}X(z) + z^{-1}x[-1] + x[-2]$

(2) For the discrete-time system given by the difference equation

$y[n] + 1.5y[n-1] + 0.5y[n-2] = x[n] - x[n-1]$

The input $x$[n] is the unit-step function.

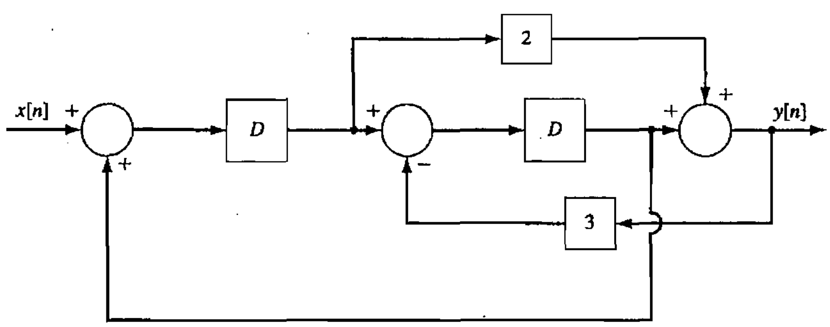
(a) (5%) Compute $y$[n] for n=0, 1, 2, 3 given that $y$[-2]= 1, $y$[-1]=2

(b) (5%) Find $Y(z)$ using the right-shift properties of one-sided z-transform in (1)

(c) (5%) Find $y$[n] by taking of inverse z-transform of $Y(z)$ and compare your answers in (a) and (c)

(3) (10%) For the system $H(\Omega) = 1 + e^{-j\Omega}$ and the sinusoid input $x[n] = 2 + 2\sin(\frac{\pi}{2}n)$, find the output $y$[n].

(4) (15%) Consider the block diagram of the discrete-time system, in which the block D represents unit delay. By assuming zero initial condition, find the transfer function in the form of $H(z) = \dfrac{b_2 z^2 + b_1 z + b_0}{a_2 z^2 + a_1 z + a_0}$.



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(5) Suppose that the continuous-time LTI system is defined by the following I/O relation: $y(t) = x(t+1) + 2x(t) + x(t-2)$

(a) (5%) Calculate the impulse response h(t)

(b) (10%) Calculate the frequency response H(jω)

(c) (5%) Plot the magnitude of H(jω)

(6) Consider a periodic signal, $p(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT_s)$, namely periodic impulse train, where the period is denoted by $T_s$.

(a) (5%) Plot the time-domain signal p(t) vs. t

(b) (5%) Calculate the Fourier coefficients { $a_k$ } by using Fourier series integral

(7) Fourier transform and convolution

(a) (10%) Find the time-domain signal x(t) of $X(j\omega)$ with inverse Fourier transform

$$X(j\omega) = \begin{cases} 1, |\omega| \le 100\pi \\ 0, |\omega| > 100\pi \end{cases}$$

(b) (5%) Calculate the following time-domain signal x(t) by convolution.

$$x(t) = \frac{\sin(100\pi t)}{\pi t} * \frac{\sin(200\pi t)}{\pi t} * \frac{\sin(300\pi t)}{\pi t} * \frac{\sin(400\pi t)}{\pi t}$$

(8) (5%) Shannon's sampling theorem tells us that "A continuous-time signal x(t) with frequencies no high than fmax can be reconstructed exactly by its samples x[n]=x(nTs), if the samples are taken at a rate fs=1/Ts that is greater than 2fmax " . Please give me an example in the electrical engineering field which applies sampling theorem on the system design.