類組：電機類　科目：訊號與系統(300B)　　共 3 頁 第 1 頁

※請在答案卷內作答

一、(5%) The I-O relation of a CT system is $y(t) = e^{-t}x(t), t > 0$. Determine whether the system is (a) memoryless, (b) stable, (c) causal, (d) linear, and (e) time invariant.

二、(10%)

(a) (5%) The impulse response of an LTI system is $h(t) = \begin{cases} \cos(\pi t), & |t| < 0.5 \\ 0, & \text{otherwise} \end{cases}$. Use linearity and time invariance to determine and plot the output $y(t)$ for $x(t) = \delta(t+1) - \delta(t-1)$.

(b) (5%) Evaluate the convolution sum: $y[n] = (u[n+3] - u[n-1]) * u[n-4]$.

三、(15%)

(a) (10%) Find the frequency response (5%) and impulse response (5%) of the discrete-time system described by $8y[n] - 2y[n-1] - y[n-2] = x[n] + x[n-1]$.

(b) (5%) Draw direct form II implementation of the system in (a).

四、(10%)

Find the time domain signal x(t) corresponding to the following Fourier Transform representations

(a) (4%) $X(j\omega) = 4\pi\delta(\omega - 3\pi) + 2j\pi\delta(\omega - 5\pi) + 4\pi\delta(\omega + 3\pi) - 2j\pi\delta(\omega + 5\pi)$

(b) (6%) $X(j\omega) = \sum_{k=0}^{6} \frac{\pi}{1+|k|}\left\{\delta\left(\omega - \frac{k\pi}{2}\right) + \delta(\omega + \frac{k\pi}{2})\right\}$

五、(20%)

A periodic signal has the Fourier Series (FS) representation

$x(t) \overset{FS;\pi}{\longleftrightarrow} X[k] = -k2^{-|k|}$. Without determining x(t), find the FS representation (Y[k]and ω_0) if

(a) (2%) $y(t) = x(3t)$

(b) (2%) $y(t) = \frac{d}{dt}x(t)$

(c) (2%) $x(t) = x(t-1)$

(d) (2%) $y(t) = \mathrm{Re}\{x(t)\}$

(e) (6%) $y(t) = \cos(4\pi t)\, x(t)$

(f) (6%) $y(t) = x(t) * x(t-1)$　[* stands for convolution]

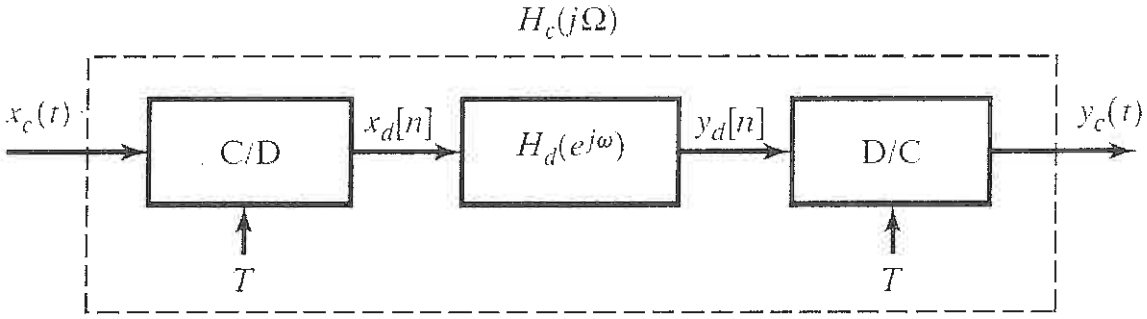
六、(10%)

The system shown below is intended to approximate a differentiator for bandlimited continuous-time input waveforms.

注意：背面有試題

類組：電機類　科目：訊號與系統(300B)　　共 3 頁 第 2 頁

※請在答案卷內作答



- The continuous-time input signal $x_c(t)$ is bandlimited to $|\Omega| < \Omega_M$.
- The ideal C/D converter has sampling period $T = \pi/\Omega_M$, and produce the signal $x_d[n] = x_c(nT)$.
- The discrete-time filter has the frequency response $H_d(e^{j\omega}) = \dfrac{e^{j\omega T/2} - e^{-j\omega T/2}}{T}$, $|\omega| \le \pi$.
- The ideal D/C converter is such that $y_d[n] = y_c(nT)$.

(a) (4%) Find the continuous-time frequency response $H_c(j\Omega)$ of the end-to-end system.

(b) (6%) Find $x_d[n]$, $y_c(t)$, and $y_d[n]$ when the input signal is $x_c(t) = \dfrac{\sin(\Omega_M t)}{\Omega_M t}$.

七、(5%)

A BIBO stable system has a transfer function $H(s) = \dfrac{s(s-1)}{(s+2)(s+a)}$, which has a partial fraction expansion:

$H(s) = A + \dfrac{B}{s+2} + \dfrac{C}{s+a}$. If $a \neq 2$ and B = 1.5, then put the correct answers in the following blanks.

(a) (3%) a = _____, A = _____, C = _____

(b) (2%) The ROC (region of convergence) of the transfer function $H(s)$ is _____

八、(10%)

The following figure shows some pole-zero plots of transfer functions of systems of the general form:

$H(s) = A\dfrac{(s-z_1)\cdots(s-z_N)}{(s-p_1)\cdots(s-p_D)}$, where A=1, z_i's are the zeros, and p_i's are the poles. Answer the following questions.

(a) (2%) Which one(s) have a magnitude frequency response that is nonzero at $\omega = 0$?

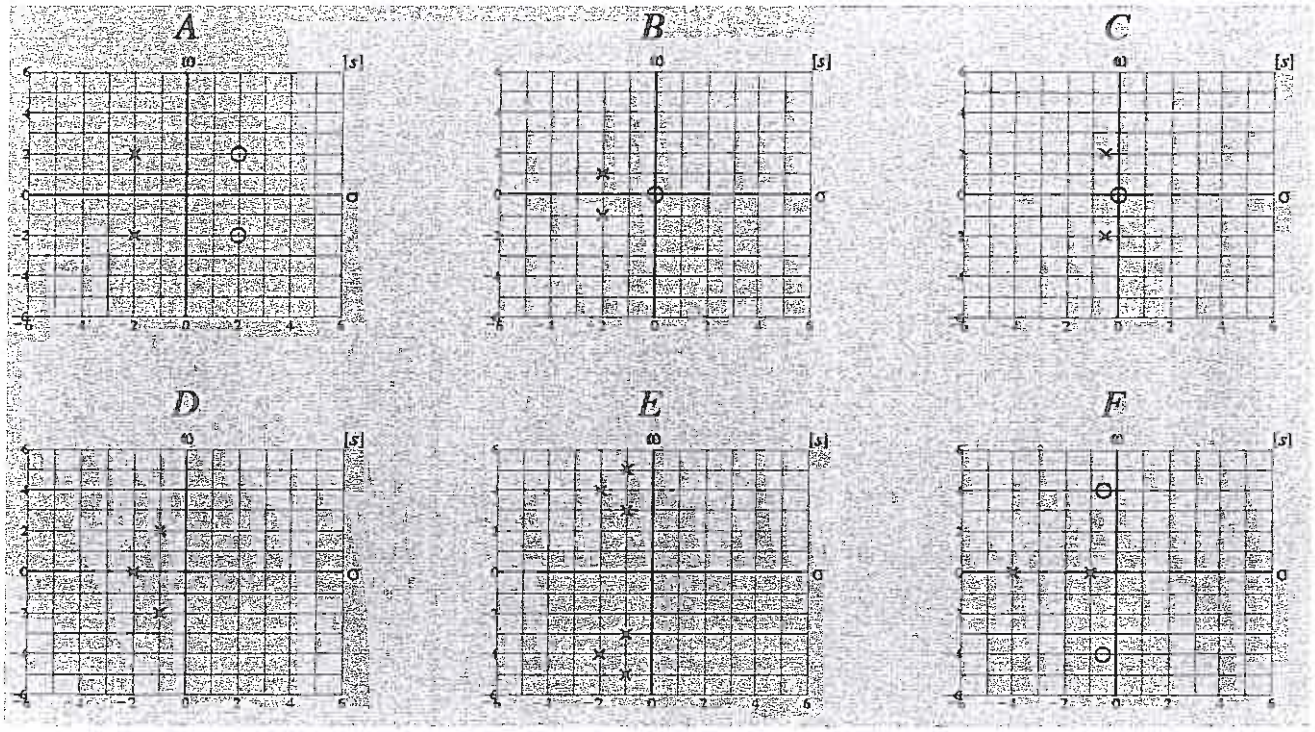
(b) (2%) Which one(s) have a magnitude frequency response that is nonzero at $\omega \to \infty$?

(c) (2%) There are two that have a bandpass frequency response (zero at $\omega = 0$ and $\omega \to \infty$). Which one is more underdamped?

(d) (2%) Which one has a magnitude frequency response whose shape is closest to being a bandstop filter?

(e) (2%) Which one has a magnitude frequency response that is constant?

注：背面有試題



九、(15%)

A causal LTI system with system function $H(z)$ is represented by the following block diagram.

(a) (3%) Determine the system function $H(z)$.

(b) (3%) Give a linear constant coefficient difference equation describing the system.

(c) (3%) What is the region of convergence of $H(z)$?

(d) (4%) Find the impulse response of the system.

(e) (2%) Is the system stable?