107EE06

國立臺北科技大學 107 學年度碩士班招生考試

系所組別：2142 電機工程系碩士班丁組

第一節　訊號與系統　試題　（選考）

注意事項：

1. 本試題共 5 題，每題 20 分，共 100 分。
2. 請標明大題、子題編號，並按照題號依序作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。
4. 答案若可化簡，應化到最簡或題目指定形式，否則不予計分。

1. (20%) Given the system of Figure 1, sketch $A(\omega)$, $B(\omega)$, $C(\omega)$, and $Y(\omega)$, which are Fourier Transforms of $a(t)$, $b(t)$, $c(t)$, and $y(t)$, respectively. Show all amplitudes and radian frequencies in your plots.

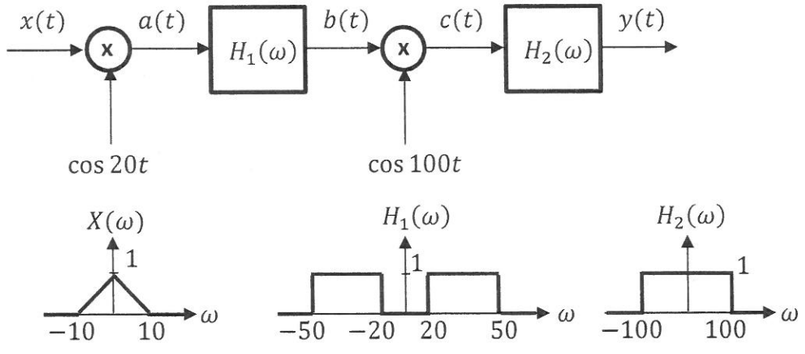

Figure 1

2. (20%) Assume you are given ideal system components to sample the signal below,

$$x(t) = 100 \cdot \text{sinc}^2(100t)$$

(a) (5%) Let $X(\omega)$ be the Fourier transform of $x(t)$. Find and plot $X(\omega)$.

(b) (5%) Find the minimum sampling frequency (in rad/s) to avoid aliasing.

(c) (10%) If the sampling frequency $\omega_s = 500$ rad/s, plot the magnitude spectrum of this sampled signal.

Note1: $\text{sinc}(x) = \sin(x)/x$, and the Fourier transform of $\text{rect}(t/\tau)$ is $\tau \cdot \text{sinc}(\tau\omega/2)$

Note2: You should show all amplitudes and radian frequencies in all plots.

3. (20%) Determine whether the system described by

$$y[n] = \left[\frac{n+2}{n+1.5}\right]^2 x[n]$$

is

(a) (4%) Causal?

(b) (4%) Invertible?

(c) (4%) Stable?

(d) (4%) Time-invariant?

(e) (4%) Linear?

Note: You should explain or prove your answers to score points.

4. (20%) Consider an LTI system with the input and output related by

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

(a) (5%) Find the system impulse response $h[n]$.

(b) (5%) Determine the system response $y[n]$ for the input $x[n] = u[n+1]$.

(c) (5%) Consider the interconnections of the LTI systems given in Figure 2, where $h[n]$ is the function found in part (a). Find the impulse response of the total system.

(d) (5%) Solve for the response of the system of part (c) for the input of part (b).

Note: You should write each answer as an equation that is valid for all n

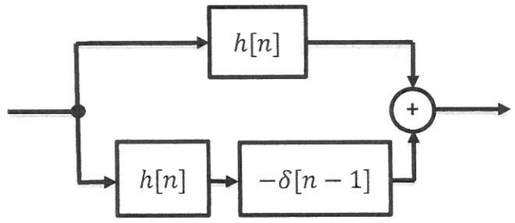

Figure 2

5. (20%) A causal LTI system has zeros at ± 1 and ± 2 and four poles at $z = 0$, and the system impulse response $h[0] = 1$. The input $x[n]$ to this system is

$$x[n] = 50 + 20 \cdot \cos\left(0.5\pi n + \frac{\pi}{4}\right) + \delta[n], \text{ for } -\infty < n < \infty$$

(a) (5%) Determine the impulse response of the system $h[n]$.

(b) (5%) Determine the transfer function of the system $H(z)$.

(c) (10%) Determine the output of the system $y[n]$ corresponding to the above input $x[n]$.

Note: Give an equation for $y[n]$ that is valid for all n, and simplify your answer.