

# 國立臺北科技大學 105 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

## 第二節 訊號與系統 試題 (選考)

第一頁 共一頁

### 注意事項：

1. 本試題共 6 題，配分共 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%) The output signal  $y(t)$  of a system is given by

$$y(t) = \int_{t-3}^{t+1} x(\tau) d\tau$$

- (a) Find the impulse response  $h(t)$  of the system. Simplify and express your answer in terms of unit step functions  $u(t)$  if possible. (5%)
- (b) Use  $h(t)$  in (a) to determine if the system is causal or not. (5%)
- (c) Use  $h(t)$  in (a) to determine if the system is stable or not. (5%)
- (d) Use  $h(t)$  in (a) and convolution integral to find the system response  $y(t)$  to the input  $x(t) = \delta(t - 1) - 2\delta(t + 1)$ . Simplify your answer  $y(t)$  as much as possible, and plot it. (5%)

2. (10%) Find the Fourier series in complex-exponential form for the impulse train signal shown in Figure 1.

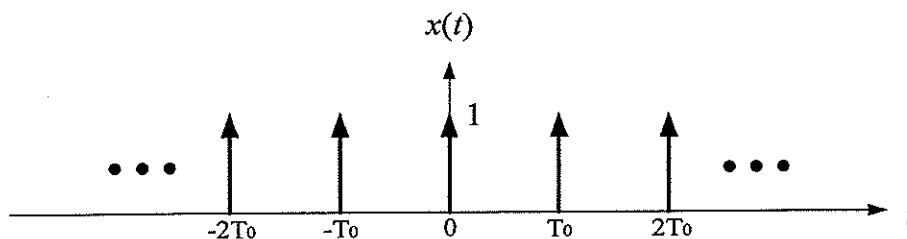


Figure 1

3. (15%) Find the Fourier transform  $X(\omega)$  for the following functions using either Fourier integral or properties. Simplify and express your answer in terms of unnormalized *sinc* functions ( $\text{sinc}(x) = \sin(x)/x$ ) if possible.

(a)  $x(t) = \cos(2\pi t)[u(t + 4) - u(t - 4)]$ , where  $u(t)$  is unit step function. (5%)

(b)  $x(t) = e^{-|t|}$  (5%)

(c) The Fourier transform of  $y(t)$  is known as  $Y(\omega) = \frac{j\omega}{-\omega^2 + 7j\omega + 6}$ , find the Fourier transform of  $x(t) = e^{-jt}y(t)$  (5%)

4. (15%) The signal  $F(\omega)$  shown in Figure 2 is sampled to  $F_s(\omega)$  by the use of an ideal sampler with sampling rate  $\omega_s = 300 \text{ rad/sec}$ .

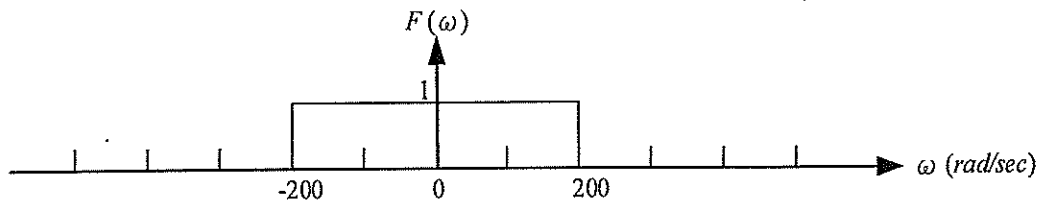


Figure 2

(a) Sketch the frequency spectrum of the sampled signal  $F_s(\omega)$ . Please mark the important values on the x and y axes. (the unit of x-axis is  $\text{rad/sec}$ ) (10%)

(b) Does this sampled signal satisfy the sampling theorem? Explain your answer. (5%)

5. (25%) Given a causal LTI system with difference equation and initial condition:

$$y[n] - 1.7y[n - 1] + 0.72y[n - 2] = x[n], \quad y[-1] = 0, y[-2] = 1.$$

(a) What is transfer function  $H(z)$  of the system? (5%)

(b) Is the system stable? Why? (5%)

(c) Is the system a low-pass filter? Why? (5%)

(d) What is the steady-state response of the system for the input  $x[n] = u[n]$ . (5%)

(e) What is the transient response of the system for the input  $x[n] = u[n]$ . (5%)

6. (15%) Find the inverse of the bilateral z-transform

$$X(z) = \frac{0.6z^{-1}}{1 - 1.6z^{-1} + 0.6z^{-2}}$$

for the following regions of convergence:

(a)  $|z| > 1$  (5%)

(b)  $0.6 < |z| < 1$  (5%)

(c)  $|z| < 0.6$  (5%)