

科目：訊號與系統 適用：電機所系統組

編號：432

考生注意：

1. 依次序作答，只要標明題號，不必抄題。
2. 答案必須寫在答案卷上，否則不予計分。
3. 限用藍、黑色筆作答；試題須隨卷繳回。

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1. The autocorrelation of a real signal  $x(t)$  is defined as

$$r_{xx}(t) = \int_{-\infty}^{\infty} x(\tau)x(\tau-t)d\tau$$

Evaluate the autocorrelation of the following signals:

- (a) (5%)  $x(t) = e^{-t}u(t)$
- (b) (5%)  $x(t) = \cos(\pi t)[u(t+1) - u(t-1)]$
- (c) (5%)  $x(t) = u(t) - 2u(t-1) + u(t-2)$
- (d) (5%)  $x(t) = u(t-a) - u(t-a-1)$

2. A linear system  $H$  has the input-output pairs depicted in Fig. P2(a). Answer the following questions, and explain your answers.

- (a) (5%) Could this system be causal?
- (b) (5%) Could this system be time-invariant?
- (c) (5%) Could this system be memoryless?
- (d) (5%) What is the output for the input depicted in Fig. P2(b)?

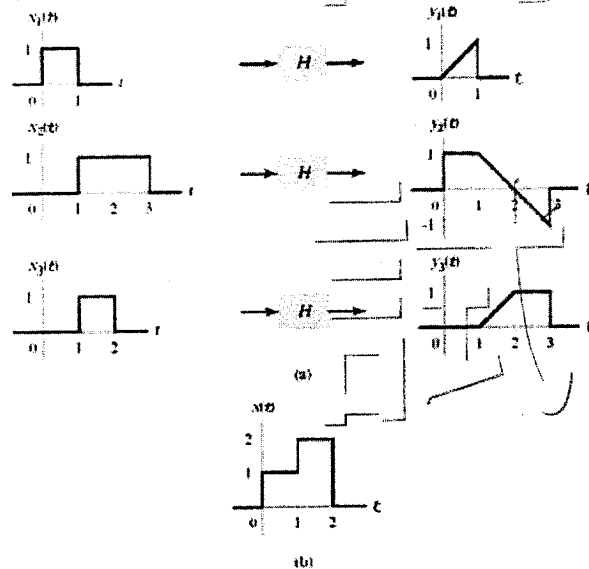


Figure P2

3. Determine the inverse continuous-time Fourier Transform for the following signals

(a) (5%)  $X(j\omega) = \frac{j\omega - 2}{-\omega^2 + 5j\omega + 4}$

(b) (5%)  $X(j\omega) = \frac{j\omega + 3}{(j\omega + 1)^2}$

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4. Determine the **inverse discrete-time Fourier Transform** for the following signals

(a) (5%)  $X(e^{j\Omega}) = \frac{2e^{-j\Omega}}{-\frac{1}{4}e^{-j2\Omega} + 1}$

(b) (5%)  $X(e^{j\Omega}) = \frac{6 - \frac{2}{3}e^{-j\Omega} - \frac{1}{6}e^{-j2\Omega}}{1 + \frac{1}{6}e^{-j\Omega} - \frac{1}{6}e^{-j2\Omega}}$

5. For each of the following signals, sampled with sampling interval  $T_s$ , determine the bounds on  $T_s$ , which guarantee that there will be no aliasing:

(a) (5%)  $x(t) = \frac{\sin(3\pi t)}{t} + \cos(2\pi t)$

(b) (5%)  $x(t) = \cos(12\pi t) \frac{\sin(\pi t)}{2t}$

6. Given the z-transform pair  $x[n] \leftrightarrow \frac{z^2}{z^2 - 16}$ , with ROC  $|z| < 4$ , determine the z-transform of the following signals

(a) (5%)  $y[n] = nx[n]$

(b) (5%)  $y[n] = x[n] * x[n-3]$  (\* : linear convolution)

7. Determine the time-domain signal corresponding to the following z-transforms:

(a) (5%)  $X(z) = \cos(z^{-3}), |z| > 0$

(b) (5%)  $X(z) = \ln(1 + z^{-1}), |z| > 0$

8. (10%) Determine the transfer function  $H(z) = Y(z)/X(z)$  of the system depicted in Fig P8.

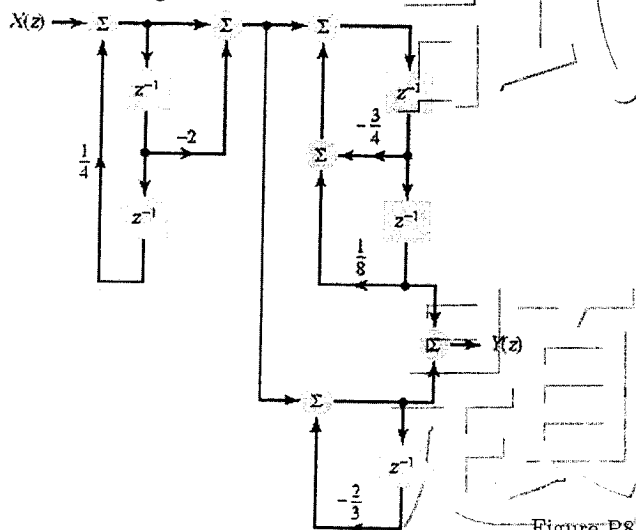


Figure P8