

※ 考生請注意：本試題不可使用計算機。請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. (20%) Let $h[n] = u[n + 4]$ and

$$x[n] = (-1)^n(u[n] - u[n - 6])$$

where $u[n]$ is the unit step function. Find and sketch $y[n] = x[n] * h[n]$.

2. (10%) The spectrum of a continuous-time signal $x(t)$ is

$$X(j\omega) = 4\pi\delta(\omega) + \pi\delta(\omega - 5\pi) + \pi\delta(\omega + 5\pi)$$

where $\delta(\omega)$ is the delta function. Find the signal $x(t)$.

3. (10%) Please show that

$$\int_{-\infty}^t x(\tau) d\tau = x(t) * u(t)$$

where $u(t)$ is the unit step function.

4. (15%) Let $x(t)$ be a periodic signal with period 6 and with the Fourier series coefficients given as

$$a_k = \begin{cases} jk, & |k| \leq 3; \\ 0, & \text{otherwise} \end{cases}$$

where $j = \sqrt{-1}$. Find the periodic signal $x(t)$.

5. (10%) Determine the Fourier transform $X(j\omega)$ of the continuous-time signal $x(t) = e^{-4|t-1|}$.

6. (20%) Consider a discrete-time system with input $x[n]$ and output $y[n]$ related by $y[n] = x[n - 1] + x[n] + x[n + 1]$.

- (5%) Is this system stable?
- (5%) Is this system causal?
- (5%) Is this system linear?
- (5%) Is this system time-invariant?

7. (15%) The frequency-domain signal of a continuous-time signal $x(t)$ is given by

$$X(j\omega) = \frac{\sin^2(2\omega)}{\omega^2}$$

Sketch the time-domain signal $x(t)$.