

Signals and Systems HW5

Deadline: 2019/04/12 before 18:30

(You should submit hand-writing paper to BL B1 EE student office.)

1. Let $x_1[n]$ and $x_2[n]$ be two discrete-time signals defined as

$$x_1[n] = \begin{cases} 1, & 0 \leq n \leq 4 \\ 0, & \text{otherwise} \end{cases}$$

and $x_2[n] = e^{j2n}$

- (a) (10%) Is $x_2[n]$ a periodic signal? If yes, what is its fundamental period?

If no, please show why?

- (b) (20%) Find the discrete-time Fourier transforms $X_1(e^{j\omega})$ and $X_2(e^{j\omega})$ for $x_1[n]$ and $x_2[n]$, respectively.

- (c) (10%) Let $x_3[n] = x_1[n] * x_2[n]$, where $*$ is denoted as convolution. Then find the discrete-time Fourier transform $X_3(e^{j\omega})$ for $x_3[n]$.

2. An LTI system with impulse response $h_1[n] = (\frac{1}{2})^n u[n]$ is connected in parallel with another causal LTI system with impulse response $h_2[n]$. However, we just know that the equivalent discrete-time Fourier transform of the total resulting parallel interconnection ($h_1[n] // h_2[n]$) is

$$H(e^{j\omega}) = \frac{-12 + 5e^{-j\omega}}{12 - 7e^{-j\omega} + e^{-j2\omega}}$$

- (a) (10%) Find the discrete-time Fourier transform $H_1(e^{j\omega})$ for $h_1[n]$.

- (b) (20%) Determine $h_2[n]$ and its discrete-time Fourier transform $H_2(e^{j\omega})$.

3. Assume that $|\alpha| < 1$,

- (a) (10%) Show the discrete-time Fourier transform $X(e^{j\omega})$ of the signal $x[n]$, where

$$x[n] = (n+1)\alpha^n u[n] .$$

- (b) (20%) Show the signal $y[n]$ for its discrete-time Fourier transform $Y(e^{j\omega})$, where

$$Y(e^{j\omega}) = \frac{1}{(1 - \alpha e^{-j\omega})^r} .$$