

## Signals and Systems HW3

**Deadline: 2024/03/29 23:59**

**You can convert your handwritten paper to a .pdf file by taking photos, file scanning or typing. Please name the file with your student ID (e.g., B11901xxx.pdf), and then upload the .pdf file to NTU COOL.**

1. Consider a continuous-time LTI system with impulse response

$$h(t) = e^{-4|t|}.$$

Find the Fourier series representation of the output  $y(t)$  for each of the following inputs:

- (a) (10%)

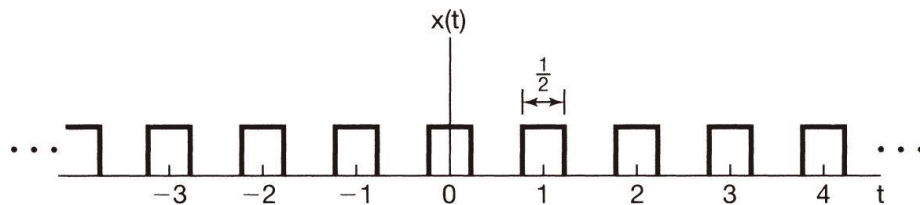
$$x(t) = \sum_{n=-\infty}^{+\infty} \delta(t - n)$$

- (b) (10%)

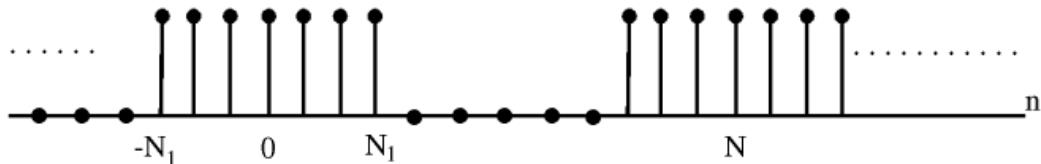
$$x(t) = \sum_{n=-\infty}^{+\infty} (-1)^n \delta(t - n)$$

- (c) (20%)

$x(t)$  is the periodic wave depicted in the below figure.



2. (20%) Consider a periodic discrete-time square signal  $x[n]$  given by



where the  $x[n]$  is equal to either zero or one. Find the Fourier coefficients  $a_k$  of the Fourier series representation of  $x[n]$ . Justify your answer.

3. (40%) Let  $x[n]$  be a periodic discrete-time signal with fundamental period  $N$  and Fourier series representation below:

$$x[n] = \sum_{k=\langle N \rangle} a_k e^{jk(2\pi/N)n}$$

Now for  $y[n]$  below, represent  $y[n]$  in its Fourier series representation with coefficients  $b_k$ . Express  $b_k$  in terms of  $a_k$ .

(a) (20%)

$$y[n] = x[n] + x\left[n + \frac{N}{2}\right], \quad \text{here } N \text{ is even.}$$

(Hint: what is the fundamental period here?)

(b) (20%)

$$y[n] = (-1)^n x[n], \quad \text{here } N \text{ is odd.}$$

(Hint: what is the fundamental period here?)