

國立成功大學

112學年度碩士班招生考試試題

編 號： 111

系 所： 工程科學系

科 目： 訊號與系統

日 期： 0207

節 次： 第 2 節

備 註： 不可使用計算機

※ 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. (10%) Let  $x[n]$  be an odd signal and  $h[n]$  be an odd signal. Is  $y[n] = x[n] * h[n]$  an even signal or odd signal? Please prove your answer.
2. (10%) Let  $y[n] = x[n] * h[n]$ . Is  $y[n - 2022] = x[n - 2000] * h[n - 22]$ ? Please give the derivations or reasons.
3. (20%) Consider a discrete-time system with input  $x[n]$  and output  $y[n]$ . Let

$$y[n] = \sum_{k=4n-1}^{4n+1} x[k].$$

- a. (4%) Determine the output of this system when the input is  $\delta[n]$ .
  - b. (4%) Is this system causal?
  - c. (4%) Is this system invertible?
  - d. (4%) Is this system linear?
  - e. (4%) Is this system time-invariant?
4. (10%) Could this signal

$$\frac{\sin(6\omega)}{\sin(\omega/2)}$$

be a valid spectrum of a discrete-time signal? Please provide your reasons.

5. (20%) Let  $x(t)$  be a periodic signal with period  $2\pi$  and  $x(t) = t^2$  for  $-\pi < t < \pi$ .
  - a. (10%) Find the Fourier series coefficients for  $x(t)$ .
  - b. (10%) Find the value of

$$\sum_{k=1}^{\infty} \frac{1}{k^4}.$$

6. (20%) Let  $x(t)$  be a periodic signal with period  $2\pi$  and

$$x(t) = \begin{cases} \frac{1}{4}, & \text{for } |t| \leq 2; \\ 0, & \text{for } 2 < |t| < \pi. \end{cases}$$

- a. (10%) Find the Fourier series coefficients for  $x(t)$ .
- b. (10%) Find the value of

$$\sum_{k=1}^{\infty} \frac{\sin(2k)}{k}.$$

7. (10%) Please find the inverse Fourier transform of

$$X(j\omega) = \frac{2}{(3 + j\omega)^3}.$$