Name: _____

Student ID: _____

Signature: _____

CITY UNIVERSITY OF HONG KONG

Semester A 2015/2016

EE3210: Signals and Systems

Quiz 7

1. Time allowed: 15 minutes
2. Total number of problems: 2
3. Total marks available: 11
4. This paper may not be retained by candidates

Special Instructions

5. This is a closed book exam
6. Attempt all questions from each problem
7. A list of possibly relevant equations is attached at the end of this paper

Problem 1: (6 marks)

Let $x_1(t)$ be a continuous-time periodic signal with fundamental period T and Fourier series coefficients a_k. Consider

$$x_2(t) = x_1(1-t) + x_1(-1-t).$$

Find a relationship between the Fourier series coefficients b_k of $x_2(t)$ and the coefficients a_k of $x_1(t)$.

Problem 2: (5 marks)

Let

$$x[n] = \begin{cases} 1, & 0 \leq n \leq 7 \\ 0, & 8 \leq n \leq 9 \end{cases}$$

be a discrete-time periodic signal with fundamental period $N = 10$. Determine the Fourier series coefficients of $x[n]$.

Appendix – A list of possibly relevant equations

- Continuous-time Fourier series:
  - Formulas: Consider $x(t)$ periodic with fundamental period $T_0 = T$.
    - Synthesis: $x(t) = \sum_{k=-\infty}^{+\infty} a_k e^{jk\omega_0 t} = \sum_{k=-\infty}^{+\infty} a_k e^{jk(2\pi/T)t}$
    - Analysis: $a_k = \frac{1}{T}\int_T x(t)e^{-jk\omega_0 t}dt = \frac{1}{T}\int_T x(t)e^{-jk(2\pi/T)t}dt$
  - Properties: Consider $x(t)$ and $y(t)$ periodic with period T, $x(t) \leftrightarrow a_k$, $y(t) \leftrightarrow b_k$.
    - Linearity: $Ax(t) + By(t) \leftrightarrow Aa_k + Bb_k$
    - Time shift: $x(t - t_0) \leftrightarrow \left[e^{-jk(2\pi/T)t_0}\right] a_k$
    - Time reversal: $x(-t) \leftrightarrow a_{-k}$
    - Time scaling: $x(\alpha t) = \sum_{k=-\infty}^{+\infty} a_k e^{jk(\alpha\omega_0)t}$
    - Multiplication: $x(t)y(t) \leftrightarrow \sum_{l=-\infty}^{+\infty} a_l b_{k-l}$

- Discrete-time Fourier series:
  - Formulas: Consider $x[n]$ periodic with fundamental period $N_0 = N$.
    - Synthesis: $x[n] = \sum_{k=\langle N\rangle} a_k e^{jk\Omega_0 n} = \sum_{k=\langle N\rangle} a_k e^{jk(2\pi/N)n}$
    - Analysis: $a_k = \frac{1}{N}\sum_{n=\langle N\rangle} x[n]e^{-jk\Omega_0 n} = \frac{1}{N}\sum_{n=\langle N\rangle} x[n]e^{-jk(2\pi/N)n}$

— End of Paper —