[IT CookBook] 기초 신호 및 시스템
　　: 개념과 원리가 한눈에 보이는 200여 개의 풍부한 예제

[연습문제 답안 이용 안내]

Chapter 10 이산 시간 푸리에 급수

[Quick Review]

[1] *Ans)* ×

[2] *Ans)* 2π

[3] *Ans)* 주기

[4] *Ans)* ○

[5] *Ans)* 샘플링

[6] *Ans)* 단위원, 등간격

[7] *Ans)* ○

[8] *Ans)* ×

[9] *Ans)* ×

[10] *Ans)* 반주기

[11] *Ans)* 공액 대칭

[12] *Ans)* ×

[13] *Ans)* ×

[기초 문제]

10.1 *Ans)*

(a) $X_0 = 1, \quad X_1 = -j\frac{1}{2}, \quad X_2 = 0, \quad X_3 = j\frac{1}{2}$

(b) $X_0 = 0, \quad X_1 = -j\frac{1}{2}, \quad X_2 = -1, \quad X_3 = j\frac{1}{2}$

(c) $X_0 = \frac{1}{2}, \quad X_1 = \frac{1}{4} - j\frac{1}{4}, \quad X_2 = 0, \quad X_3 = j\frac{1}{4} + j\frac{1}{4}$
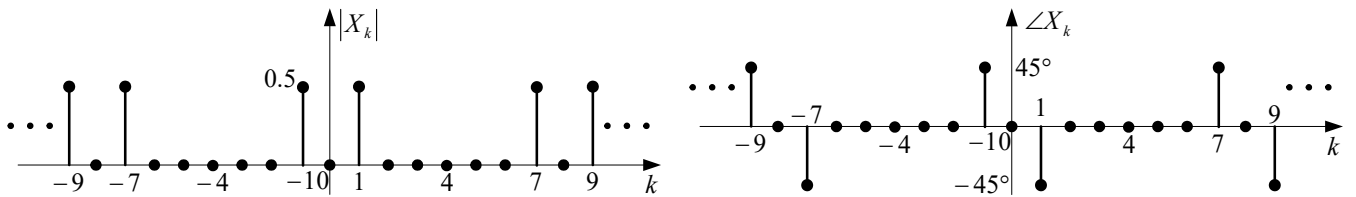
10.2 *Ans)*

(a) $X_0 = \frac{1}{8}(1+1+1) = \frac{3}{8}, \quad X_1 = \frac{2+\sqrt{2}}{16}(1-j1), \quad X_2 = -j\frac{1}{8}, \quad X_3 = \frac{2-\sqrt{2}}{16}(1+j1)$

$X_4 = \frac{1}{8}, \quad X_5 = \frac{2-\sqrt{2}}{16}(1-j1), \quad X_6 = j\frac{1}{8}, \quad X_7 = \frac{2+\sqrt{2}}{16}(1+j1)$
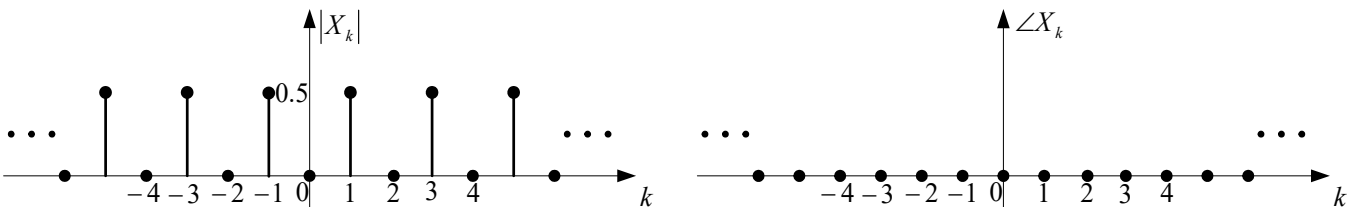
(b) $X_1 = \frac{1}{2}e^{-j\frac{\pi}{4}} = \frac{\sqrt{2}}{4} - j\frac{\sqrt{2}}{4}, \quad X_3 = \frac{1}{2}e^{j\frac{\pi}{4}} = \frac{\sqrt{2}}{4} + j\frac{\sqrt{2}}{4}, \quad X_0 = X_2 = 0$

10.3 *Ans)*

(a) $X_1 = \frac{1}{2}e^{-j\frac{\pi}{4}} = \frac{\sqrt{2}}{4} - j\frac{\sqrt{2}}{4}, \quad X_7 = \frac{1}{2}e^{j\frac{\pi}{4}} = \frac{\sqrt{2}}{4} + j\frac{\sqrt{2}}{4}, \quad X_k = 0, \quad k = 0, 2, 3, 4, 5, 6$
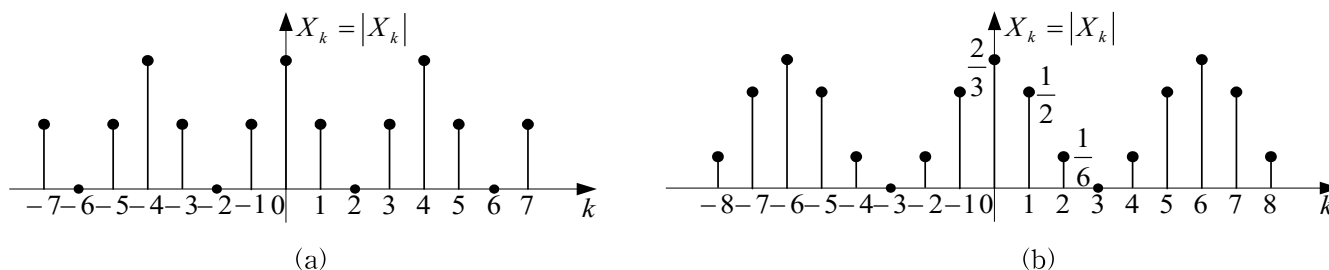

(b) $X_0 = 0, \quad X_1 = \frac{1}{2}, \quad X_2 = 0, \quad X_3 = \frac{1}{2}$

(c) $X_3 = \frac{1}{2}e^{-j\frac{\pi}{2}}, \quad X_4 = \frac{1}{2}, \quad X_8 = \frac{1}{2}, \quad X_9 = \frac{1}{2}e^{j\frac{\pi}{2}}$

$X_k = 0, \quad k = 0, 1, \cdots, 11, \quad k \neq 3, 4, 8, 9$

10.4 Ans)

(a) $X_0 = \frac{1}{2}\left(1 + \cos\frac{0\pi}{2}\right) = 1$ $\qquad X_2 = \frac{1}{2}\left(1 + \cos\frac{2\pi}{2}\right) = 0$

$\quad X_1 = \frac{1}{2}\left(1 + \cos\frac{\pi}{2}\right) = \frac{1}{2}$ $\qquad X_3 = \frac{1}{2}\left(1 + \cos\frac{3\pi}{2}\right) = \frac{1}{2}$

(b) $X_0 = \frac{1}{3}\left(1 + \cos\frac{0\pi}{3}\right) = \frac{2}{3}$ $\qquad X_3 = \frac{1}{3}\left(1 + \cos\frac{3\pi}{3}\right) = 0$

$\quad X_1 = \frac{1}{3}\left(1 + \cos\frac{\pi}{3}\right) = \frac{1}{2}$ $\qquad X_4 = \frac{1}{3}\left(1 + \cos\frac{4\pi}{3}\right) = \frac{1}{6}$

$\quad X_2 = \frac{1}{3}\left(1 + \cos\frac{2\pi}{3}\right) = \frac{1}{6}$ $\qquad X_5 = \frac{1}{3}\left(1 + \cos\frac{5\pi}{3}\right) = \frac{1}{2}$

(a)

(b)

10.5 Ans)

(a) $x[n] = 2 + 2\cos\left(\frac{3\pi}{4}n\right)$

(b) $x[n] = (1 + (-1)^n)(1 - 2\cos\left(\frac{\pi}{4}n\right)) + 2\cos\left(\frac{\pi}{2}n\right) = \begin{cases} 8, & n = 4,\ 12,\ 20,\ 28,\cdots, \\ 0, & \text{그 외} \end{cases}$

$\quad$ 즉 $\ x[n] = [\ \cdots\ \overset{\smile}{0},\ 0,\ 0,\ 0,\ 8,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 8,\ 0,\ 0,\ 0,\ 0,\ \cdots\ ]$

(c) $x[n] = (1 + (-1)^n)(1 + 2\cos\left(\frac{\pi}{4}n\right))$

$\quad$ 즉 $\ x[n] = [\ \cdots\ \overset{\smile}{6},\ 0,\ 2,\ 0,\ -2,\ 0,\ 2,\ 0,\ 6,\ 0,\ 2,\ 0,\ -2,\ 0,\ 2,\ 0,\ 6,\ \cdots\ ]$

[응용 문제]

10.6 *Ans)* 다음과 같은 이산 주기 신호의 DTFS를 구하여라.

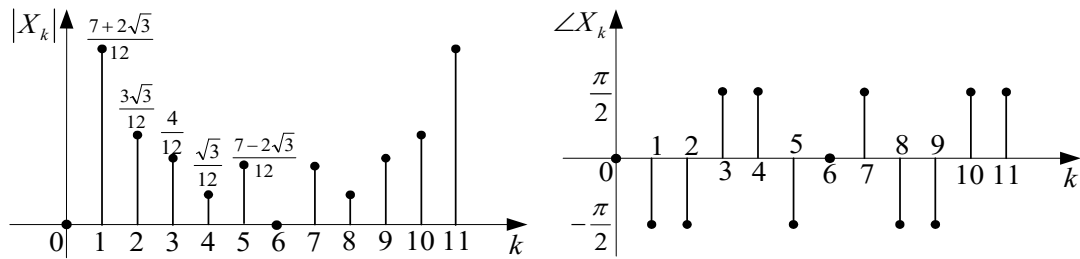(a) $X_0 = X_1 = \dfrac{1}{2}$

(b) $X_0 = 0, \quad X_1 = 1$

10.7 *Ans)*

(a) $X_k = \dfrac{j}{12}\left(-2\sin\dfrac{\pi}{6}k - 4\sin\dfrac{\pi}{3}k - 6\sin\dfrac{\pi}{2}k\right)$

$X_0 = 0, \quad X_1 = -\dfrac{j}{12}(7+2\sqrt{3}), \quad X_2 = -\dfrac{j}{12}(3\sqrt{3}), \quad X_3 = \dfrac{j}{12}(4),$
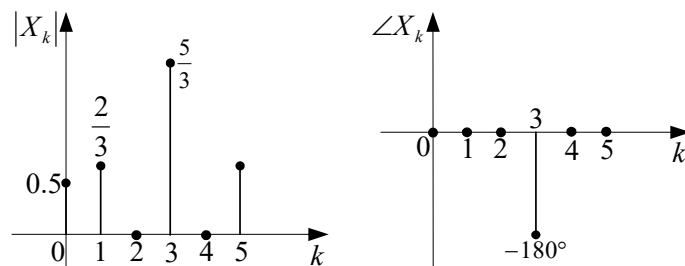
$X_4 = \dfrac{j}{12}(\sqrt{3}), \quad X_5 = -\dfrac{j}{12}(7-2\sqrt{3}), \quad X_6 = 0, \quad X_7 = \dfrac{j}{12}(7-2\sqrt{3})$

$X_8 = -\dfrac{j}{12}(\sqrt{3}), \quad X_9 = \dfrac{j}{12}(-4), \quad X_{10} = \dfrac{j}{12}(3\sqrt{3}), \quad X_{11} = \dfrac{j}{12}(7+2\sqrt{3})$

(b) $X_k = \dfrac{1}{6}\left(1 + 4\cos\left(k\dfrac{\pi}{3}\right) - 2\cos\left(2k\dfrac{\pi}{3}\right)\right)$
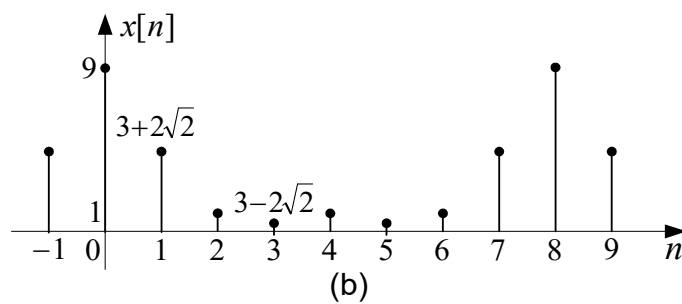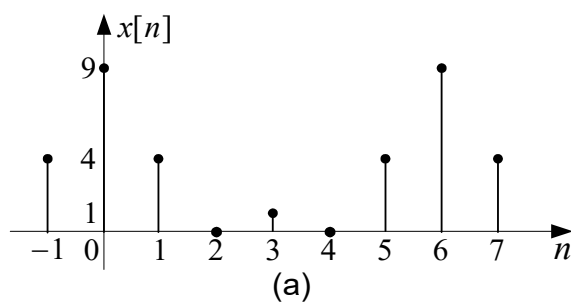
$X_0 = \dfrac{1}{2}, \quad X_1 = \dfrac{2}{3}, \quad X_2 = 0, \quad X_3 = -\dfrac{5}{3}, \quad X_4 = 0, \quad X_5 = \dfrac{2}{3}$

10.8 *Ans)*

(a) $x[n] = [\check{9},\ 4,\ 0,\ 1,\ 0,\ 4]$

(b) $x[n] = [\check{9},\ 3+2\sqrt{2},\ 1,\ 3-2\sqrt{2},\ 1,\ 3-2\sqrt{2},\ 1,\ 3+2\sqrt{2}]$

(a)

(b)

10.9 *Ans)*

(a) $X'_k = (1 - e^{-j\frac{2\pi}{N}k})X_k$

(b) $X'_k = X_{k-\frac{N}{2}}$

(c) $X'_k = (1 + (-1)^k)X_k$

10.10 *Ans)* $P = X_0 + \sum_{k=1}^{12} 2|X_k|^2 = 21$