

自动控制原理裴润版

第六章课后习题答案

- 6.1 (1) $c(0) = 0, c(1) = 0.181, c(2) = 0.33, c(3) = 0.451, c(4) = 0.551$
 (2) $x(0) = 1, x(1) = 0.412, x(2) = 0.049, x(3) = 0.0486, x(4) = 0.411$
 (3) $y(0) = 10, y(1) = 10, y(2) = 12, y(3) = 16, y(4) = 22$
 (4) $e(0) = 0, e(1) = 1.414, e(2) = 2, e(3) = 2.45, e(4) = 2.83$

- 6.2 (1) $X(z) = \frac{z(1 - e^{-bT})}{(z - 1)(z - e^{-bT})}$ (2) $X(z) = \frac{z}{z - a^T}$
 (3) $X(z) = \frac{z(e^{-T} - e^{-2T})}{(z - e^{-T})(z - e^{-2T})}$ (4) $X(z) = \frac{Tz}{(z - 1)^2}$
 (5) $X(z) = \frac{T}{(z - 1)^2}$

- 6.3 $C(z) = \frac{1}{z^2(z - e^{-0.1a})}$ 式中 $C(z)$ 应该为 $E(z)$

- 6.4 (1) $E(z) = \frac{1}{b - a} \left[\frac{z}{z - e^{-aT}} - \frac{z}{z - e^{-bT}} \right]$
 (2) $E(z) = \frac{K}{a} \frac{(1 - e^{-aT})z}{(z - 1)(z - e^{-aT})}$ (3) $E(z) = \frac{z^2 + z(z - 1)}{(z - 1)^2}$

- 6.5 $X(z) = \frac{z^{-1} - z^{-3}}{2(z - 1)^2}$

- 6.6 (1) $x^*(t) = \sum_{k=0}^{\infty} 0.5^k \delta(t - kT)$ (2) $x^*(t) = \sum_{k=0}^{\infty} (2^k - 1) \delta(t - kT)$
 (3) $x^*(t) = \sum_{k=0}^{\infty} \frac{e^{-akT} - e^{-bkT}}{e^{-aT} - e^{-bT}} \delta(t - kT)$ (4) $x^*(t) = \sum_{k=0}^{\infty} (2^k - 1 - k) \delta(t - kT)$
 (5) $x^*(t) = 11\delta(t) + 29\delta(t - T) + 67\delta(t - 2T) + 145\delta(t - 3T) + 303\delta(t - 4T) + 621\delta(t - 5T) + \dots$
 (6) $x^*(t) = \delta(t) + 3.5\delta(t - T) + 4.75\delta(t - 2T) + 6.375\delta(t - 3T) + 7.187\delta(t - 4T) + 7.593\delta(t - 5T) + \dots$

- 6.7 (1) $x(0) = 1, x(\infty) = 0$ (2) $x(0) = 1, x(\infty) = 0$
 (3) $x(0) = 0, x(\infty) = 1$ (4) $x(0) = 1, x(\infty) = 1.58$
 (5) $x(0) = 0, x(\infty) = \infty$

6.8 无

$$6.9 \quad (a) \frac{10z^2}{(z - e^{-2T})(z - e^{-5T})} \quad (b) \frac{3(e^{-2T} - e^{-5T})z}{10(z - e^{-2T})(z - e^{-5T})}$$

$$6.10 \quad \frac{G_1(z) G_2(z)}{1 + G_2(z) + G_1(z) G_2 H(z)}$$

$$6.11 \quad (a) C(z) = \frac{RG_1(z) G_0 G_3 G_4(z) + R(z) G_2 G_4(z)}{1 + G_0 G_3 G_4(z)}$$

$$(b) C(z) = \frac{[D_1(z) + D_2(z)] G_0 G_1 G_2(z) + FG_2(z)}{1 + D_1(z) G_0 G_1 G_2(z)}$$

$$(c) C(z) = \frac{Z\left[\frac{R(s) G_1(s)}{1 + G_1(s) G_2(s)}\right]}{1 + Z\left[\frac{G_1(s) G_2(s)}{1 + G_1(s) G_2(s)}\right] D(z)}$$

$$(d) C(z) = Z\left[\frac{R(s)}{2 + G_2(s)}\right] + Z\left[\frac{G_1(s) G_2(s)}{2 + G_2(s)}\right] \frac{Z\left[\frac{1 + G_2(s)}{2 + G_2(s)} R(s)\right]}{1 + Z\left[\frac{G_1(s) G_2(s)}{2 + G_2(s)}\right]}$$

$$(e) C(z) = R(z) + \frac{RG_1(z) G_2(z) - RH(z) G_2(z)}{1 + G_2 H(z)}$$

$$(f) C(z) = \frac{RG_1(z) G_2(z)}{1 + G_1 H_1(z) G_2 H_2(z)}$$

$$6.12 \quad \frac{C(z)}{R(z)} = \frac{0.00778z + 0.00758}{z^2 - 1.90z + 0.9307}, \text{稳定}$$

$$c(0) = 0, c(0.02) = 0.00778, c(0.04) = 0.0301$$

$$c(0.06) = 0.0654, c(0.08) = 0.1112$$

$$6.13 \quad C(z) = \frac{2[(T-1+e^{-T})z + (1-e^{-T}-Te^{-T})]R(z)}{z^2 + [2(T-1+e^{-T}) - (1+e^{-T})]z + [2(1-e^{-T}-Te^{-T}) + e^{-T}]} + \frac{Z\left[\frac{2N(s)}{s(s+1)}\right]}{1 + \frac{2[(T-1+e^{-T})z + (1-e^{-T}-Te^{-T})]}{(z-1)(z-e^{-T})}}$$

$$6.14 \quad \frac{C(z)}{R(z)} = \frac{D(z)H_0G_1G_2(z)}{1 + D(z)H_0G_1(z) + D(z)H_0G_1G_2(z)}$$

$$\frac{X(z)}{R(z)} = \frac{D(z)H_0G_1(z)}{1 + D(z)H_0G_1(z) + D(z)H_0G_1G_2(z)}$$

$$6.15 \quad \frac{Y_1(z)}{R(z)} = \frac{D_1(z)D_2(z)H_0G_1G_2(z)}{1 + D_2(z)H_0G_2(z) + D_1(z)D_2(z)H_0G_1G_2(z)}$$

6.16 无

$$6.17 \quad \frac{C(z)}{R(z)} = \frac{0.2z + 0.15}{10z^2 - 14.98z + 5.015}, \text{稳定}$$

6.18 (1) 不稳 (2) 不稳 (3) (4) 无答案

6.19 (1) 不稳 (2) 稳定 (3) 稳定

$$6.20 \quad -1 < A < \frac{1}{1 - e^{-aT}} \quad 8.19 \quad (a) 0 < K < 17.5 \quad (b) 0 < K < 17.3$$

6.21 无

$$6.22 \quad C(z) = \frac{0.181z^2}{z^3 - 1.819z^2 + z - 0.181} \quad c^*(t) = 0.181\delta(t - T) + 0.329\delta(t - T) + \dots$$

$$6.23 \quad 0 < K < 4.329$$

6.24 无

6.25 无

6.26 稳定

6.27 无

6.28 无

$$6.29 \quad D(z) = \frac{5.435(1 - 0.5z^{-1})(1 - 0.368z^{-1})}{(1 - z^{-1})(1 + 0.717z^{-1})}$$

6.30 $D(z) = \frac{1}{1 - e^{-T}} \frac{1 - e^{-T} z^{-1}}{1 - z^{-1}}$, 输出无波纹

6.31 $D(z) = \frac{2.5413(1 - 0.6065z^{-1})}{(1 - z^{-1})(1 + z^{-1})}$

6.32 无