

19-51-Q5

(a) Since the pole of the controlled object is the second order and the zero is the first order, $k \geq 2-1=1$, so it can choose $G_c(z) = z^{-1}$

$$G_c(z) = \frac{C(z) G_{zas}(z)}{1 + C(z) G_{zas}(z)}$$

$$C(z) = \frac{1}{G_{zas}(z)} \frac{G_c(z)}{1 - G_c(z)}$$

$$= \frac{(z - 0.9048)(z - 0.3679)}{35.501 \times 10^{-4} (z + 0.6945)} \frac{z^{-1}}{(1 - z^{-1})}$$

(b) $r(k) = 1(k)$ $R(z) = \frac{1}{1 - z^{-1}}$

$$G_{zas}(z) = \frac{35.501 \times 10^{-4} (z + 0.6945)}{(z - 0.9048)(z - 0.3679)}$$

$$U(z) = \frac{Y(z)}{R(z)} \frac{R(z)}{G_{zas}(z)} = G_u(z) \frac{R(z)}{G_{zas}(z)}$$

$$= G_c(z) \frac{(z - 0.9048)(z - 0.3679)}{35.501 \times 10^{-4} (z + 0.6945)} (1 - z^{-1})$$

$$= G_{cc}(z) \frac{281.6822 (1 - 0.9048 z^{-1}) (1 - 0.3679 z^{-1})}{z^{-1} (1 + 0.6945 z^{-1}) (1 - z^{-1})}$$

design $G_{cc}(z) = K z^{-1} (1 + 0.6945 z^{-1})$

$$G_{cc}(1) = K (1 + 0.6945) = 1$$

$$K = 0.5901$$

So $G_{cc}(z) = 0.59 z^{-1} (1 + 0.6945 z^{-1})$

$$C(z) = \frac{1}{G_{zas}(z)} \frac{G_{cc}(z)}{1 - G_{cc}(z)}$$

$$= \frac{166.19 (1 - 0.9048 z^{-1}) (1 - 0.3679 z^{-1})}{(1 - z^{-1}) (1 + 0.41 z^{-1})}$$

(c)

5(a) the designed controller can only meet the corresponding indicators, but there will be more oscillation in the process

5(b) The controller is designed to be ripple free and responsive fast.