homework 3

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3.3 忽略 T_a 系统微分方程为.

$$8\frac{d^2\varphi}{dt^2} + 20\frac{d\varphi}{dt} + 50\varphi = 50\psi - 250M_L$$

$$T = \sqrt{\frac{8}{50}} = \frac{2}{5}$$

$$\xi = \frac{20}{50 \cdot 2T} = \frac{1}{2}$$ ✓

由图 3.9.4 可知 在 $\Delta = 5\%$ 下

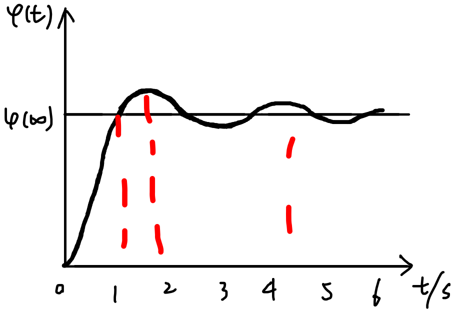
$$t_s = 5 \cdot T = 2s$$

$$t_r = \frac{T}{\sqrt{1-\xi^2}}(\pi - \arccos\xi) = 0.97s.$$

$$t_p = \frac{\pi T}{\sqrt{1-\xi^2}} = 1.45s$$

$$\sigma = \exp\left[-\frac{\xi\pi}{\sqrt{1-\xi^2}}\right] = 16.3\%$$ ✓

阶跃响应曲线



阅.

3.16 $Y(s)=\dfrac{G(s)}{1+G(s)}U(s)$

1) (a) $Y(s)=\dfrac{\frac{c}{2}}{s(\frac{T}{2}s+1)}$ $\quad \lim\limits_{s\to 0} sY(s)=\frac{c}{2}$

(b) $Y(s)=\dfrac{\frac{c}{2}}{s^2(\frac{T}{2}s+1)}$ $\quad \lim\limits_{s\to 0} s^2Y(s)=\frac{c}{2}$

(c) $Y(s)=\dfrac{\frac{c}{2}}{s^3(\frac{T}{2}s+1)}$ $\quad \lim\limits_{s\to 0} s^3Y(s)=\frac{c}{2}$

2) (a) $Y(s)=\dfrac{c}{s(Ts^2+s+1)}$ $\quad \lim\limits_{s\to 0} sY(s)=c$

(b) $Y(s)=\dfrac{c}{s^2(Ts^2+s+1)}$ $\quad \lim\limits_{s\to 0} s^2Y(s)=c$

(c) $Y(s)=\dfrac{c}{s^3(Ts^2+s+1)}$ $\quad \lim\limits_{s\to 0} s^3Y(s)=c$

3) (a) $Y(s)=\dfrac{c(\tau s+1)}{s(Ts^3+s^2+\tau s+1)}$ $\quad \lim\limits_{s\to 0} sY(s)=c$

(b) $Y(s)=\dfrac{c(\tau s+1)}{s^2(Ts^3+s^2+Ts+1)}$ $\quad \lim\limits_{s\to 0} s^2Y(s)=c$

(c) $Y(s)=\dfrac{c(\tau s+1)}{s^3(Ts^3+s^2+\tau s+1)}$ $\quad \lim\limits_{s\to 0} s^3Y(s)=c$

	单位阶跃输入	单位斜坡输入	单位加速度输入
0型	$\frac{K}{1+K}$	$\frac{K}{1+K}$	$\frac{K}{1+K}$
I型	1	1	1
II型	1	1	1

对比表3.6.1和3.6.2，静态误差系数和静态误差间的规律一致

3.17 (a) 系统稳定

① 由$u(t)$引起的误差 令$p(t)=0$ I型系统 查表得

$u(t)=4+6t$

$e_u=0+\frac{6}{10}=\frac{3}{5}$

② 由 $P(t)$ 引起的误差 令 $u(t)=0$

扰动之前不会积分，扰动之后会积分.

$P(t) = -1(t)$.

$$e_p = \frac{1}{4}$$

$$e_{st} = e_u + e_p = \frac{17}{20}$$

(b) 假设扰动之前框的比例系数为 K_1，之后框比例系数为 K_2

则 $e_p = \dfrac{1}{K_1}$

要减小 e_p，应提高 K_1.

3.21 (a)

$$G(s) = \frac{Y(s)}{U(s)} = \frac{\frac{1}{s} + \frac{0.2}{s+60} - \frac{1.2}{s+10}}{\frac{1}{s}}$$

$$= 1 + \frac{0.2s}{s+60} - \frac{1.2s}{s+10}$$

$$= \frac{600}{s^2+70s+600}$$

(b)

$$T = \sqrt{\frac{1}{600}} = \frac{\sqrt{6}}{60}$$

$$\xi = \frac{70}{600 \cdot 2T} = \frac{7\sqrt{6}}{12}$$

3.26

$$\frac{Y(s)}{U(s)} = (K_1 s+1) \cdot \frac{\frac{K}{s(Ts+1)}}{1+\frac{K}{s(Ts+1)}} = \frac{K(K_1 s+1)}{Ts^2+s+K}$$

$$\frac{G_{开}(s)}{1+G_{开}(s)} = \frac{K(K_1 s+1)}{Ts^2+s+K}$$

$$\Rightarrow G_{开}(s) = \frac{K(K_1 s+1)}{s(Ts+1-KK_1)}$$ I型系统.

$u(t) = t$

$$e_{st} = \frac{1-KK_1}{K} = 0$$

解得 $K_1 = \dfrac{1}{K}$