2001 年西北工业大学硕士研究生入学考试
自动控制原理试题简要解答

1. (1) $K=3$, $\omega=\sqrt{2}$

   (2) $2 \leqslant K<3$

2. (1) $d=5$, $\begin{cases}\omega=0\\ K^{*}=1\end{cases}$, $\begin{cases}\omega=5\\ K^{*}=\dfrac{4}{5}\end{cases}$

   (2) $1<K=K^{*}<\infty$

   (3) $\lambda_{1,2}=-\dfrac{5\sqrt{2}}{2} \pm z\dfrac{5\sqrt{2}}{2}$, $K=0.317$

   $\sigma=4.32\%$, $t_s=0.99$ s

3. (1) $d=\sqrt{10}$

   (2) $K_t=0.216$, $\sigma=16\%$, $t_s=2.216$ s

4. (1) $\Phi(s)=\dfrac{K_\varphi\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}=\dfrac{0.875\times 4^2}{s^2+2\times 0.375\times 4s+4^2}=$

   $\dfrac{14}{s^2+3s+16}$

   (2) $\sigma=28\%$, $t_s=2.3$ s

   (3) $\omega_c=3.74$, $\gamma=43.1^\circ$

5. (1) $\omega_c=1$, $\gamma=5.71^\circ$, $h=\infty$

   (2) $\Phi(s)=\dfrac{1}{s^2+0.1s+1}$

   (3) $\omega_r=0.997\,5$, $M_r=10$

6. (1) $\omega_c=5.313\,3$, $\gamma(5.313\,3)=-46^\circ$

若用一级超前校正，则 $\varphi_m = \gamma^* - \gamma + 5^\circ = 40^\circ + 46^\circ + 5^\circ = 91^\circ$（不可能达到）。若用滞后，则校正后系统在 $\omega'_c = 2.5$ 处的相角裕度为 $\gamma(2.5) = -9.06^\circ$（不满足要求）。

故只能采用滞后-超前校正。

(2) $\omega_c^* = 3$， $\gamma^* = 43.65^\circ$，满足要求

7. $5 \leqslant K < 20.343$

8. $K = \dfrac{K^*}{2} < \dfrac{3\pi a}{2}$

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1. (1) $\dfrac{C(s)}{E(s)} = \dfrac{2G_1G_2 + G_2 - G_1}{1 + G_1G_2}$

(2) $\dfrac{C(s)}{R(s)} = \dfrac{2G_1G_2 + G_2 - G_1}{1 + G_1G_2 + (2G_1G_2 + G_2 - G_1)H}$

(3) $0.5 < K_1 < 2$

2. (1) $d = -10$， $\theta_{p_1} = -150^\circ$， $\theta_{p_2} = 150^\circ$

(2) $0 < K_D < 0.1$

(3) $K_D = 0.0414$

$$\Phi(s) = \frac{100(1 + 0.0414s)}{s^2 + 14.14s + 100}$$

3. (1) $\Phi(s) = \dfrac{316.2}{s^2 + 10s + 316.2}$

(2) $\sigma = 40\%$， $t_s = 0.7$ s

(3) $G(s) = \dfrac{316.2}{s\left(\dfrac{s}{10} + 1\right)}$

渐近线 $\lim\limits_{\omega \to 0^+} \mathrm{Re}[G(j\omega)] = -3.162$，开环幅相曲线（略）。

4. $G(s) = \dfrac{K}{(T_1s + 1)(T_2s + 1)} = \dfrac{19}{(4.17s + 1)(0.4116s + 1)}$

5. (1) $K_c = 0.316$，$T = 0.316$

(2) $e_{ss} = 6.33$