

2000 年哈尔滨工业大学控制原理考研试题

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2000 年哈尔滨工业大学研究生考试试题

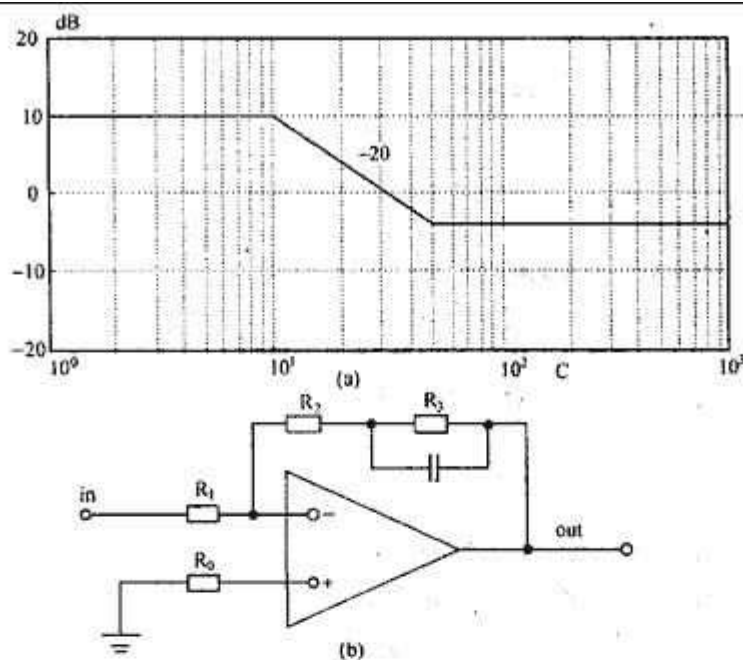
考试科目:控制原理

一、(10 分)

一有源串联迟后校正装置的对数幅频特性如试图 1(a) 所示,其电路如试图 1(b) 所示。已知 $C = 1 \mu\text{F}$,求 R_1 、 R_2 和 R_3 的电阻值。

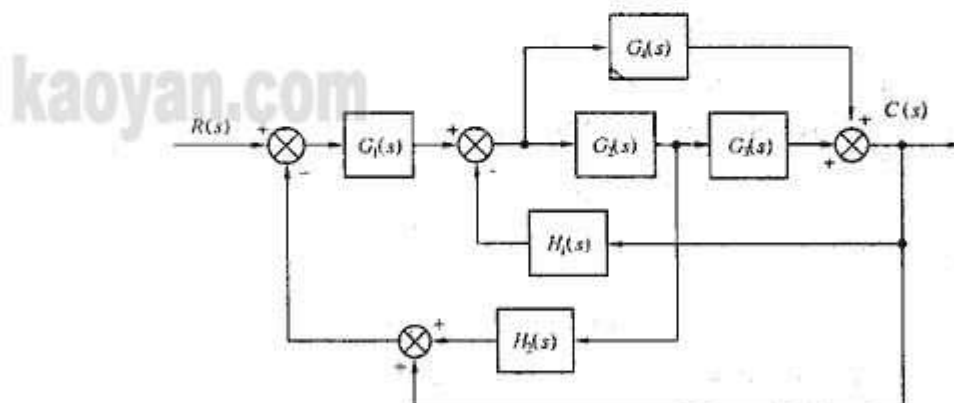
二、(10 分)

对于试图 2 所示系统:



试图 1

- (1) 化简方框图, 求出闭环传递函数 $\phi(s) = \frac{C(s)}{R(s)}$;
- (2) 绘出相应的信号流程图。



试图 2

三、(10 分)

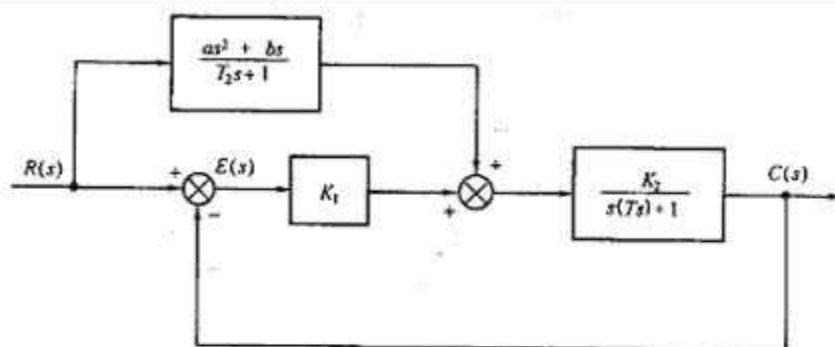
控制系统的方框图如试图 3 所示, 要求该系统在输入信号 $r(t) = \frac{1}{2}t^2$ 作用下, 稳态误差为零, 求参数 a 和 b 。

注: (1) 其它参数均作为已知常数;

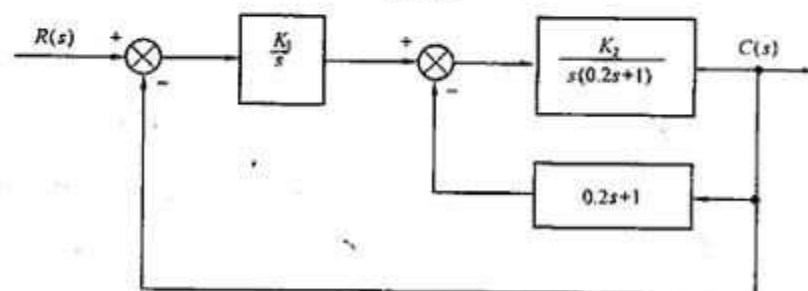
(2) 误差为 $e(t) = r(t) - c(t)$ 。

四、(10 分)

带有局部反馈的闭环控制系统如试图 4 所示。

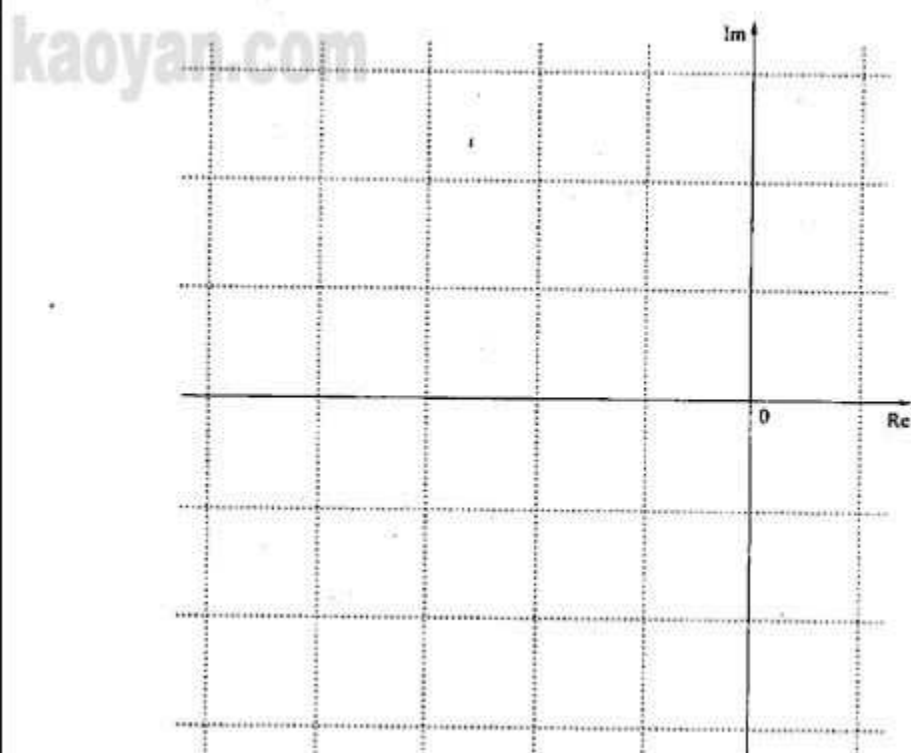


试图 3



试图 4

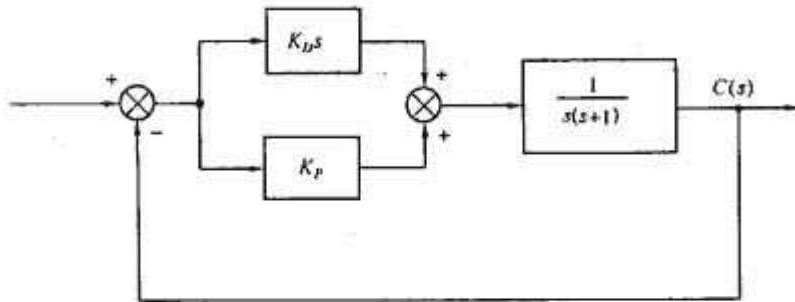
(1) 当 $K_2 = 2$ 时, 绘出 K_1 从 0 变到 $+\infty$ 时该系统的根轨迹图。(要求标清根轨迹的各特征数据, 根轨迹绘在本题所附的坐标纸上)。



(2) 若要求闭环系统有一对复数极点: $s_1, s_2 = -1 \pm j1$, 求 K_1 和 K_2 。

五、(10分)

试图 5 是一采用 PD 串联校正的控制系统。



试图 5

(1) 当 $K_P = 10, K_D = 1$ 时, 求相角裕度 γ ;

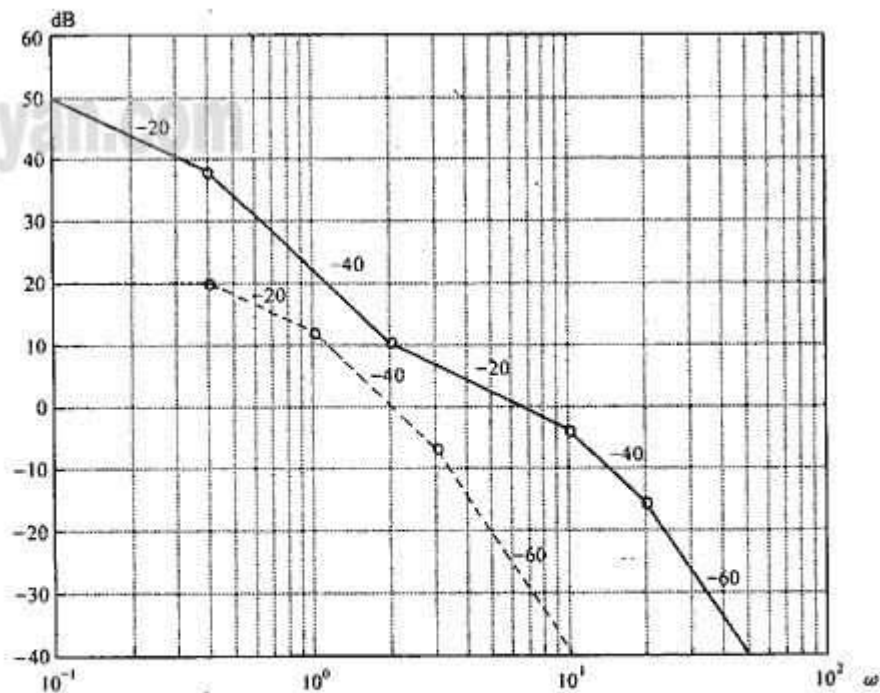
(2) 若要求该系统剪切频率 $\omega_c = 5$, 相角裕度 $\gamma = 50^\circ$, 求 K_P 和 K_D 的值。

六、(10分)

一单位负反馈最小相位系统的开环对数幅频特性如试图 6 所示, 其中虚线是未加校正的, 线是加串联校正后(图中小圆圈为折线的折点)。

(1) 求串联校正环节的传递函数 $G_c(s)$;

(2) 求串联校正后, 使闭环系统稳定的开环放大倍数 K 的取值范围。



试图 6

七、(10分)

一非线性控制系统如试图 7 所示。设 $M = 1$, 初始条件为 $e(0) = 1, \dot{e}(0) = 2$ 。

(1) 绘制在给定的初始条件下, 无速度反馈($\tau = 0$) 时, 误差 $e(t)$ 的相轨迹;

The block diagram shows a control system with the following components and connections:

- Input:** $r(t)$ enters a summing junction with a positive sign.
- First Summing Junction:** The output of the first summing junction is $E(t)$, which enters a second summing junction with a positive sign.
- Relay:** The output of the second summing junction enters a relay block labeled with M and $-M$.
- Integrator 1:** The output of the relay block enters an integrator block labeled $\frac{1}{s}$.
- Feedback Path:** The output of the first integrator splits into two paths:
 - One path goes through a block labeled τ and then enters the second summing junction with a negative sign.
 - The other path goes directly to the second integrator block.
- Integrator 2:** The output of the second integrator block is $c(t)$.
- Output Feedback:** The output $c(t)$ is fed back to the first summing junction with a negative sign.

八、(10分)

The block diagram shows a control system with the following components and connections:

- Input:** $R(s)$ enters a summing junction with a positive sign.
- First Summing Junction:** The output of this junction is the error signal $E(s)$.
- Disturbance:** A disturbance signal T_0 enters a second summing junction with a positive sign.
- Feedback:** The error signal $E(s)$ is fed back into the second summing junction with a negative sign.
- Forward Path:** The output of the second summing junction passes through a block $G(s)$.
- Output:** The output of $G(s)$ is the system output $C(s)$.
- Feedback Paths:**
 - A feedback signal is taken from the output $C(s)$ and passes through a block $H_1(s)$ to the disturbance input T_0 .
 - Another feedback signal is taken from the output $C(s)$ and passes through a block $H_2(s)$ back to the first summing junction.

九、(10分)

$$\dot{X}(t) = \begin{bmatrix} 0 & 1 & 0 \\ a & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix} X(t) = \begin{bmatrix} 0 \\ 1 \\ b \end{bmatrix} u(t)$$

$$y(t) = [0 \quad c \quad 1] X(t)$$

十、(10分)

(1) 用极点配置法设计状态反馈阵, 使反馈系统成为阻尼比 $\zeta = 0.7$, 无阻尼自振角频率 $\omega_n = 5 \text{ s}^{-1}$ 的典型二阶系统;

(2) 画出反馈系统的状态变量图,并求出闭环系统的传递函数。