大同大學 102 學年度研究所碩士班入學考試試題

考試科目:控制系統　　　所別:電機工程研究所　　　

註:本次考試 不可以參考自己的書籍及筆記； 不可以使用字典； 可以使用簡單計算器。

1. Consider the compensator $D(s) = 10\dfrac{s+1}{10s+1}$.

   (a) (5%) Calculate the magnitude and phase of $D(s)$ by hand for $\omega = 0.01, 0.1, 1, 10, 20, 30$, and 50 rad/sec.

   (b) (5%) Sketch the asymptotes for $D(s)$ according to Bode plot rules and compare these with your computed results from part (a).

   (c) (5%) From (a) and (b), is $D(s)$ the lead or lag compensator ? Explain your answer and simple lead and lag will not be granted any point.

2. Consider the PID feedback system shown in Fig. P-2, where $Y(s)$ is the output and $R(s)$ is the input.

   (a) (5%) Please find the transfer function $G(s)= Y(s)/R(s)$.

   (b) (10%) Use Routh's criterion to determine the region in the K_P versus K_D plane for which the system is stable when $K_I = 1$ (Use K_P as the horizontal axis and K_D as the vertical axis.)

   (c) (5%) From (b), what conditions must K_P and K_D satisfy so that the system is BIBO stable ?

   (d) (10%) From (a) and (b), what conditions must K_P and K_D satisfy so that the system is stable and its output can track a step reference input with constant steady-state error ?

   (e) (5%) From (a) and (b), please find K_P and K_D so that the closed-loop system poles are located at $s = -2 \pm j\sqrt{2}$.

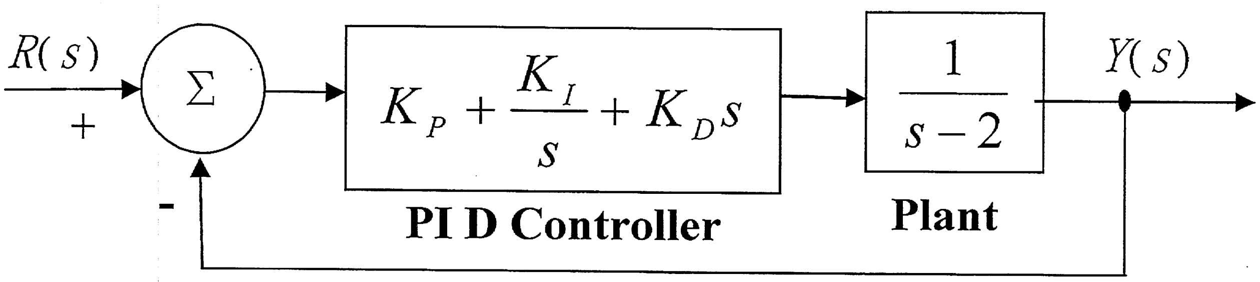

Fig. P-2

<背面繼續>

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3. Consider the continuous-time system with the following differential equation

$$\ddot{y}(t) = u(t).$$

(a) (15%) Determine the state-space representation of the above continuous-time system.

(b) (15%) Find the state-transition matrix $\Phi(t)$ by using the result of (a).

4. Consider the discrete-time system

$$y(k+2) - 2y(k+1) + y(k) = 0.5u(k+1) + 0.5u(k)$$

(a) (10%) Determine the state-space representation of the above discrete-time system.

(b) (10%) Determine a state-feedback controller such that the characteristic equation of the closed-loop system is $z^2 + p_1 z + p_2 = 0$. (in terms of p_1 and p_2)