淡江大學九十三學年度碩士班招生考試試題

系別：機械與機電工程學系　　科目：自動控制

准帶項目請打「○」否則打「×」
簡易型計算機
○

(各小題所佔分數比例在括號內，總分爲 100 分)

1. (20%) A closed-loop motor speed control system is shown in Figure 1. A cascade amplifier, k_a, is used to adjust the transient response and a tachometer, k_t, is utilized to feedback a voltage proportional to the speed.

   a. Derive the closed-loop transfer function, $\frac{\omega(s)}{R(s)}$, of the motor speed control system;
   b. Find the step response, $\omega(t)$, to a step input command, $R(t)=E$.
   c. It is desired to set the time constant of the closed-loop speed control system to be $0.1Sec$. Choose an appropriate amplifier gain k_a, if the gain of the tachometer is k_t=0.18 $Volt\ Sec/rad$.

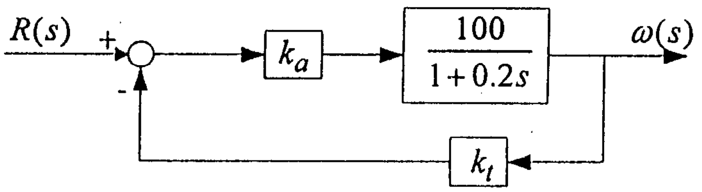

Figure 1　Closed-loop motor speed control

2. (20%) Consider the closed-loop control system of Figure 2, where the loop transfer function is expressed as

$$G(s)=\frac{1}{\tau s+1}$$

   a. Derive the closed-loop transfer function, $\frac{Y(s)}{R(s)}$, by using Mason's signal-flow gain formula.
   b. Select an appropriate gain k_a and a parameter τ to retain a percent overshoot (P.O.) to be less than 3% and keep the settling time (T_s) to within 2% of the final value is less than 0.25 sec.

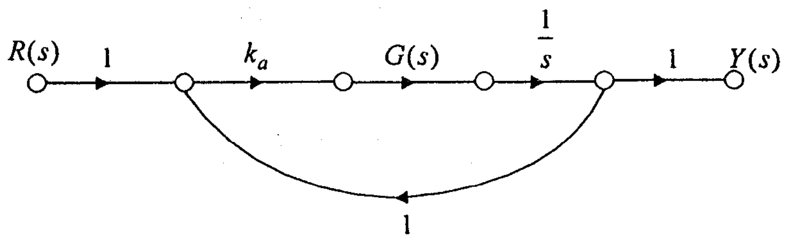

Figure 2 Closed-loop control system

【注意背面尚有試題】

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3. (20%) Consider the closed-loop control system shown in Figure 3, if the loop transfer functions of the system are expressed as

$$G(s)=\frac{k}{(s+2)(1+\tau s)}\,,\qquad H(s)=1$$

a. Utilize the Routh-Hurwitz criterion to determine the regions of k and τ for the system to be stable;

b. Select k such that the steady-state error to a step input is less than or equal to 25% of the input magnitude A, if $\tau>0$ and the step input is $R(s)=\frac{A}{s}$.

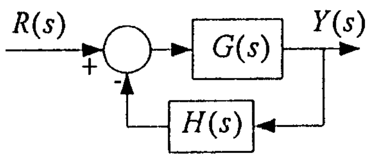

Figure 3 Closed-loop control system

4. (20%) Consider the closed-loop control system of Figure 3, where

$$G(s)H(s)=\frac{K}{s(s+2)(s+5)}$$

a. Locate the root loci when K=0 and K=∞ ;

b. Find the center and angles of the asymptotes for the root loci as K approaches infinity;

c. Compute the breakaway point;

d. Determine the point at which the locus crosses the imaginary axis, using the Routh-Hurwitz criterion;

e. Complete the root locus plot approximately.

5. (20%) Consider the closed-loop control system of Figure 3, where

$$\frac{Y(s)}{R(s)}=\frac{50(s-2)}{(s+1)(s^2+12s+25)}$$

Sketch the Bode diagram of frequency responses for the system.