國立臺灣海洋大學一００學年度研究所碩士班暨碩士在職專班入學考試試題

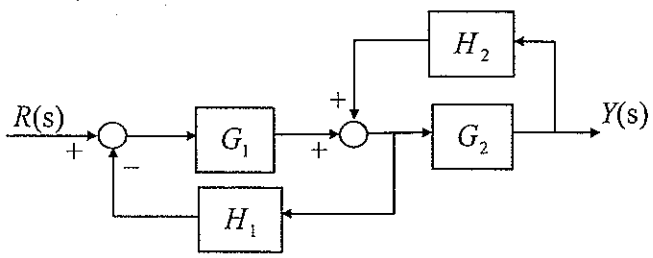
考試科目： 控制系統(含線性系統理論)

系所名稱： 通訊與導航工程學系碩士班控制組(聯)、通訊與導航工程學系碩士班電子導航與定位組(聯)、電機工程學系碩士班控制組(聯)

※可使用計算器

1.答案以橫式由左至右書寫。2.請依題號順序作答。

1. (20%) A control system is shown below, where $G_1(s)=\frac{1}{s+2}$, $G_2(s)=\frac{4}{s+5}$, $H_1(s)=3$, $H_2(s)=K$, and K is a constant.

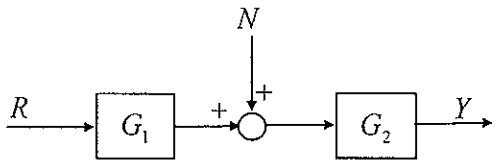


(a) Determine the transfer function $M(s)=\frac{Y(s)}{R(s)}$ for this system.

(b) Determine the range of K such that the system is stable.

(c) Find the value of K such that the damping ratio ζ of the system is $\frac{1}{3}$ and the natural undamped frequency ω_n is 3 rad/sec.

2. (20%) An open loop control system is shown below, where R is the input, Y is the output, and N denotes the noise. By adding a negative feedback (with gain H) from output Y to the input R, the effect of noise can be reduced.

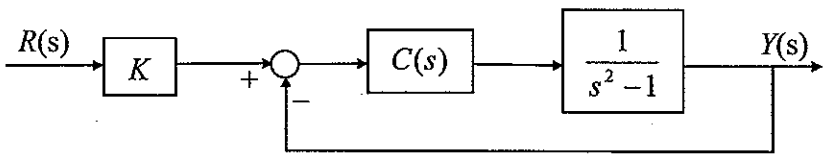


(a) Determine the output Y of the open loop system in terms of R, G_1, G_2, and N.

(b) Determine the output Y of the closed-loop system (with feedback H) in terms of R, G_1, G_2, H, and N.

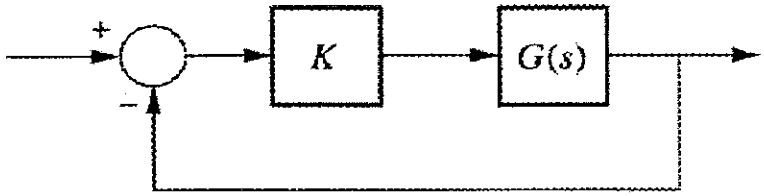
(c) From the solutions of part (a) and (b), explain why the effect of noise can be reduced.

3. (10%) A control system is shown below, where the controller is $C(s)$. Design a proper controller of degree one, $C(s)=\frac{b_0+b_1 s}{a_0+a_1 s}$, with proper value of gain K such that the closed-loop system has all poles located at -2 and the output $y(t)$ will track unit step reference input $r(t)$.



4. (20%) Consider the diagram shown below where $G(s) = \dfrac{s+b}{s(s-a)}$ with $a > b > 0$.

- Plot the bode diagram of $G(s)$.
- Find the stabilizing range of K using Nyquist stability criterion.



5. (15%) Given a plant $G(s) = \dfrac{1}{s(s+2)}$, a cascade lead compensator $C(s) = K\,\dfrac{s+z}{s+p}$ is to be designed such that (1%) settling time $T_s = 2.3$ sec and damping ratio $\zeta = 0.5$.

- Where is the desired point s_o in s-plane which satisfies the spec?
- If we let $z = 4$, what is p for which this lead compensator provides the exact phase angle and the gain K when the root locus stays right on s_o?

6. (15%) Consider the diagram shown below.

- Write down the state space representation with state $x = [x_1\ x_2]^T$, input u and output y.
- Is the system controllable? observable? Explain or prove the reason.