淡江大學九十二學年度碩士班招生考試試題

系別：航空太空工程學系　　科目：自　動　控　制

准帶項目請打「○」否則打「×」
簡單型計算機
○

1. (10%) A linear time-invariant system has its poles at $-5, -1, -2 \pm j2$, and its zeros at 1 and -8.

   (a) (5%) Determine the dominant pole(s) of the system.

   (b) (5%) If the system D.C. (direct current) gain is equal to 1, find the system transfer function.

2. (15%) Consider the system shown in Figure 1, with

$$H_1(s) = \frac{6}{s+2} \quad ; \quad H_2(s) = \frac{7}{s+3}$$

   (a) (5%) What is the transfer function from u to y?

   (b) (5%) What are system poles? What are system zeros (if any)?

   (c) (5%) If the system input is $u(t) = 2\cos(2t)$, find the system output in steady state.

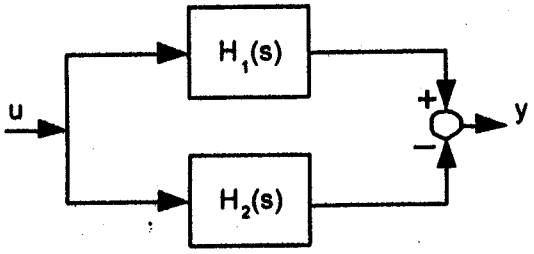

Figure 1: Parallel connection system

3. (20%) For the unity-feedback control system shown in Figure 2, where the plant to be controlled $G(s)$ and the controller $C(s)$ are given as

$$G(s) = \frac{1}{s^2 + 2s + 3} \quad : \quad C(s) = K_P + K_I \frac{1}{s}$$

   (a) (10%)Determine the conditions on the parameters K_P and K_I, for which the closed-loop system is stable.

   (b) (10%) Find a controller (a particular values of K_P and K_I) such that the closed-loop system dynamics is dominated by the factor $s^2 + 0.8s + 4.16$.

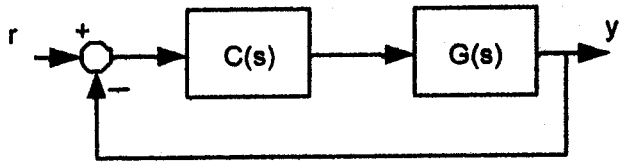

Figure 2: An unity feedback control system with PI control

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4. (20%) For the system in Problem 3, assume $K_P = 2$.

   (a) (14%) Sketch the root locus of the closed-loop poles using K_I as the variable. Find, if any, the break points or re-entry points, asymptotes and centroids, angles of departure or arrival.

   (b) (6%) Find the value of K_I when one of the closed-loop system poles is $s = -1$. What are the other poles of the closed-loop system for this value of K_I.

5. (10%) Consider an unity feedback system with loop transfer function

$$GH(s) = \frac{\omega_n^2}{s(s + 2\zeta\omega_n)}$$

   where $\zeta, \omega_n > 0$. Find the phase margin as a function ζ.

6. (10%) The loop transfer function of a unity feedback system is

$$GH(s) = \frac{10}{s(s+2)(s+5)}$$

   (a) Determine the steady-state position, velocity, and acceleration error constants.

   (b) Determine the steady-state error of the system when the input signal is $r(t) = 5+t$.

7. (15%) Consider the lead/lag transfer function

$$G(s) = \frac{s+z}{s+p} \quad ; \quad z > 0, \quad p > 0$$

   (a) Sketch the bode plot for $z > p$. Describe the characteristic of this function as detail as you can.(Your answer should include, at least, the amount of gain amplification/attenuation, the range of phase lead/lag, the frequency where maximum phase lead/lag occurs)

   (b) Repeat the problem in part (a) for $z < p$.