

國立中正大學九十二學年度碩士班招生考試試題
 系所別：機電光整合工程研究所 科目：自動控制

第 1 頁，共 3 頁

1. (25%) Consider the control system as shown in Fig. 1 where K is a constant gain.

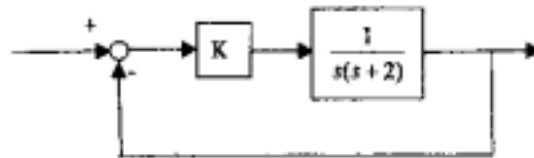


Fig. 1

- (a) (15%) Determine the range of K such that the feedback system satisfies the following:

- (1) Damping ratio ≤ 0.4
- (2) Steady state error due to step function $\leq 5\%$
- (3) Settling time ≤ 6 sec

- (b) (10%) If K is chosen to be 4, find the rising time and overshoot for a unit step input.

2. (25%) Consider the feedback control system shown in Fig. 2.

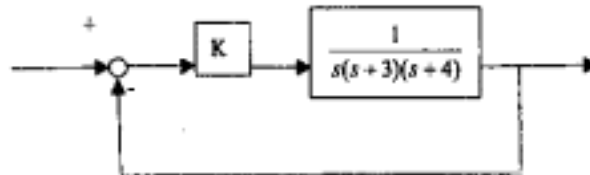


Fig. 2

- (a) (10%) Determine the range of K that makes the system stable?
- (b) (5%) If $K=14$, what is the gain margin of the system?
- (c) (10%) Determine the steady state errors for a unit step and for a ramp input if K is equal to 10?

3. (30%) Consider the following feedback control system (Fig. 3) where r is the command input, y the output, and w an external disturbance.

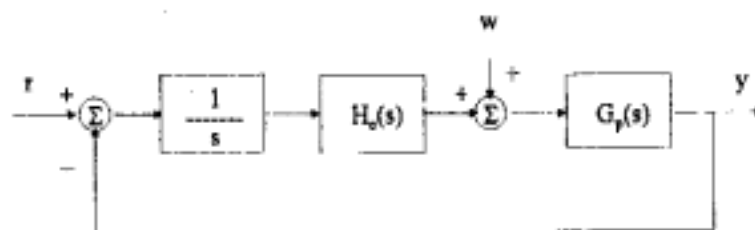


Fig. 3

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- (a) (4%) Assume the system is stable. Show that the output y will track a step command asymptotically, i.e., as time goes to infinity.
- (b) (4%) Assume the system is stable and w a constant disturbance. Show that the effect of the disturbance on output y becomes zero asymptotically.
- (c) (2%) Assume $H_c(s) = K_p(s + K_i)$ where K_p and K_i are two control gains. Show that the combined effect of H_c and the $(1/s)$ block represents a PI controller.
- (d) (10%) Assume $G_p(s) = 1/(s+1)^2$ and H_c as defined in (c). Plot the Nyquist plot of the loop transfer function $G_{loop}(s) = H_c G_p/s$. Note you only need to plot the Nyquist plot qualitatively. No precise numbers are required.
- (e) (10%) A control engineer is required to select proper values of K_p and K_i such that the feedback system achieves a 60 degrees phase margin and both the asymptotic tracking error of the unit step command and the effect of constant disturbances are zero. If you were the engineer, how will you design the controller? State your thoughts. No detailed calculation is necessary.

4. (20%) Consider the following feedback control system (Fig. 4) with w representing an external disturbance.

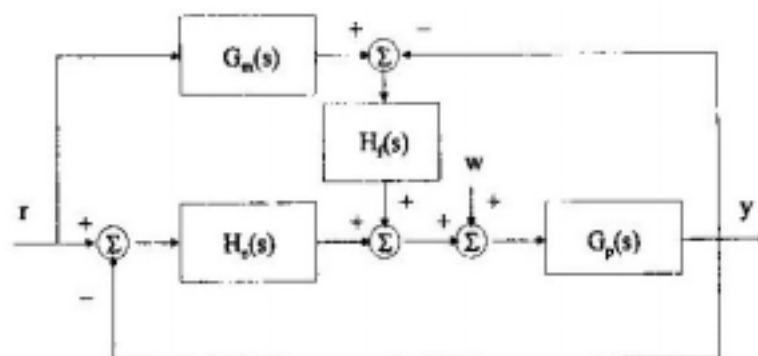


Fig. 4

- (a) (5%) Show that if $G_m = H_c G_p / (1 + H_c G_p)$, the transfer function from r to y become equivalent to G_m .
- (b) (5%) With the same choice of G_m as in (a), calculate the transfer function from w to y .
- (c) (5%) Assume the system is stable. Show that if $H_f = 1/s$, the effect of a constant

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external disturbance on the output y will go to zero asymptotically.

- (d) (5%) As in (c), show that if $H_f = 1/(s^2 + \omega^2)$, the effect of a sinusoidal disturbance with frequency ω on the output will go to zero asymptotically.