國立臺灣科技大學
九十二學年度博士班招生考試試題
系所組別：電子工程系博士班乙組
科　目：控制系統

題分100分

1. Please consider a feedback control system shown in Fig. P1.

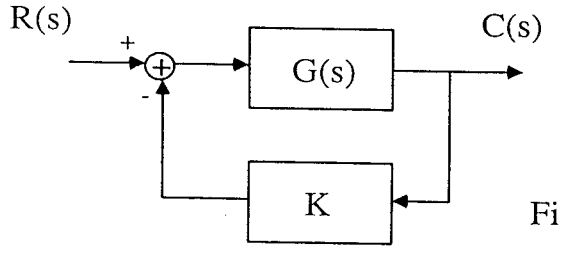

Fig. P1

(a). (10%) It is assumed that $K = 1$ and the open-loop system has exactly two real poles. Please find a function $G(s)$ such that the open-loop system is unstable and the closed-loop system is stable.

(b). (10%) Suppose $G(s) = \dfrac{10}{(S+1)^2(s+10)}$ and $K > 0$. Please determine the complete range of K such that the closed-loop system is stable.

(c). (15%) Suppose there is a time delay factor in the open-loop transfer function, i.e., $G(s) = \dfrac{10}{(S+1)^2(s+10)} \exp(-sT)$, where $T > 0$. Please describe the procedure to determine the complete range of T and K such that the system is stable.

2. The system equations of a state-space control system are given by

$$X'(t) = \begin{bmatrix} -2 & 1-K \\ 1 & -1 \end{bmatrix} X(t) + \begin{bmatrix} 1 \\ 2 \end{bmatrix} r(t)$$

and

$$y(t) = \begin{bmatrix} 0 & 1 \end{bmatrix} X(t) + r(t).$$

(a). (10%) Please determine the transfer function $H(s) = \dfrac{Y(s)}{R(s)}$ for $K = 1$.

(b). (15%) For the case $K = 1$, please write a time-domain integral equation describing the state $X(t)$ as a function of the input $r(t)$ and initial state $X(0^-)$.

(c). (10%) Please determine the range of K such that the system is observable and controllable.

3. It is known that a unity feedback system has the open-loop transfer function $\dfrac{K}{(s-1)(s+2)(s+3)}$, where $K > 0$.

(a). (10%) Determine the range of K such that the closed-loop system is stable.

(b). (5%) Please find the breakaway point for the complex pair of poles of the closed-loop system.

(c). (15%) Please plot the detailed root-locus plot for the closed-loop system.