國立臺北科技大學

九十四學年度車輛工程系碩士班入學考試

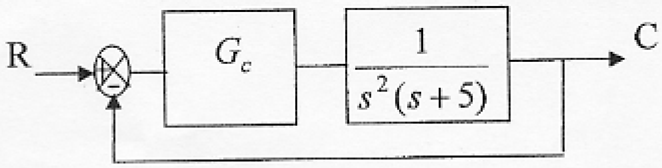
自動控制試題

填准考證號碼

注意事項：

1. 本試題共貳題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. A block diagram of the control system is shown in the following figure.



(a) (5%) If $G_c(s)=10(s+1)$, find the steady-state error for the input $R(s)=1/s^3$.

(b) (5%) If $G_c(s)=1$, plot the Bode diagram of the open loop transfer function.

(c) (5%) If $G_c(s)=K(1+aTs)/(1+Ts)$, is it possible to make the closed-loop system stable when $a<1$? Explain your reason or obtain no point.

(d) (5%) If $G_c(s)=K(s+a)$, find the range of a for a stable closed-loop system.

(e) (10%) If $G_c(s)=K(s+9)$, plot the root-locus diagram of the closed-loop poles from $K=0$ to $K=\infty$ and find the intersection and angles of the asymptotes.

(f) (10%) If $G_c(s)=K(s+a)$, find the values K and a such that one of the closed-loop poles located at $-1+j$.

(g) (10%) If $G_c(s) = K$, sketch the Nyquist plot of the open loop transfer function for $K = 1$ and find the number of unstable closed-loop poles when K varies from 0 to ∞.

2. A system is described by the state equation $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$ and the output equation $y = \begin{bmatrix} a & b \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$ where u is the input, y the output, and x_1, x_2 states.

(a) (5%) Draw the signal flow graph including the input $U(s)$, the output $Y(s)$ and states $X_1(s)$, $X_2(s)$ for the system.

(b) (5%) Determine the transfer function $Y(s)/U(s)$.

(c) (5%) Find the state equation and the output equation in vector-matrix form for the differential equation $\ddot{y} - y = au + b\dot{u}$.

(d) (5%) Find the discrete state equation when the system is sampled at 0.1sec and $u = 0$. ($e^{0.1} + e^{-0.1} = 2.010$, $e^{0.1} - e^{-0.1} = 0.200$)

(e) (10%) If the state-feedback control law is $u = -(k_1 x_1 + k_2 x_2)$, find the feedback gains k_1 and k_2 such that the closed-loop poles located at $-1 \pm j$.

(f) (10%) If the closed-loop poles located at $-1 \pm j$, find the damping ratio and natural frequency of the closed-loop system.

(g) (10%) Determine the conditions of a and b in the output equation when the system is unobservable.