國立臺灣科技大學

九十二學年度碩士班招生考試試題

系所組別：機械工程系碩士班丁組

科　目：線性系統控制

總分 100 分

1. The open-loop transfer function of a unity feedback control system is $G(S)=\frac{1}{S(S+2)}$. Design a suitable controller so that $K_v=4$, $\zeta=0.5$ *and* $t_s\approx 2$. Is it a phase-lead or phase-lag controller? [20%]

2. The open-loop transfer function of a unity feedback control system is $G(S)=\frac{K(S+2)}{S(S-2)}$.

   (i) If K=1, draw the asymptotic Bode diagram of $G(j\omega)$. [10%]

   (ii) Sketch the corresponding Nyquist plot of $G(j\omega)$ and use the Nyquist stability criterion to determine the condition of K for a stable control system. [10%]

3. The state model of a linear system is $\dot{X}=AX+BU$, $Y=CX$ and $A=\begin{bmatrix}-1 & -1\\ 1 & -3\end{bmatrix}$ $B=\begin{bmatrix}1\\ 0\end{bmatrix}$ $C=[0\quad 1]$.

   (i) Find the state transition matrix e^{At}. [6%]

   (ii) Design the state feedback controller so that the desired poles are $-3\pm 3j$. [6%]

   (iii) Design the reduced order observer so that the desired pole is –6. [8%]

4. If the system is $\dot{x}=-x+u$ *and* $x(0)=1$, find the optimal control law $u=-Kx$ to minimize the performance index $J=\int_0^\infty (x^2+u^2)dt$, and also find the value of J. [20%]

5. As the following digital control system and $G(S)=\frac{1}{S+1}$, find *c(k)* for a unit step input. [20%]

   [Hint: $e^{-1}\approx 0.37$]