淡江大學 103 學年度碩士班招生考試試題

系別：電機工程學系控制晶片與系統組　　科目：控制系統

考試日期：3 月 2 日(星期日)　第 2 節　　本試題共　5 大 題，2 頁

1. Consider the unity feedback system of Fig.1, where $G(s)=\dfrac{b}{s(s+a)}$.

   (i) Find the ranges of a and b under which the closed-loop system is stable. (10%)

   (ii) Find a and b to yield a settling time of 0.2 second and a 10% overshoot subject to unit step input. (10%)

2. Consider the inverting operational amplifier circuit as shown in Fig. 2.

   (i) Find the transfer function from $v_i(t)$ to $v_0(t)$. (10%)

   (ii) Change the way in which the components are connected so that the transfer function from $v_i(t)$ to $v_0(t)$ becomes that of a PID (proportional-integral-derivative) controller. Calculate the resulting transfer function. (10%)

3. Consider the unity feedback system of Fig. 1, where $G(s)=\dfrac{K}{s^n(s+7)(s+11)}$ is to have steady state error $e(\infty)$ smaller than 0.1 between an input $r(t)$ of $tu(t)$ and the output $c(t)$. Find n and the range of the value of K that guarantee closed-loop stability and the steady state error specification. (20%) (note: $e(t):=r(t)-c(t)$ is the inverse Laplace transform of $E(s)$)

4. Consider the system: $\dot{x}(t)=Ax(t)+Bu(t)$, $y(t)=Cx(t)$, where $A=\begin{bmatrix}-2 & 1\\ 0 & -1\end{bmatrix}$, $B=\begin{bmatrix}0\\ 1\end{bmatrix}$, $C=\begin{bmatrix}1 & 0\end{bmatrix}$。

   (i) Design a state-variable feedback $u(t)=-K_1x(t)$ to make the closed-loop poles located at $-1\pm j$. (10%)

   (ii) Design a state-variable feedback $u(t)=-K_2x(t)$ to improve the design mentioned in (i) with a threefold reduction in settling time while keeping the percent overshoot unchanged. (10%)

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5. Consider the system: $G(s) = \dfrac{1}{s+3}$.

(i) Calculate the magnitude frequency response and the phase frequency response of the system $G(s)$. (10%)

(ii) Find the steady state response of $G(s)$ subject to the sinusoidal input $\cos\left(20t + 30^\circ\right)$. (5%)

(iii) Find a state-space representation for $G(s)$. (5%)

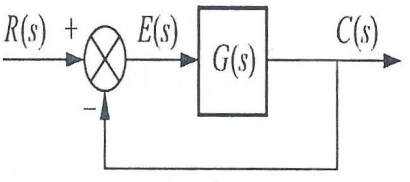

Fig. 1

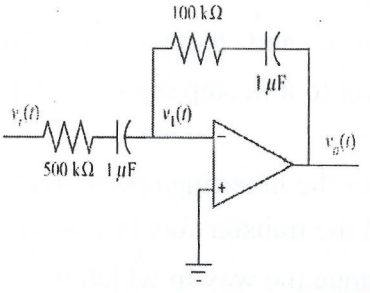

Fig. 2