逢甲大學104學年度碩士班考試入學試題

編號：050　科目代碼：223

科目	控制系統	適用系所	自動控制工程學系	時間	100 分鐘

※請務必在答案卷作答區內作答。　　　共 2 頁第 1 頁

1. One dynamic equation shown as:

$$\begin{bmatrix}\dot{x}_1(t)\\ \dot{x}_2(t)\end{bmatrix} = \begin{bmatrix}0 & 2\\ -3 & -5\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix}u(t),\ x(0) = \begin{bmatrix}1\\ 1\end{bmatrix},\ y(t) = \begin{bmatrix}2 & 1\end{bmatrix}x(t),\ u(t) = 2u_s(t).$$

   (a) Find state transition equation $x(t)$ (6%)

   (b) Find the transfer function $G(s)$ (8%)

2. Suppose a linear time-invariant system with input $u(t)$ and output $y(t)$ has an impulse response $h(t) = e^{-t}\sin t,\ t \ge 0$. (i.e. if $u(t) = \delta(t)$ then $y(t) = e^{-t}\sin t$)

   (a) Compute the step response of the system. (6%)

   (b) Suppose it is desired to have the output as $y(t) = 1 - 2e^{-t} + e^{-2t}\quad t \ge 0$, what the corresponding input $u(t)$ should be? (8%)

3. Check the controllability and observability of the following systems.

   (a) $\dot{x}(t) = \begin{bmatrix}1 & 1 & 0\\ 0 & 2 & 0\\ 0 & 1 & 2\end{bmatrix}x(t) + \begin{bmatrix}1 & 0\\ 0 & 1\\ 1 & 1\end{bmatrix}u(t),\ y(t) = \begin{bmatrix}1 & 2 & 0\end{bmatrix}x(t)$ (6%)

   (b) $$\dot{x}(t) = \begin{bmatrix}3 & 1 & 0 & 0 & 0 & 0 & 0\\ 0 & 3 & 1 & 0 & 0 & 0 & 0\\ 0 & 0 & 3 & 0 & 0 & 0 & 0\\ 0 & 0 & 0 & 3 & 0 & 0 & 0\\ 0 & 0 & 0 & 0 & 3 & 0 & 0\\ 0 & 0 & 0 & 0 & 0 & 9 & 1\\ 0 & 0 & 0 & 0 & 0 & 0 & 9\end{bmatrix}x(t) + \begin{bmatrix}1 & 0 & 0\\ 0 & 0 & 0\\ 0 & 1 & 0\\ 1 & 0 & 1\\ 1 & 2 & 1\\ 2 & 0 & 0\\ 1 & 2 & 1\end{bmatrix}u(t),$$

   $$y(t) = \begin{bmatrix}1 & 1 & 0 & 1 & 2 & 1 & 0\\ 0 & 0 & 0 & 1 & 1 & 1 & 2\\ 1 & 0 & 0 & 0 & 0 & 0 & 4\end{bmatrix}x(t)$$ (6%)

4. One SFG shown as Fig., by using Manson's gain formula

   (a) $\frac{y_7}{y_1}$ (5%)

   (b) $\frac{y_6}{y_3}$ (5%)

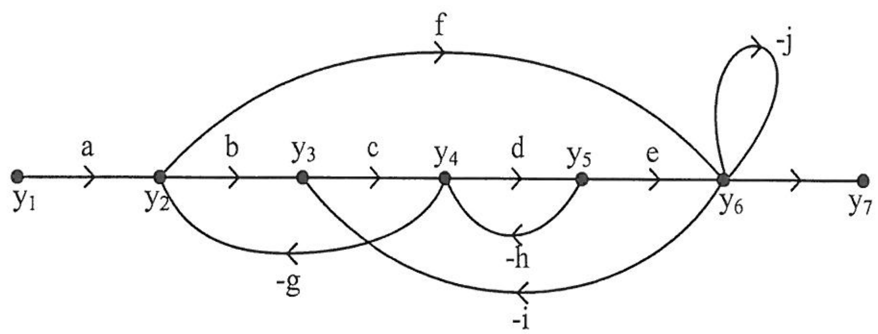
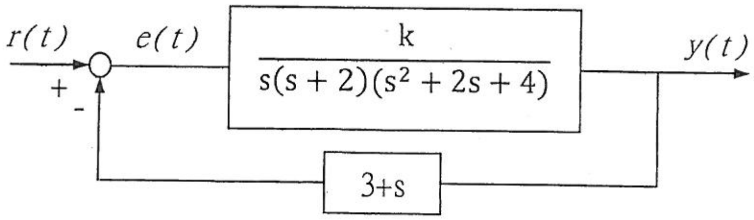


Fig.1

5. Consider the following system

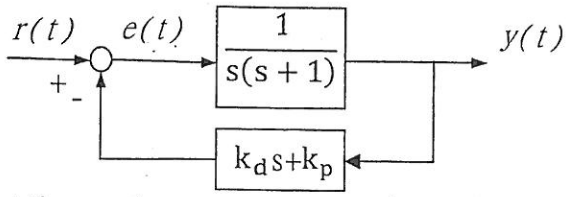


(a) Find the range of k such that the closed loop system is stable. 10%

(b) Find the imaginary poles when k ($k > 0$) is the value that the closed loop system is marginally stable. 5%

(c) Find the range of k such that the steady state error $e(t)$ to the input $r(t) = -3 + 2t$ is less than 2. 5%

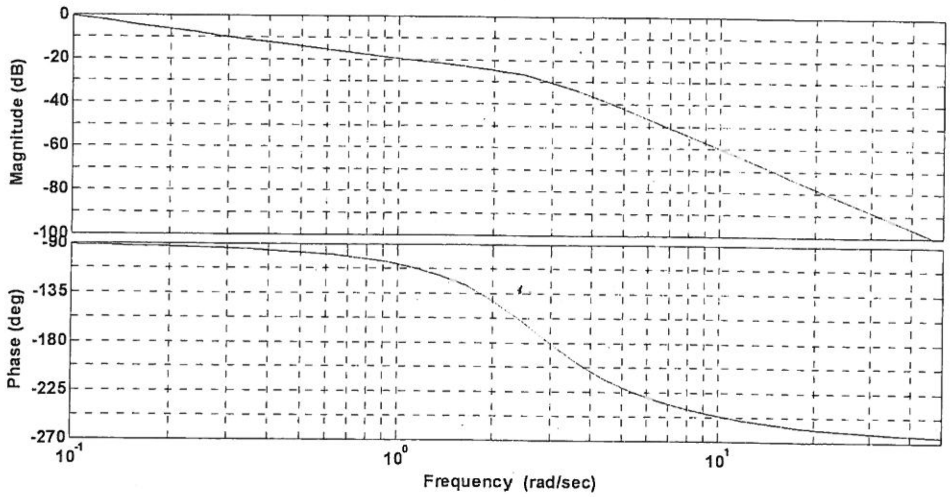
6. A control system is shown in the following block diagram.



(a) Find k_p and k_d such that the maximum percent overshoot of a step input and the settling time (1% error criterion) are 20% and 3 sec respectively. 10%

(b) With the values of k_p and k_d in (a), find the peak time and the rise time (rise from 10% to 90% of the final value). 10%

7. The forward-path transfer function of a unity negative feedback system is $KG(s)$, where K is a constant gain. The bode diagram of G(s) is shown as the following.



(a) Find the range of K such that the closed loop system is stable. 5%

(b) If $K = 2$ and the input of the closed loop system is $u(t) = 5$, find the steady state error. 5%