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：自動化及控制研究所碩士班丙組
科　目：控制系統

總分為 100 分，題號請標示清楚。

1. If a system is described by $\dot{x}(k)= Ax(k)+ Bu(k)$, the state transition matrix is defined by $A=\begin{bmatrix}2 & 2\\ 3 & 1\end{bmatrix}$. Compute $A^{10}+A$. (10%)

2. For each of the following Laplace-transformed signals, find the initial value and the final values. (20%)

(1) $Y(s)=\dfrac{16}{s^3+2s^2-8s}$

(2) $Y(s)=\dfrac{6s^2+8s+32}{s^3+2s^2+16s+32}$

3. The signal flow graph of a control system is shown in figure 1. The r(t) is the system input and c(t) is the system output. The initial states $x1(t_0)$ and $x2(t_0)$ are given.

(1) Find the state equation $\dot{x}(t)=Ax(t)+Br(t)$ and output equation $c(t)=Dx(t)$. (6%)
(2) Find transfer function $G(s)=c(s)/r(s)$. (4%)
(3) Investigate the system controllability and the observability. (6%)
(4) Find output c(t) with unit step input r(t) for $t > t_0$. (4%)

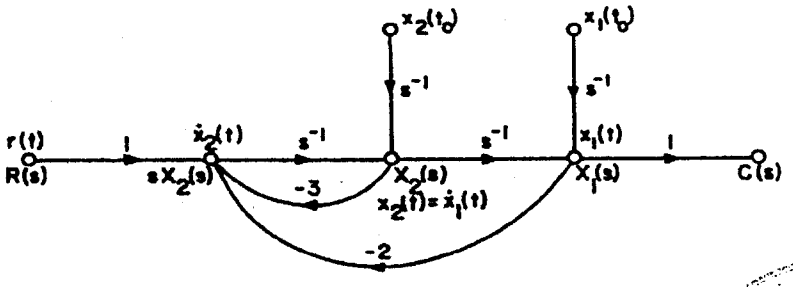

Figure 1

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4. (20%) A unity feedback control system has an open loop transfer function as

$$G(s)=\frac{k}{(s+2)(s+3)(s^2+2s+5)}$$

Please sketch the root locus plot of this system **(5%)**, and determine the following values.

(a) **(5%)** centroid, asymptotic angles

(b) **(5%)** angle of departure of root loci from the poles

(c) **(5%)** the range of k value which makes the system stable.

5. (15%) For a unity negative feedback system with the open loop transfer function

$$G(s)=\frac{K}{s(s+2)(s+5)}$$

(a) (10%) Please sketch the Nyquist plot of this system with brief explanation.

(b) (5%) Use the Nyquist criterion to find the range of gain K for stability and the gain margin for $K=1$.

6. (15%) Please find the system open loop transfer function $G(s)=\frac{kB(S)}{A(s)}$ based on the following asymptotic Bode diagram, with each step explanation **(8%)** . Write down the phase margin and gain margin. **(4%)** If we want the system has 50° phase margin, how to adjust the gain value k ? **(3%)**