南台科技大學100學年度研究所考試入學招生考試

系組： 電機系甲組、電機系海外　　准考證號碼：□□□□□□

科目： **控制系統**　　(請考生自行填寫)

注意事項	一、 請先檢查准考證號碼、報考系(組)別、考試科目名稱，確定無誤後再作答。 二、 所有答案應寫於答案紙上，否則不予計分。 三、 作答時應依試題題號，依序由上而下書寫，作答及未作答之題號均應抄寫。

1. Consider Fig. 1 below.

(7%) (a) Find the transfer function between $R(s)$ and $C(s)$.

(7%) (b) Let $G(s)=\dfrac{k}{s(s+2)(s+4)}$, $H(s)=\dfrac{1}{(s+6)}$. Are some of the poles of $\dfrac{C(s)}{R(s)}$ on the imaginary axis for some $k>0$? If so, what are the imaginary axis crossovers?

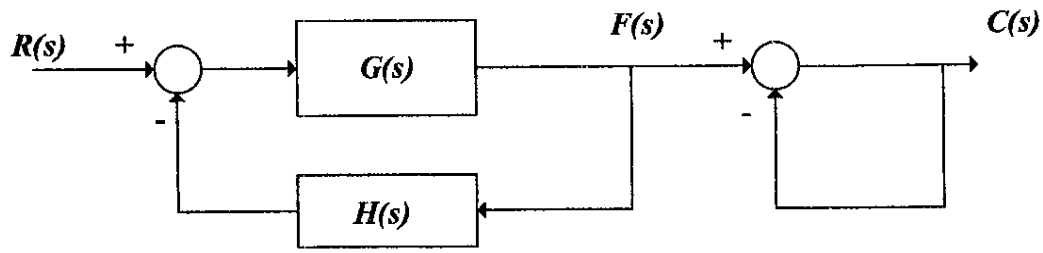

Fig. 1

2. Consider also Fig. 1 above

(7%) (a) Find the range of non-negative k such that the system is stable.

(7%) (b) Let $R(s)=\dfrac{1}{s}$, k=1000. Note that $C(s)$ represents the Laplace transform of $c(t)$. Can the output $c(t)$ reach a steady state?

(7%) (c) Does the Nyquist plot of $\dfrac{1}{s(s+1)(s+4)(s+5)}$ encircle (-1, 0)? Please explain. (Note: You DO NOT need to draw the Nyquist plot).

3. $\dfrac{d^2c(t)}{dt^2}+2\dfrac{dc(t)}{dt}+3c(t)=u_1(t)+u_2(t)$ represents a two-input, one-output linear time invariant system. Here $c(t)$ is the output, $u_1(t)$ and $u_2(t)$ are the inputs. Suppose all initial conditions are unknown.

(5%) **(a)** Find the two transfer functions of this system.

(5%) **(b)** If the inputs were sinusoidal with identical frequencies, is your answer for (a) above still the same?

4. (5%) Does $s^3+6s^2+s+6=0$ have roots on the right-half plane ?

5. (10%) Consider the following difference equation

$$m(k)=u(k)-u(k-1)$$

where $u(k)$=1 for $k\geq 0$. Find $m(k)$ for $k>0$ when $m(0)$=1.

6. We have a system described by the state equations

$$\begin{bmatrix}\dot{x}_1(t)\\ \dot{x}_2(t)\end{bmatrix}=\begin{bmatrix}-1 & 0\\ 1 & 1\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix}+\begin{bmatrix}-2\\ 1\end{bmatrix}u(t),\quad \begin{bmatrix}x_1(0)\\ x_2(0)\end{bmatrix}=\begin{bmatrix}x_{10}\\ x_{20}\end{bmatrix}$$

$$y(t)=[0\quad 1]x(t)$$

(1) Calculate $x_1(t)$,$x_2(t)$, and y(t) for t>0. (9%)

(2) What is the transfer function of the system described by these state equations? (6%)

7. Choose state variables as shown for the system shown in Fig. 2.

(1) Write the state equations. (5%)

(2) Is the system realization controllable? Observable? (8%)

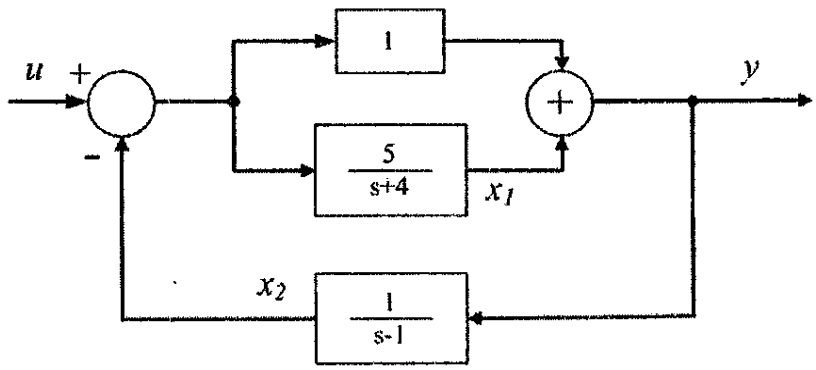

Fig. 2 Control system

8. Fig. 3 shows a block diagram of a space vehicle control system.

(1) Determine the gain K such that the phase margin is 60°. (6%)

(2) What is the gain margin in this case? (6%)

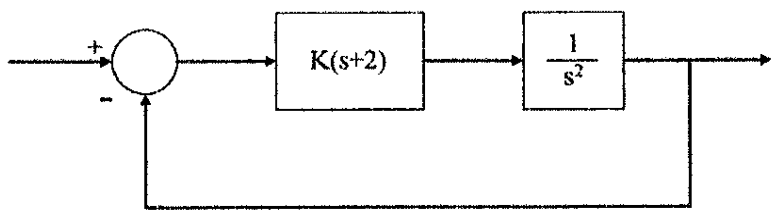

Fig. 3 Space vehicle control system