86-1

淡江大學96學年度碩士班招生考試試題

系別：航空太空工程學系　　　　　　科目：自　動　控　制

准帶項目請打「V」	
V	簡單型計算機

本試題共 3 頁

Figure 1

1. (a) (5%) In the control system, we usually consider the **Bounded-Input-Bounded-Output (BIBO) stability**. Please briefly explain what it is.

   (b) (10%) Assume that you are given an unknown plant, as shown in Fig. 1. Is it possible to figure out, only depending on experiments, whether or not this plant is BIBO stable? Why or why not? You can use an example to backup your explanations.

   (c) (10%) Assume that you know the dynamics (or transfer function) of this plant, can you figure out if it is stable? If yes, how? If not, explain it. You can use an example to backup your explanations.

2. Please answer the following problems based on Fig. 2.

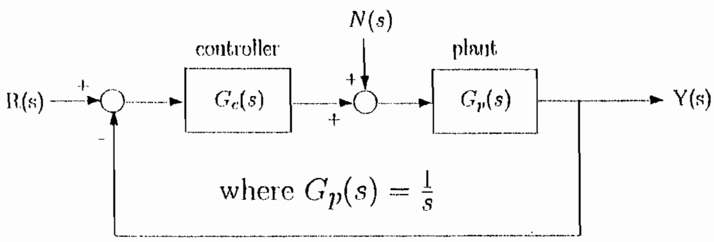

Figure 2

   (a) (5%) Find the steady-state response due to a unit step disturbance $N(s)$.

   (b) (10%) Is it possible to eliminate the effect of a unit step disturbance at steady state by using a cascade integral compensator ($G_c(s) = k_I/s$)? why or why not?

3. Please answer the following problems based on Figs. 3 and 4. Also, assume that the gain cross-over frequency is 3.87.

   (a) (9 %) How much is the gain margin and how much is the phase margin? Please give a comment to the stability of this system.

   (b) (12 %) Consider the phase-lead compensated system:

$$G_c(s) = \frac{K(s/\omega_z + 1)}{s/\omega_p + 1} \quad \omega_z < \omega_p$$

   Choose the parameters K,ω_z,ω_p, so that the gain cross-over frequency remains at 3.87 but the phase margin is near 50.

本試題雙面印製

◀注意背面尚有試題▶

86-2

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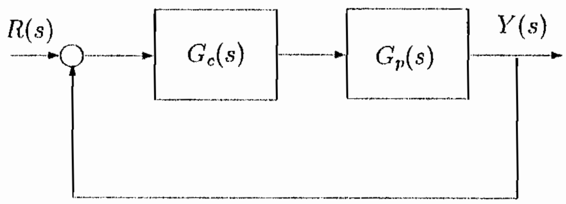

Figure 3

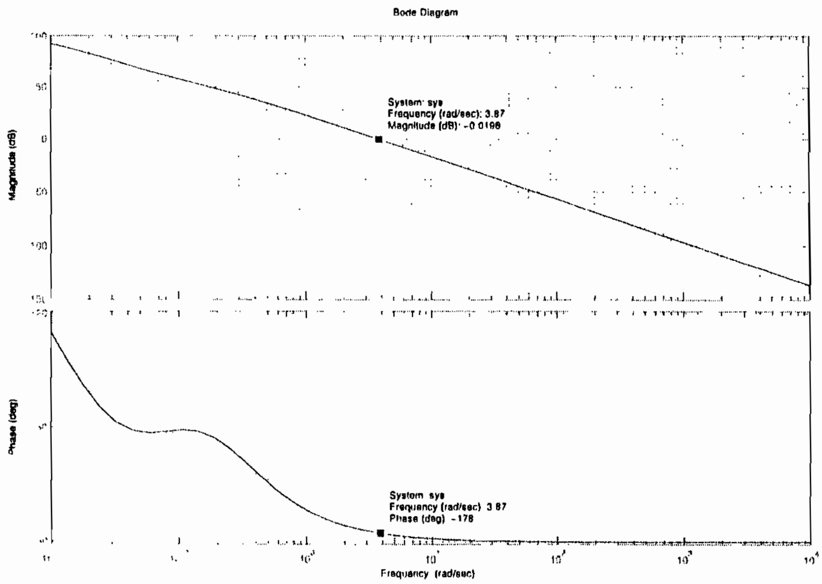

Figure 4

4. Consider a time-invariant system:

$$\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ -3 & 4 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

   (a) (9%) Is this system stable? Is this system completely controllable?

   (b) (10%) Assume that the closed-loop system is implemented by constant-gain state feedback, $u(t) = -Kx(t)$, where $K = [k_1 \quad k_2]$, so that the closed-loop poles move to $-5 \pm 5j$. What are k_1 and k_2?

5. Consider a pendulum system, shown in Fig. 5, whose dynamics can be written as the following equation of motion:

$$l\ddot{\theta} + g\sin(\theta) = M(t)/ml$$

where m denotes the mass of the pendulum, g denotes the gravitational acceleration, l denotes the length of the massless bar, $M(t)$ denotes the applied moment, and $\theta \in [0, 2\pi)$ denotes the angle between the pendulum and the downward vertical line. Please answer the following questions:

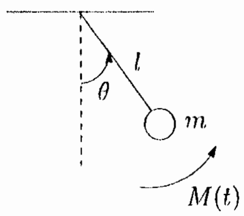

Figure 5

(a) (2%) What are the equilibria in this system?

(b) (5%) Please linearize this pendulum system about a nominal angle $\theta = \theta_0$ and a nominal applied moment $M(t) = 0$.

(c) (3%) Let $\theta_0 = \pi$. Is this a stable system?

(d) (5%) Let $x_1 = \theta$ and $x_2 = \dot{\theta}$. Please write down the linearized equation of motion you derived previously for $\theta_0 = \pi$ in the state-space form.

(e) (5%) If $\dot{\theta}$ is what we concerned (i.e., the output), is this a completely observable system?