淡江大學 95 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

本試題雙面印製

1. (12%) Sketch a basic structure (a block diagram) of a feedback control system. In the diagram, you have to include, at least, a **desired input**, a **disturbance input**, a **controlled output**, a **controlled plant**, a **controller**, an **actuator**, and a **sensor**. Describe the purpose and basic function of each component and explain the objective and operation of the control system (You can use an example to backup your explanations).

2. (10%) Given a dynamical system with transfer function

$$G(s)=\frac{Y(s)}{R(s)}=\frac{1}{s^2+3s+2}$$

Where $R(s)$ is the Laplace transform of the input signal $r(t)$, $Y(s)$ is the Laplace transform of the output signal $y(t)$. Find the steady state response, $y_{ss}(t)$, and the transient response, $y_t(t)$, to the input $r(t)=10t,\ (t\geq 0)$.

3. (15%) A feedback control system is shown in Figure 1 below with a PID controller $C(s)$ and plant $G(s)$ given as

$$C(s)=3(1+\frac{1}{K_I s}+K_D s)\ ;\ G(s)=\frac{6}{s^2+3s+18}$$

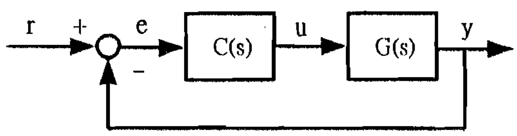

Figure 1

(a). If integral action is not employed, find the derivative gain K_D required to make the closed-loop system critically damped.

(b). With the result of (a), do you expect that the step response of the closed-loop system will have overshoot? Give reasons.

(c). If K_D is maintained as in (a), determine the minimum value of K_I that can be used without causing instability.

淡江大學 95 學年度碩士班招生考試試題

85-2

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 P2

4. (15%) The loop transfer function $G(s)$ of a unit feedback system has the following frequency response.

ω (rad/sec)	2	3	4	8	9	10	15
$\lvert G(j\omega)\rvert$	10.25	6.35	2.50	1.00	0.75	0.50	0.18
$\angle G(j\omega)$	-120°	-145°	-158°	-170°	-175°	-180°	-210°

(a). Determine the gain margin and phase margin of the system.
(b). Determine the change in gain required so that the gain margin of the system is 10 dB.
(c). Determine the change in gain required so that the phase margin of the system is 60°.

5. (18%) The step responses of the following transfer functions are shown in Figure 2, in random order. Match the system with its response.

(a). $H_1(s)=\dfrac{1}{s+1}$　(b). $H_2(s)=\dfrac{10}{s+10}$　(c). $H_3(s)=\dfrac{1}{s^2+0.4s+1}$

(d). $H_4(s)=\dfrac{1}{s^2+4s+1}$　(e). $H_5(s)=\dfrac{s}{s^2+0.4s+1}$　(f). $H_6(s)=\dfrac{s-2}{s^2+0.4s+1}$

(g). $H_7(s)=\dfrac{s+2}{s^2+0.4s+1}$　(h). $H_8(s)=\dfrac{2}{s^2+0.4s+2}$　(i). $H_9(s)=\dfrac{5}{s^2+4s+4}$

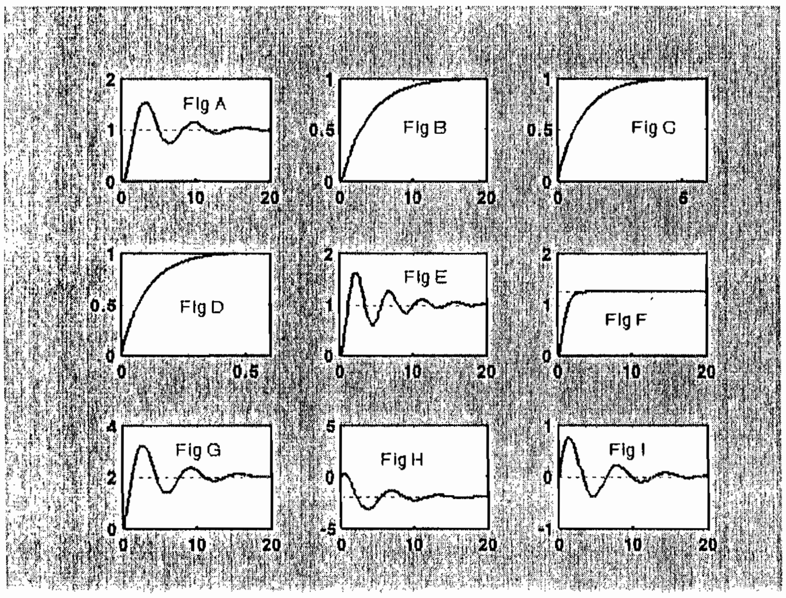

Figure 2

Write your answer in the format as: $H_1(s)\to$ Fig X, $H_2(s)\to Y$, ... (where X, Y are picked from A ~ I).

淡江大學95學年度碩士班招生考試試題

81-3

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 P3

6. (20%) The closed-loop frequency response $|M(j\omega)|$-verse-frequency of a stable second-order system with no finite zero is shown in figure 3 below. Sketch the corresponding unit-step response of the system; **indicate the value of the maximum overshoot, peak time, and the steady-state error** due to unit-step input.

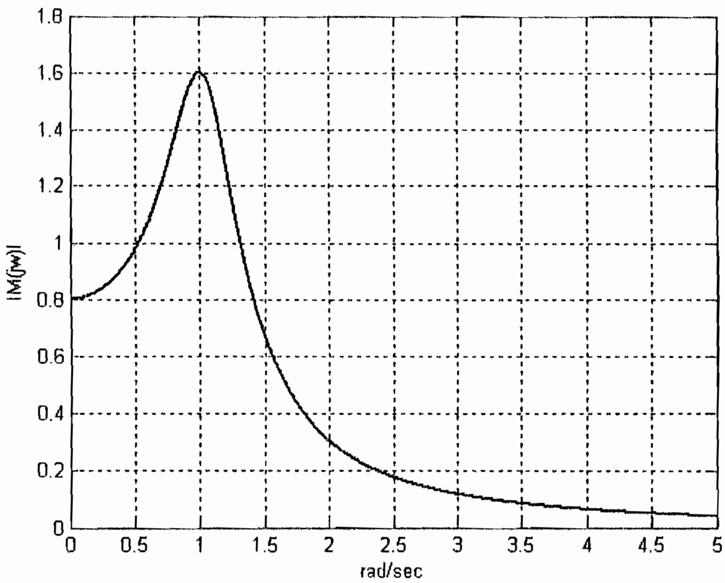

Figure 3.

7. (10%) The lead/lag compensator has the form

$$C(s) = K\frac{s+z}{s+p}$$

Where $K, z,$ and p are constant.

(a). What do the names "lead", "lag" refer to?

(b). Can we use lag compensator to improve phase margin? Explain.