類組：電機類　科目：控制系統(300D)　※請在答案卷內作答

Note: In this exam, you have 6 problems need to solve. Each problem has its own credit point as shown. The total credit point is 100.

1. (8%) Consider the closed-loop feedback system as given by

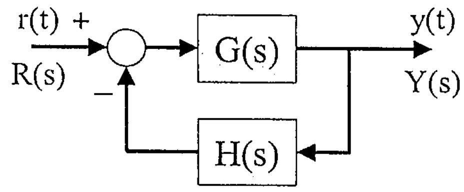

Figure 1.

where $G(s)=\dfrac{K(s+2)}{s(s+10)(s+5)}$ and $K=25$.

Let the error be defined as $E(s)=R(s)-Y(s)\cdot H(s)$.

(a) (2%) Solve the steady-state error for the input $R(s)=\dfrac{1}{s}$ and $H(s)=1$.

(b) (2%) Solve the steady-state error for the input $R(s)=\dfrac{1}{s^2}$ and $H(s)=1$.

(c) (2%) Solve the steady-state error for the input $R(s)=\dfrac{1}{s}$ and $H(s)=s$.

(d) (2%) Solve the steady-state error for the input $R(s)=\dfrac{1}{s^2}$ and $H(s)=s$.

2. (17%) Consider the characteristic equation of a given unity feedback system as given by (for $K\geq 0$)

$$s^3+\frac{14}{3}\cdot s^2+\left(\frac{49}{9}+K\right)\cdot s+3K=0.$$

(a) (4%) Find the poles and zeros of the corresponding open-loop transfer function.
(b) (4%) Find the angles of asymptotes.
(c) (2%) Find the interception of asymptotes on the real axis.
(d) (4%) Find the breakaway and/or break-in points on the real axis.
(e) (3%) Construct the root loci for the given unity feedback system with respect to the variation Of K.

注意：背面有試題

參考用

類組：電機類　科目：控制系統(300D)　※請在答案卷內作答

3. (12%) Let the forward-path transfer function of a unity-feedback control system be given by

$$G(s)=\frac{K}{s(s+a)}.$$

(a) (2%) Find the natural undamped frequency ω_n of the closed-loop system in terms of positive constants a and K with $K>a$.

(b) (2%) Find the damping ratio ζ of the closed-loop system in terms of positive constants a and K with $K>a$.

(c) (4%) Solve the resonance peak M_r of the closed-loop system in terms of positive constants a and K with $K>a$.

(d) (4%) Solve the resonant frequency ω_r of the closed-loop system in terms of positive constants a and K with $K>a$.

4. (13%) Consider a unity feedback system with the forward path transfer function as given by $G(s)=K\cdot G_1(s)$. The Nyquist plot of $G(s)$ with $K=1$ is given as shown in Figure 2 below.

(a) (6%) Find the Gain margin and Phase margin.

(b) (4%) How many finite poles and zeros for the corresponding forward-path transfer function?

(c) (3%) Determine the range of K so that the closed-loop system will be stable for $K>0$.

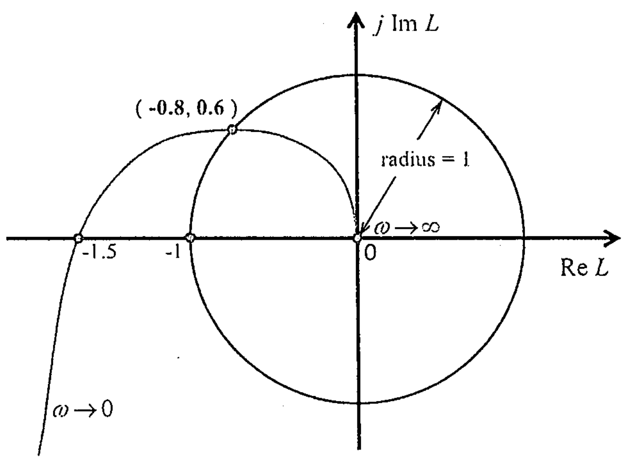

Figure 2.

注意：背面有試題

參考用

類組：電機類　科目：控制系統(300D)　※請在答案卷內作答

5. (22%) Consider the forward transfer function as

$$G(s) = K \cdot \frac{2(s^2+2s+5)}{s(s+5)(s^2+s+1.25)},$$

(a) (6%) Determine the range of the gain K to obtain a stable system.

(b) (8%) Sketch its Nyquist plot with direction (without calculation).

(c) (8%) Determine the gain K from the root locus, as shown in Figure 3, so that one pole is with $\zeta = 0.707$.

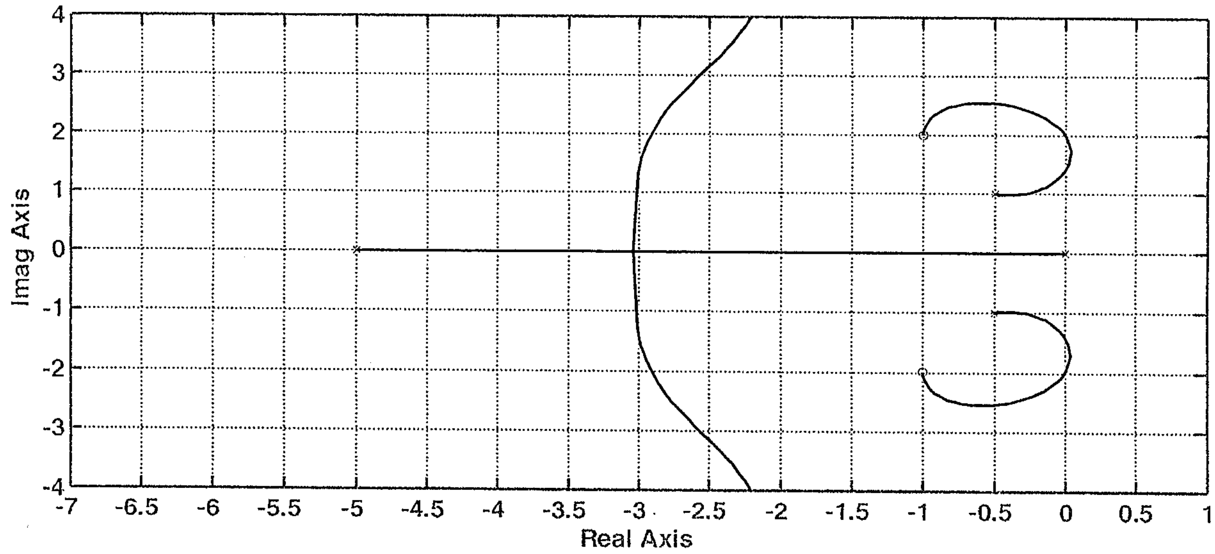

Figure 3

參考用

注意：背面有試題

類組：電機類 科目：控制系統(300D) ※請在答案卷內作答

6. (28%) The Bode plot of an unknown plant is as shown in Figure 4.

(a) (6%) Obtain its steady-state time response with the input $u(t) = \sin(2t)$ for the open-loop plant.

(b) (6%) Obtain its steady-state time response with the input $u(t) = \sin(2t)$ for the closed-loop control system with the gain $K = 1$.

(c) (6%) Determine the gain K to obtain a marginally unstable system.

(d) (10%) Design a lead controller so that the phase margin can be improved 30 degree as in (c).

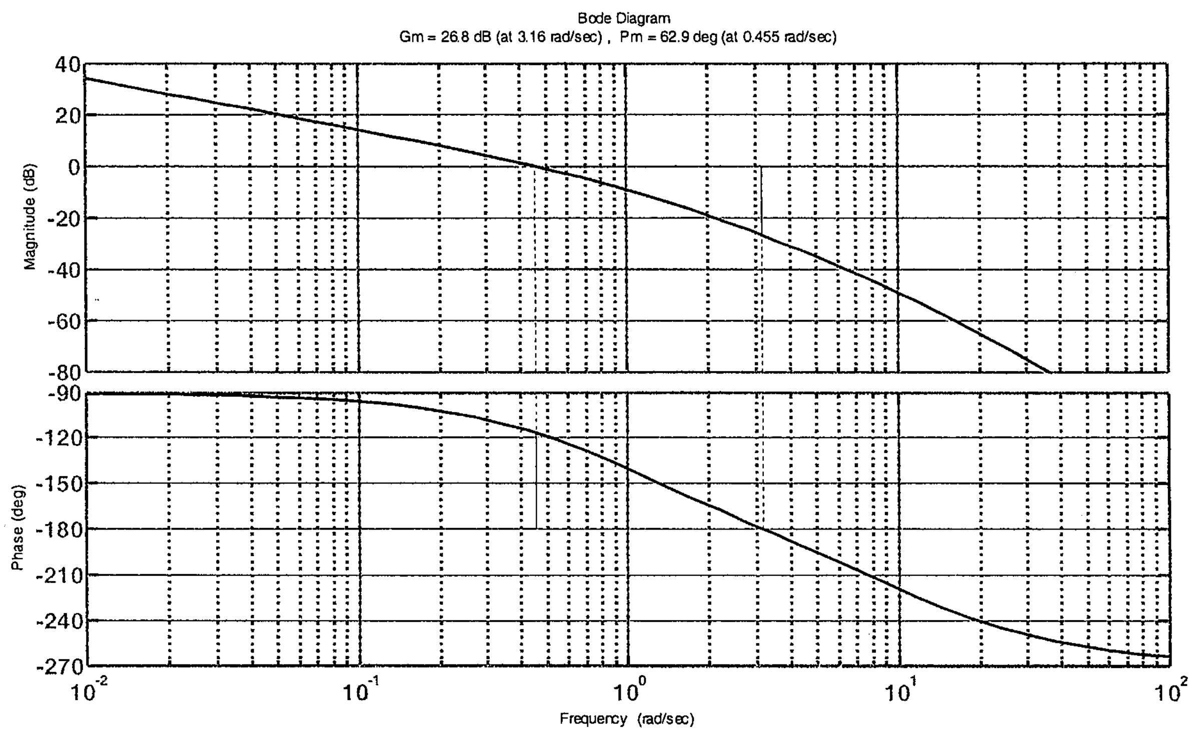

Figure 4

注意:背面有試題

影印用