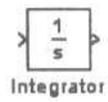
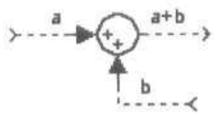
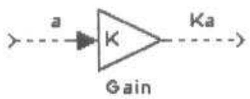
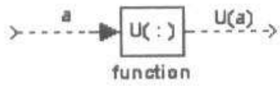
國立中正大學九十六學年度碩士班招生考試試題

系所別：光機電整合工程研究所　　　　科目：自動控制

第3節　

1. (10%) Develop a block diagram representation of each of the coming dynamic systems by using only the following block units

integration block:		summing block:	
scalar gain block:		mathematic function block:	

Note that when using the scalar gain or the mathematical function block, you are required to specify the gain value or the mathematical function you desire.

1a. (5%) $\ddot{y}+4\dot{y}+3y=u$

1b. (5%) $\begin{aligned}&\ddot{y}-2y+y^3=u\\&u=-5y-\dot{y}\end{aligned}$

2. (15%) Consider the following dynamic system

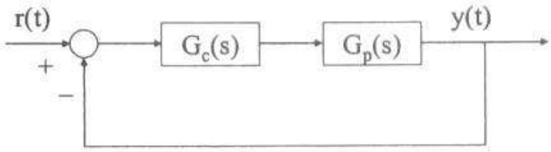
$$\ddot{y}+4\dot{y}+3y=u$$

2a. (5%) With y(0) = 1, dy(0)/dt = 0, and u(t) = 0 for all $t \geq 0$, use the Laplace transform method to solve for y(t).

2b. (5%) With y(0) = 1, dy(0)/dt = 0, and u(t) = 1 for all $t \geq 0$, find $\lim_{t\to\infty} y(t)$.

2c. (5%) In 2b, will $\lim_{t\to\infty} y(t)$ depend on the initial values, y(0) and dy(0)/dt? Why?

3. (25%) Consider the following feedback control system



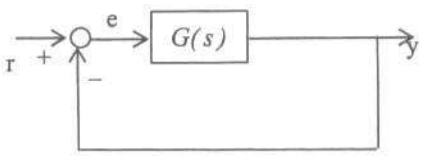
where $G_p(s)=\dfrac{1}{s(s+1)}$ and $G_c(s)$ a feedback controller.

3a. (5%) Assume $G_c(s)$ is a proportional control. Determine the root locus of the closed-loop system as the proportional gain varying.

3b. (10%) Consider the case where $G_c(s)$ is a PD (proportional-derivative) control. Use this example to elaborate the effect of the addition of an extra zero on the closed-loop root locus.

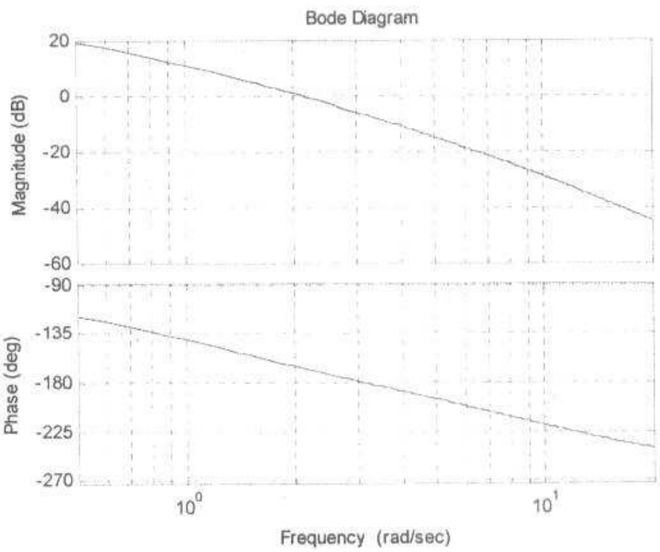
3c. (10%) Consider the case where $G_c(s)$ provides an additional pole, e.g., $G_c(s) = \frac{K}{s+p}$. Use this example to elaborate the effect of the addition of an extra pole on the closed-loop root locus.

4. (25%) Given a unit feedback system as shown in the figure below, where r is the reference, y the output, and e the error.



The transfer function G(s) and its Bode plot are given as follows.

$$G(s) = \frac{50}{s(s+1)(s+10)}$$



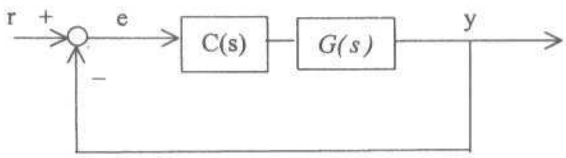
4a. (5%) Please plot the Nyquist Diagram of G(s).

4b. (5%) From the Bode plot, determine the gain margin, phase margin, and crossover frequency.

4c. (5%) Use the information in (b), find the approximate settling, and damping ratio for the closed loop system

4d. (10%) Determine the gain margin using analytical method and compare the result obtained from (b)

5. (25%) Consider a closed loop system as shown below where G(s) is a plant and C(s) a controller.



The transfer function of G(s) is given as

$$G(s)=\frac{1}{s(s+10)}$$

and the controller is assumed to be in the following form

$$C(s)=K\frac{1+s/z_0}{1+s/p_0}$$

The specifications of the closed loop system are:

(i) the damping ratio of the dominant root of the closed loop system to be 0.45, and

(ii) the velocity error constant equal to 100.

(a) (10 %) Plot the asymptotic approximate Bode diagram of the G(s)

(b) (5%) Will you choose a lead or a lag controller for C(s) ? Explain why?

(c) (10%) Find the parameters K, z_0, p_0 of $C(s)$ to meet the specifications.