國立臺灣科技大學 104 學年度碩士班招生試題

系所組別：自動化及控制研究所碩士班乙組

科　　目：控制系統

(總分為 100 分)

1. (28%) A block diagram of an automobile speed-control system with integral control is show in Figure 1.

   (a) With a zero reference velocity input ($v_c(t) = 0$), find the transfer function relating the output $v(t)$ to the disturbance $w(t)$. (7%)

   (b) What is the steady-state response of $v(t)$ if $w(t)$ is a unit ramp function? (7%)

   (c) Explain what type the system will be in relation to reference inputs? What is the value of the corresponding error constant? (7%)

   (d) What is the type and corresponding error constant of this system in relation to tracking the disturbance $w(t)$. (7%)

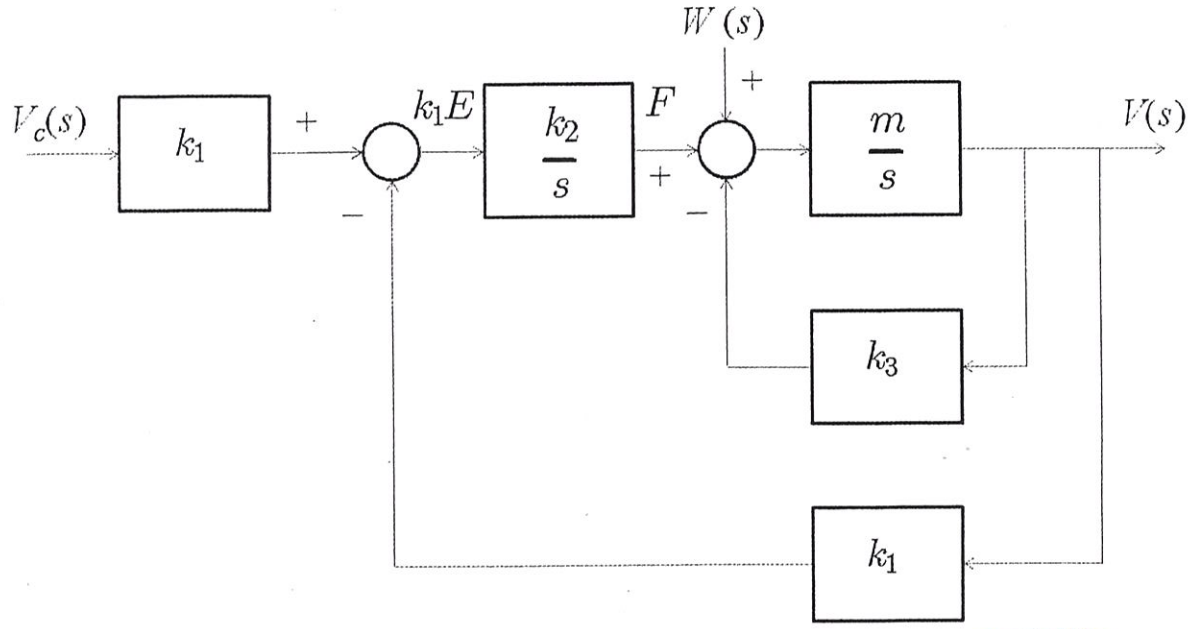

Figure 1

2. (7%) Consider a control system described by the following state equations:

$$\frac{dx_1(t)}{dt} = x_1(t) - 2x_2(t) \text{ and } \frac{dx_2(t)}{dt} = 10x_1(t) + u(t).$$

The control input $u(t) = -k_1x_1(t) - k_2x_2(t)$ is obtained from the state feedback, and k_1 and k_2 are real constants. Determine the region in the k_1-versus-k_2 parameter plane where the closed-loop system is asymptotically stable.

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3. (7%) Find the state-space representation of a system with the following transfer function:

$$G(s) = \frac{Y(s)}{U(s)} = \frac{B_1 s + B_0 s}{s^2 + A_1 s + A_0 s}.$$

4. (8%) An electric circuit is shown in Figure 2. Assuming all the initial conditions are zero, find the transfer function $\frac{V_2(s)}{V_1(s)}$.

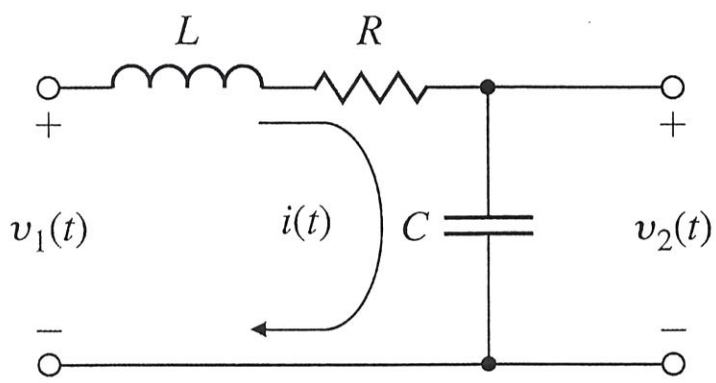

Figure 2

5. (20%) The signal flow graph of a control system is shown in Figure 3. The $u(t)$ is the system input and $y(t)$ is the system output.

(a) Find the state equation $\dot{x}(t) = Ax(t)+Bu(t)$ and output equation $y(t)=Cx(t)$. (10%)

(b) Find the transfer function $G(s)=Y(s)/U(s)$. (4%)

(c) Investigate the system controllability and the observability. (6%)

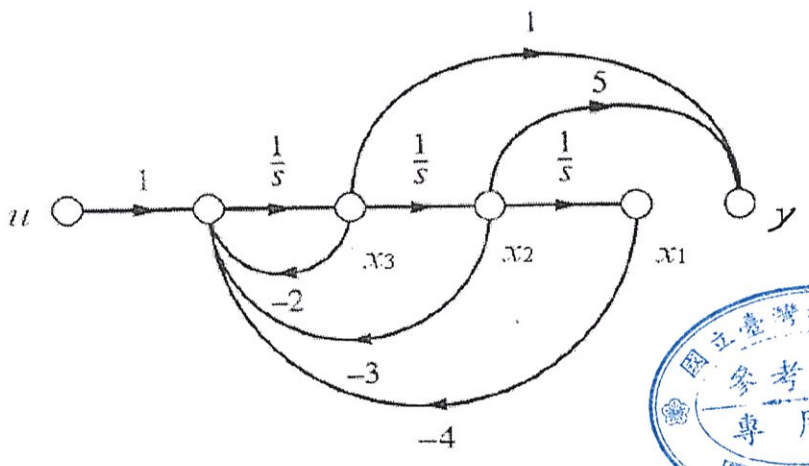

Figure 3

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6. (12%)

(a) Evaluate the stability of a control system in Figure 4. (8%)

(b) Find the number of poles in right-hand plane and left-hand plane. (4%)

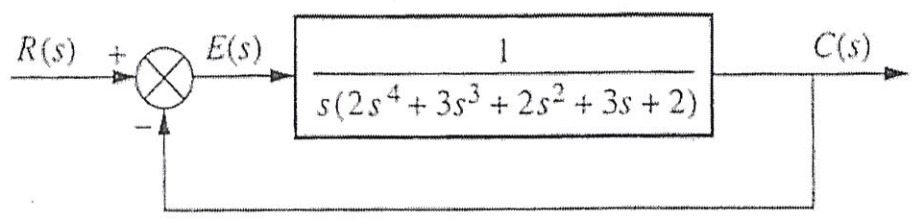

Figure 4

7. (18%)

(a) Sketch the root locus of the control system in Figure 5 for $K \geqq 0$. (12%)

(b) Find the gain margin for K=2. (6%)

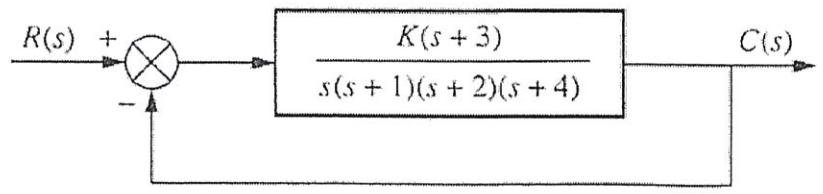

Figure 5