國立雲林科技大學
101 學年度碩士班暨碩士在職專班招生考試試題

系所：電機系
科目：自動控制(2)

1. (15%) Given the unity feedback system of Figure 1,

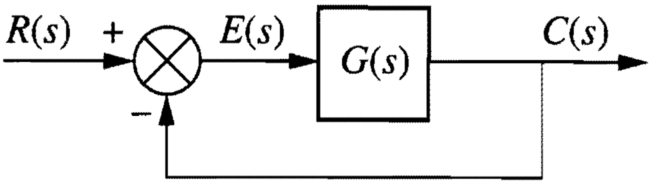

Figure 1

where

$$G(s) = \frac{K(s+\alpha)}{(s+\beta)^2}$$

is to be designed to meet the following specifications: steady-state error = 0.25 for unity step input; damping ratio = $\frac{1}{\sqrt{2}}$; natural frequency = $\sqrt{16}$. Find K, α and β.

2. (20%) Given the state space of the system represented below, where $u(t)$ is the unit step.

$$\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 \\ -20 & -9 \end{bmatrix} \mathbf{x} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$
$$y = \begin{bmatrix} 1 & 2 \end{bmatrix} \mathbf{x}, \quad \mathbf{x}(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

a. (8%) Determine the state-transition matrix, e^{At}.

b. (5%) Determine the characteristic equation.

c. (7%) Find the output $y(t)$.

3. (15%) Find the transfer function, $G(s) = \frac{V_o(s)}{V_i(s)}$, for the network shown in Figure 2.

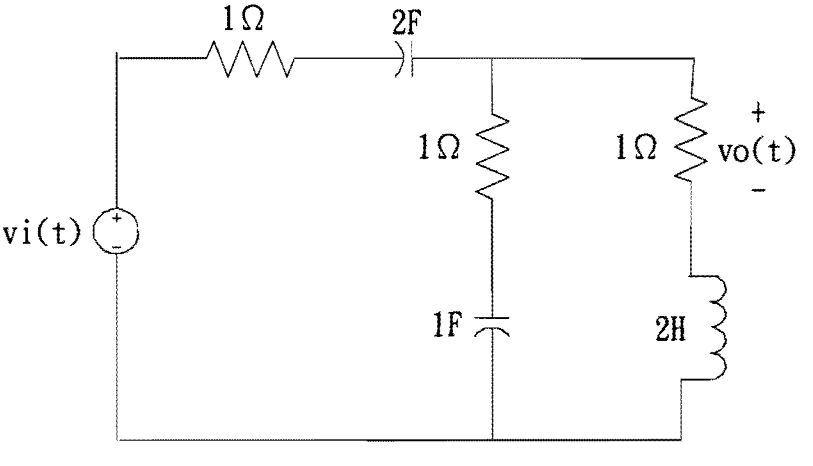

Figure 2

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4. (15%) For the system shown in Figure 3, find the following:

   a. (5%) The closed-loop transfer function, $T(s) = \frac{C(s)}{R(s)}$.

   b. (5%) The system type.

   c. (5%) The steady-state error, $r(\infty) - c(\infty)$, for the following test inputs: $15u(t)$, $15tu(t)$, and $15t^2u(t)$, respectively.

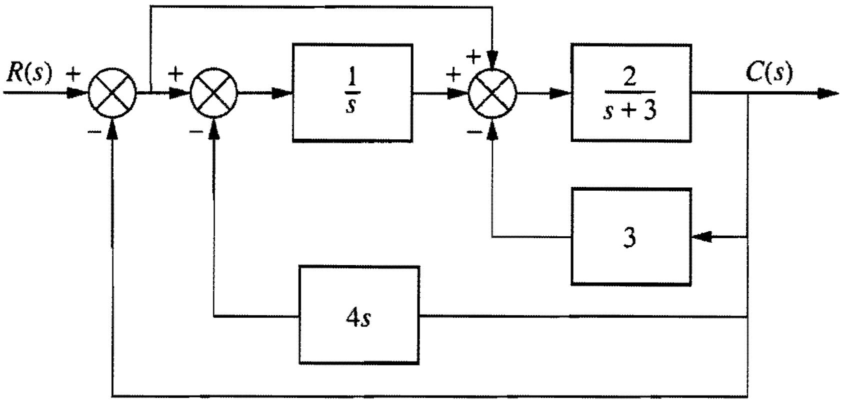

Figure 3

5. (20%) Given the unity feedback system of Figure 1, where

$$G(s) = \frac{K(s+1)}{s(s+2)(s+3)(s+5)}$$

do the following:

   a. (8%) Sketch the root locus

   b. (5%) Find the value of gain that will make the system marginally stable.

   c. (7%) Find the value of gain for which the closed-loop transfer function will have a pole on the real axis at -0.5.

6. (15%) Given the unity-feedback system shown in Figure 1, where

$$G(s) = \frac{50K}{s(s+3)(s+6)}$$

   a. (8%) For $K = 1$, sketch the Nyquist diagram and determine if the system is stable.

   b. (7%) Using the Nyquist criterion, find the range of K for stability of the system.