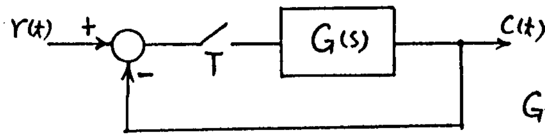
(工程科學研究所)

國立成功大學 78 學年度工科所入學考試(控制系統 試題) 共 1 頁 第 1 頁

1. Consider the discrete-data system shown in Fig. 1, with $T = 0.1$ s.

   (a) Find the closed-loop z-transfer function $C(z)/R(z)$.

   (b) Determine the range of K so that the system is stable.



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

Fig. 1

2. Consider a single-input single-output plant described by:

   state equation : $\dot{x}(t) = A\,x(t) + b\,u(t)$

   output equation : $\dot{c}(t) = D\,x(t)$

   where
   $$A = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & -1 \\ 2 & 1 & 0 \end{bmatrix}, \quad b = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \quad D = \begin{bmatrix} 0 & 1 & 1 \end{bmatrix}.$$

   (a) Find the transfer function of the plant. (5%)

   (b) Transform the state equation into the phase-variable canonical form. (7%)

   (c) Design a state feedback $u = -k\,x(t)$, that will place the closed-loop poles at -1, -2 and -3. (8%)

3. A unity feedback control system has an open-loop transfer function
   $$G(s) = K/s(s^2+3s+2)$$

   (a) Sketch the complete root locus diagram of the system.

   (b) Determine the marginal value of K that will cause instability. (5%)

4. A differential equation of a plant is $\ddot{c}(t) + w_0^2 c(t) = r(t)$, where $c(t)$ is the output variable, $r(t)$ is the input variable, and w_0 is a constant.

   (a) Can it use an output feedback $-k\,c(t)$ to stabilize the system? If can, determine the value of k. If can't, why?

   (b) Can it use a system $(s+a)/(s+b)$ in the negative feedback path to stabilize the system? If can, determine the values of a and b. If can't, why?

5. The open-loop transfer function of a unity feedback control system is
   $$G(s) = \frac{K}{s(s^2+3s+2)}$$

   (a) Determine the value of K so that the gain margin of the system is 10 dB.

   (b) Determine the value of K so that the phase margin of the system is 40°. (7%)

   (c) Determine the value of K so that the steady-state error is 0.1 for a unit ramp input. (6%) 102