

國立臺灣科技大學

九十二學年度博士班招生考試試題

系所組別：電機工程系博士班乙二組

科目：控制工程

共四題, 每題 25 分, 總分 100 分

1. (a) Find the state transition matrix
- $\phi(t)$
- of
- \mathbf{A}
- for

$$\mathbf{A} = \begin{bmatrix} 4 & 0 \\ 0 & -4 \end{bmatrix} \quad \mathbf{B} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

- (b) Does the state transition matrix $\phi(t)$ depend on the matrix \mathbf{B} ?
(c) Find the characteristic equation of this system.
(d) Does the characteristic equation depend on \mathbf{B} ?

2. The characteristic equation of a feedback control system is

$$s^3 + 2s^2 + (K+1)s + 3K = 0$$

Sketch the root loci of this equation for $-\infty < K < \infty$.

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3. The block diagram of a motor control system with tachometer feedback is shown in Fig. P. 3.

- (a) Find $\frac{C(s)}{R(s)}$, the closed-loop transfer function of the system. (10%)
- (b) Find ω_n , the natural frequency of the closed-loop system. (10%)
- (c) Find the value of the tachometer constant K_t so that the damping ratio of the closed-loop system is equal to 1.0, which is called critical damping. (5%)

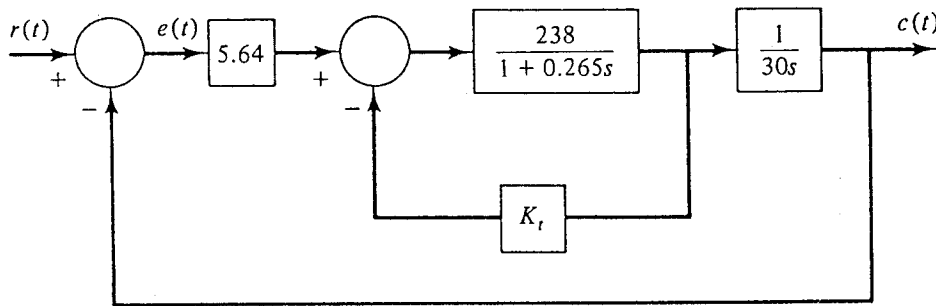


Fig. P. 3

4. The block diagram of a control system with state feedback is shown in Fig. P. 4. The parameters g_1 , g_2 , and g_3 are real constants.

- (a) Find the values of g_1 , g_2 , and g_3 so that the roots of the characteristic equation of the closed-loop system are at -1, -1, and -1. (10%)
- (b) Compute $\frac{X_1(s)}{R(s)}$, which is the closed-loop transfer function between the input and the output. (10%)
- (c) Compute the steady-state error $e_{ss} = \lim_{t \rightarrow \infty} e(t)$ when $r(t)$ is a unit step input. (5%)

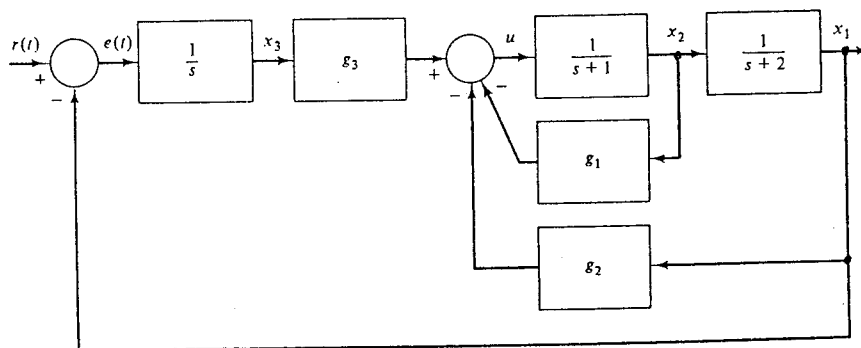


Fig. P. 4.

