

1. (50 %) The transfer function of a system is described as following

$$\frac{y(s)}{u(s)} = \frac{s+2}{s^3 + 3s^2 - 4s - 12}$$

(a) Please show how to check the controllability or observability of the system
(5 points)

(b) Please show how to check the system's stability (BIBO stable) (5 points)

(c) To realize the system as a controllable canonical form
 $\dot{x}(t) = Ax(t) + Bu(t)$ and $y(t) = Cx(t)$ and find the matrix A, B, and C (10 points)

(d) Please find the state feedback $u(t) = Kx$ to let the system eigenvalues be -1, -4, -5. (10 points)

(e) Why the state feedback will not change the controllability, may change the observability (10 points)

(f) If the input $u(t)$ is impulse function, please find the system output, $y(t)$. (10 points)

(背面仍有題目,請繼續作答)

2. (50%) The system can be described as following

$$\dot{x}(t) = Ax(t) + Bu(t)$$

$$y(t) = Cx(t)$$

A , B , and C are constant matrices. Answer the following questions.

(a) How to find the system's transfer function? (5 points)

(b) How to check whether the system realization is minimal realization? (5 points)

(c) If $A = \begin{bmatrix} 1 & 1 & 2 \\ 0 & 1 & 3 \\ 0 & 0 & 2 \end{bmatrix}$, can you find a nonsingular matrix Q , such that $Q A Q^{-1}$

become a diagonal matrix? If yes, please find Q matrix. If no, why? (10 points)

(d) If (A, B) is not completely controllable, how to decompose into controllable parts and uncontrollable parts (Write down your procedure) (10 points)

(e) How to check the system's controllability, observability and stability? (Write down your procedure) (10 points)

(f) How to find the state transition matrix? (Write down the procedure) (5 points)

(g) Any advantages on state variable description over on transfer function description? (5 points)