系所組別： 生物醫學工程學系乙組

考試科目： 控制工程

考試日期：0219，節次：2

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1. (30 %)The dynamic equation as following

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 3 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 3 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 3 \end{bmatrix} x + \begin{bmatrix} 2 & 1 & 1 \\ 2 & 1 & 1 \\ 1 & 1 & 1 \\ -2 & -2 & -2 \\ -1 & 0 & 0 \\ 1 & 0 & 1 \\ 0 & 0 & 1 \end{bmatrix} u(t)$$

$$y = \begin{bmatrix} 2 & 2 & 1 & 3 & -1 & 1 & 1 \\ 1 & 1 & 1 & 2 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 0 & 1 & 1 \end{bmatrix} x$$

(a) Is this system controllable? Give your reason. (10 points)

(b) Is this system observable ? Give your reason. (10 points)

(c) Above system transfer function can be represented by $T(s) = \frac{Q(s)}{P(s)}$,

Please find the P(s) (10 points)

2. (30 %) The transfer function of a system is described as following

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

(a) Can you check the controllability, observability and stability of the system ? why?

(b) 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. Then check the system's observability.

(c) From the realization of (b), please find the state feedback to move the eigenvalues to -1, -2, -3.

(背面仍有題目,請繼續作答)

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3. (40 %)For a dynamical equation: $\dot{x}(t) = \begin{bmatrix} 3 & 0 \\ 1 & 4 \end{bmatrix} x(t) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(t)$

$$y(t) = \begin{bmatrix} 1 & 1 \end{bmatrix} x(t)$$

Answer the following questions! (5 points each)

a. To find a nonsingular matrix P and let PAP^{-1} be a diagonal matrix?
b. To check whether the system is BIBO(Bounded Input Bounded Output) stable?
c. Please derive the transfer function of the system.
d. To check the system's controllability and observability.
e. An input-output differential equation for this system can be written in the form $\dot{y}(t) + \alpha_1 y(t) = \alpha_2 \dot{u}(t) + \alpha_3 u(t)$. Please find α_1, α_2, α_3
f. Please find exp(At)
g. Please find the impulse response of the system.
h. Using the state feedback to stabilize this system.