大同大學九十二學年度研究所碩士班入學考試試題

考試科目：控制系統　　：電機工程研究所　　

註：本次考試 [不可以] 參考自己的書籍及筆記；[不可以] 使用字典；[不可以] 使用計算器。

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1. The flow of traffic in a single lane can be described by the following equation:

$$\frac{dy(t)}{dt} = V - Ae^{-\alpha / y(t)}$$

where

$y(t)$ = relative distance between two cars,

V = constant velocity of the lead car,

A, α = real positive constants.

(a) Obtain the equilibrium value Y that results in $\dot{y}(t) = 0$. (6%)

(b) Obtain the range of V/A in $0 \le V/A < \infty$ for which Y > 0. (6%)

(c) Linearize the equation around Y, and write the resulting linearized equation. (7%)

2. Find the transfer functions Y_7/Y_1 and Y_3/Y_1 of the signal-flow graph shown in **Fig. P-2**. (14%)

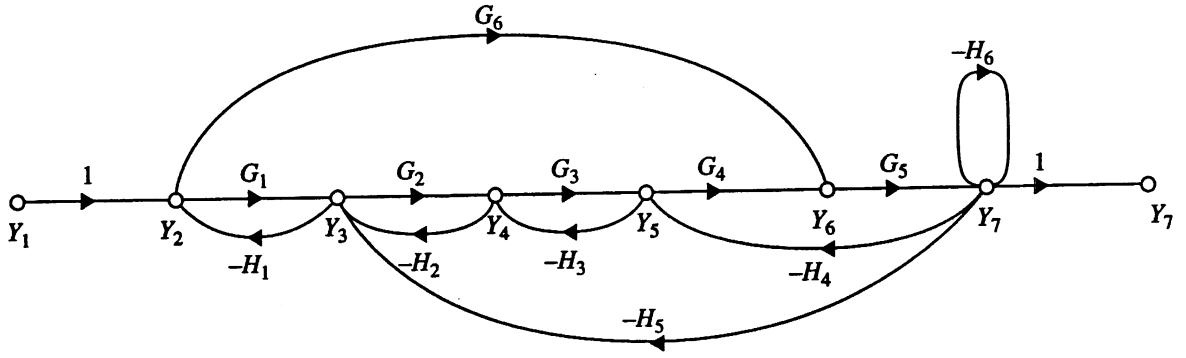

Fig. P-2

3. The block diagram of a linear control system is shown in **Fig. P-3**, where $r(t)$ is the reference input.

(a) Find the steady-state value of $e(t)$ in terms of α and K when $r(t) = tu_s(t)$, where $u_s(t)$ is the unit-step function. (8%)

(b) Find the conditions on α and K so that the solution of (a) is valid. (8%)

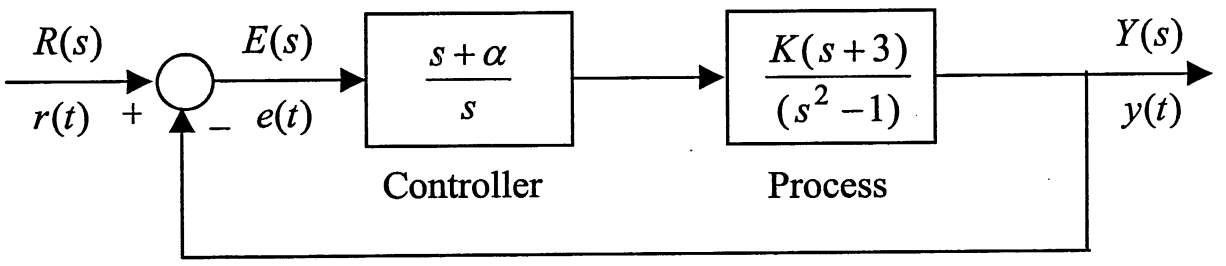

Fig. P-3

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4. A spring-mass-friction system is described by the following differential equation:

$$\frac{d^2y(t)}{dt^2}+2\frac{dy(t)}{dt}+y(t)=r(t)$$

Define the state variables as $x_1(t)=y(t)$ and $x_2(t)=dy(t)/dt$

(a) Write the state equations of the system in vector-matrix form: $\dot{\mathbf{x}}(t)=\mathbf{A}\mathbf{x}(t)+\mathbf{B}r(t)$, $y(t)=\mathbf{C}\mathbf{x}(t)$, where $\dot{\mathbf{x}}(t)\equiv[\,dx_1(t)/dt \quad dx_2(t)/dt\,]^{\mathrm{T}}$. (8%)

(b) Find the state-transition matrix $\phi(t)$ of the state equation obtained in (a). (8%)

5. **Fig. P-5b** shows the block diagram of the network system in **Fig. P-5a**

(a) Find the k_1, k_2, k_3, k_4, k_5 and k_6 shown in **Fig. P-5b**. (6%)

(b) In problem (a), if $R_1=1\Omega, k_1=1, k_2=3, k_3=1, k_4=8, k_5=1$ and $k_6=1$, find the state equation in vector-matrix form: $\dot{\mathbf{x}}(t)=\mathbf{A}\mathbf{x}(t)+\mathbf{B}e(t)$, where $\mathbf{x}(t)\equiv[\,v_1(t) \quad v_2(t)\,]^{\mathrm{T}}$. (8%)

(c) Find the eigenvalues of this network system. (6%)

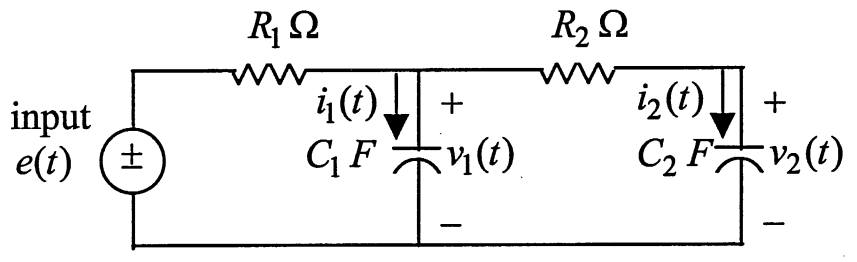

Fig. P-5a

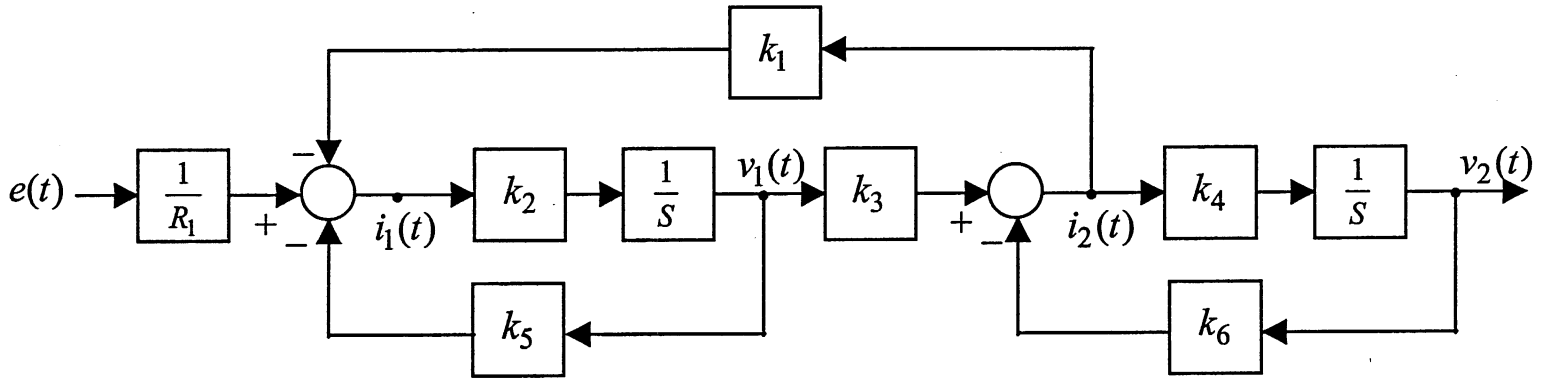

Fig. P-5b

6. Consider the discrete-data system shown in **Fig. P-6**, where T is an ideal sampler and $r(t)=e^{-2t}, t\geq 0$. (15%)

(a) Find $Y_1(z)$. (b) Find $Y_2(z)$. (c) Find $Y_3(z)$.

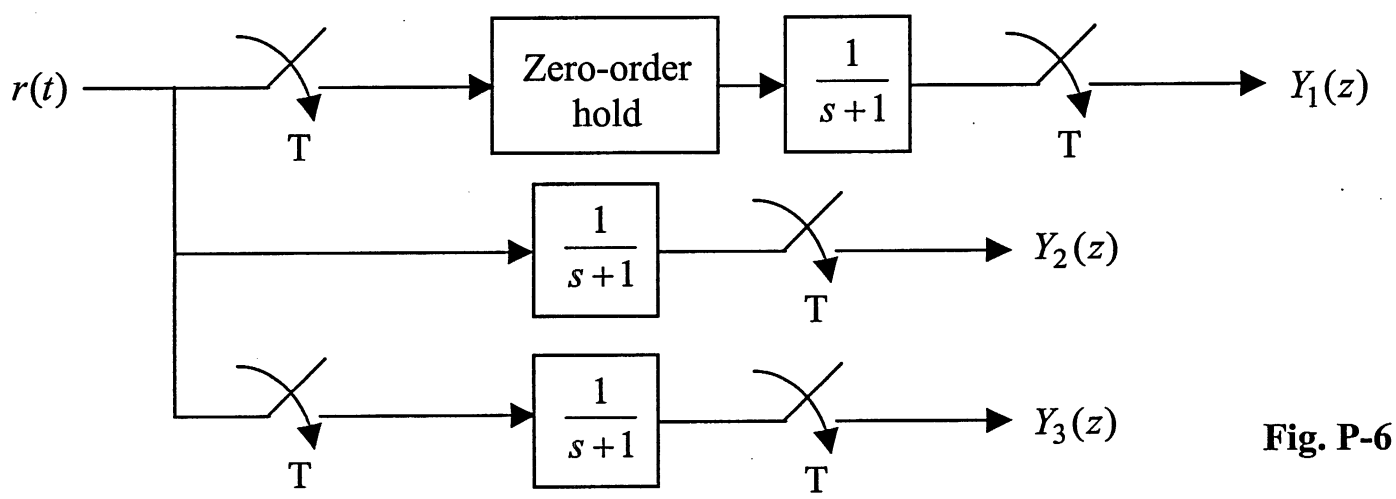

Fig. P-6

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