* 請依題号順序作答；

1. A physiological system is described by

$$\frac{d^2c(t)}{dt^2} + 5\frac{dc(t)}{dt} + 6c(t) = r(t) \qquad (1)$$

where c(t) is the output and r(t) is the unit-step input. The initial conditions are given for $t = t_0$, $c(t_0)$ and $dc(t_0)/dt$.

(a) Represent the system as a signal-flow graph.

(b) Find a state equation for the system.

2. A SISO system has the transfer function

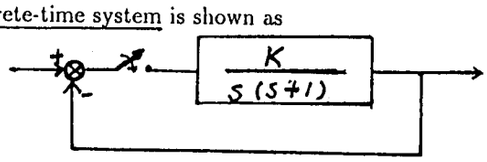
$$H(s) = \frac{(s+5)(s+a)}{(s+3)(s+2)(s+a)}$$

(a) Write the input-output differential equation for this system. Use a simulation diagram to select state variables.

(b) Repeat part (a) with canceling the common pole, zero pair.

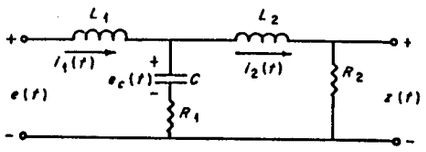
(c) Compare the controllability and observability of the two realizations obtained in (a) and (b).

3. A discrete-time system is shown as



Examine the stability of the system. (the range of K)

4. Consider the given electrical circuit where e(t) is the input (control) variable and the output z(t) is the voltage measured across the resistor R_2



(a) Let $x_1 = i_1$, $x_2 = i_2$, and $x_3 = e_c$ be the system state variables and express the system equations in state variable from. Assume that the measurement error in z(t) in negligible.

(b) Formulate (but do not solve) the equation from which the state transition matrix for the system can be determined. Set $t_0 = 0$ for this part.

5. The transfer function of a single feedback loop is

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

(a) Sketch the Nyquist plot.

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