1. Consider a second order difference equation

$$x(k+2)+0.3x(k+1)+0.2x(k)=u(k)$$

where

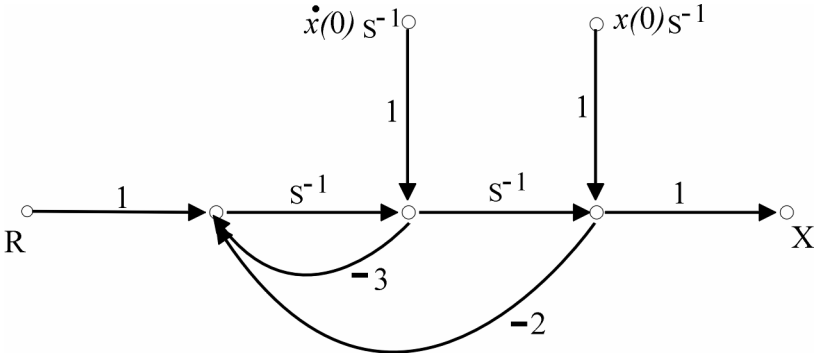
$$u(k)=1; \qquad for \quad k=0,1,2,...$$

The initial conditions are assumed to be zeros.

(1). Please find the transfer function. (5%)

(2). Please find the sequence *x(k)*, $k \geq 0$. (15%)

2. For the following state diagram of a system T,




(1). Please write out the state equation of the system T. (10%)

(2). If the input R=*0*, T becomes a homogeneous system. Please indicate whether this homogeneous system is stable or not, and explain the reasons. (10%)

3. For a magnetic ball suspension system,

$$M\frac{d^2y}{dt^2}=Mg-\frac{ci^2}{y}$$

$$v=Ri+L\frac{di}{dt}$$

where $R=1\Omega$, $M=0.1Kg$, $L=0.01H$, $g=32.2m/\sec^2$, $c=0.1Kgm^2/sce^2A^2$.

(1) Please Linearize the system at the equilibrium point with *y=0.5m*. (10%)

(2) Find the eigenvalues of this linearized system. (10%)

4. For a system with the characteristic equation

$$2s^4 + s^3 + 3s^2 + as + 10 = 0$$

(1). If $a=5$, indicate whether this system is stable or not and explain the reason. (10%)

(2). Find the stable region for the parameter $a$. (10%)

5. For a unit feedback system, if the open-loop transfer function $G(s)$,

$$G(s) = \frac{(1+0.5s)}{(1+s)(1+2s)}$$

(1). Find the damping ratio and natural frequency of the system. (5%)

(2). Let the input be $r(t)=2u(t)$, ($u(t)$ is a unit step function), what is the steady state error of this system. (5%)

(3). What kind of the controller can be used to eliminate the steady state error? Explain the reason. (10%)