SIDDHARTH GROUP OF INSTITUTIONS :: PUTTUR
Siddharth Nagar, Narayanavanam Road – 517583

QUESTION BANK (DESCRIPTIVE)

Subject with Code :DCS (16EE7502) **Course & Branch**: M.Tech - CS

Year & Sem: M.Tech I-Sem (CS) **Regulation:** R16

UNIT –I

1. With suitable diagram explain any method of digital to analog conversion. 10 M
2. a)What are the different types of sampling operations? Explain each of them. 5 M

   b)Derive the transfer function of zero order hold device 5 M
3. (a) What are the different types of sampling operations? Explain each of them. 5 M

   (b) What do you mean by the problem of aliasing? How to overcome these? 5 M
4. Explain the advantages and disadvantages of digital control systems.
5. a) With help of suitable circuit explain the principle of operation of sample and hold devises. Derive the transfer function of zero order hold circuit. 5 M

   b) State and explain the sampling theorem. 5 M
6. Define sampling? Mention the advantages, applications and limitations of the sampling in digital control Systems. 10 M
7. Consider the system shown in Fig.P1, below. Derive the difference equation describing the 10 M system dynamics when the input voltage is pieceswise constant. i.e.,

   $e(t) = e(kT)$ when $kT \leq t < (k + 1)$ and $T = 1$ Sec

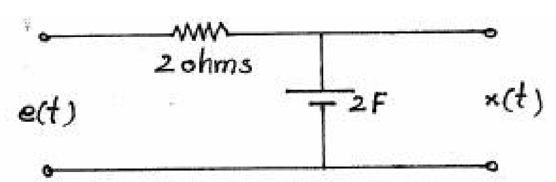


Fig.P1

   Also obtain the values of the output voltage at sampling instants of $e(kT) = kT$ for $k \geq 0$.

8. Explain clearly the configuration of basic digital control scheme with the help of neat block diagram. 10 M
9. Explain the advantages and disadvantages of digital control systems. 10 M
10. Explain the need of Zero Order Holder and derive its transfer function 10 M

UNIT –II

1. Find the inverse Z-Transform of the following:

i) $F(z)=\frac{(1-e^{-wT})z}{(z-1)(1-e^{-wT})}$ 'ω' is a positive constant; and T is the sampling period , 5 M

ii) $F(z)=\frac{3z^2+2z+1}{z^2-3z+2}$ 5 M

2. a) Find the z-transform of the following function x(k) 5 M

$$x(k)=\sum_{h=0}^{k} a^k$$, where 'a' is a constant.

b) Find the inverse z-transform of the following functions: 5 M

i)) $X(z)=\frac{z^{-1}(1-z^{-2})}{(1+z^{-2})^2}$ and ii) $X(z)=\frac{2z-0.4}{z^2+z+2}$

3. Find the z-transforms of the following: 10 M

(i) $x(k) = 9k(2^{k-1}) - 2^k + 3,$ k=0, l, 2, … …, assume x(k) =0 for k<0.

4. State and prove the following properties/theorems of z-transforms. 10 M

i) Shifting theorem

ii) Complex translation theorem

iii) Complex differentiation and Partial differentiation theorem.

5. (a) Obtain the solution of the following difference equation in terms of x(0) and x(1):

x(k+2)+(**a**+**b**)x(k+1) +**ab**x(k) = 0

where **a** and **b** are constants and k= 0, 1, 2, ….. 5 M

(b) Find the z-transforms of the following:

(i) $x(k) = 9k(2^{k-1}) - 2^k + 3,$ k=0, l, 2, … …, assume x(k) =0 for k<0.

6.a) Prove Initial Value and Final Value theorems with an example in digital control Systems. 5 M

b) Obtain the Inverse z-transform for the following using partial fraction method. 3 M

$$X(z) = \frac{5}{(z-2)(z-4)}$$

c) State the limitations of Z-transform method. 2 M

7.a) Obtain the z-transform for the following (i) f (t)= sin wt. (ii) unit-step function **us (t)** which is defined as us (t) = 1 t > 0 ; us (t) = 0 t < 0 5 M

b) Solve the following difference equation using z-transform method Where x (0) = 0,x (1) = 1.

X(k+2)-1.5x(k+1)+x(k)=2u(k) 5 M

8. (a) Find the Z-transform of the following:

(i) f(t) = t2 , (ii) f(t) =e-αt sin ωt 5 M

(b) Find the inverse Z-Transform of the following 5 M

i) F(z)= $\frac{(Z-4)}{(Z-1)(Z-2)^2}$ ii) F(z)= $\frac{3Z^2+2Z+1}{Z^2-3z+2}$

9. (a) Obtain the solution of the following difference equation in terms of x(0) and x(1):

x(k+2)+(**a**+**b**)x(k+1) +**ab**x(k) = 0

where **a** and **b** are constants and k= 0, 1, 2, ….. 5 M

(b) Find the z-transforms of the following:

x(k) = 9k(2^{k-1}) – 2^k + 3, k=0, l, 2, … …, assume x(k) =0 for k<0. 5 M

10. Find the Z-transform of the following 10 M

i) F(s) = $\frac{a^2}{s^2(s+a)^2}$ (ii) f(t) = e^{-at} sin ωt.

UNIT –III

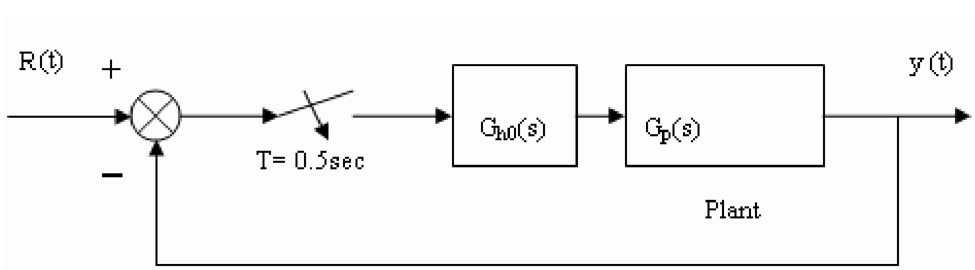
1. For positive values of the gain, sketch the root locus for unity feedback sampled data system having the open loop transfer function: 10 M

$$G(Z) = \frac{K(Z+0.1)^2}{(Z-1)(Z-0.9)(Z-0.1)}$$

For what value of the gain does the system become unstable?

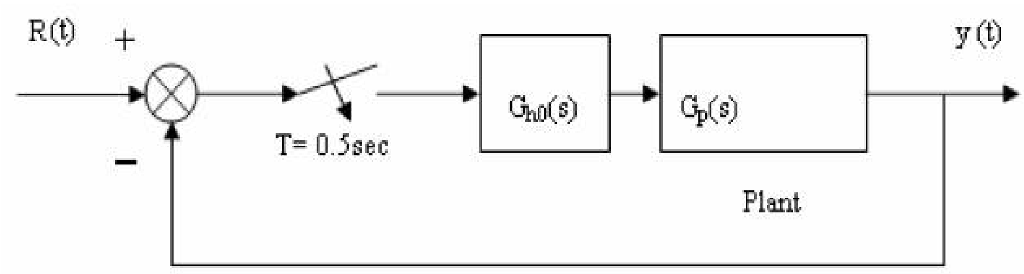
2. The block diagram of a digital control system is shown in Figure 10 M

Where Gp(s) = $\frac{K(s+1)}{s(s+2)}$



3. The block diagram of a digital control system is shown in Figure 10 M

Where Gp(s) = $\frac{K(s+5)}{s^2}$



Determine the range of K for the system to be asymptotically stable.

4. The open loop pulse transfer function of an uncompensated digital control system is 10 M

$$G_{ho}G_p(Z) = \frac{0.0453(Z+0.904)}{(Z-0.905)(Z-0.819)}$$ The sampling period T is equal to 0.1 sec.

Find the time response and steady state error of the system to a unit step input

5. a) State and explain the Liapunov stability theorems for linear digital control systems. 5 M

   b) A digital control system is described by the state equation 5 M

$$X(k+1)= \begin{bmatrix} 0.5 & 1 \\ -1 & -1 \end{bmatrix} X(k) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} U(k)$$

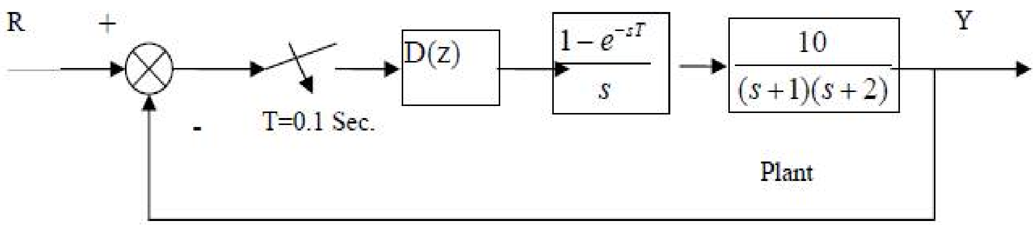
Find the Liapunov function and determine its stability with u(k)=0.

6.a) Examine the stability of the following equation using Jury-Stability test. Where x (k) is input and y (k) is output.

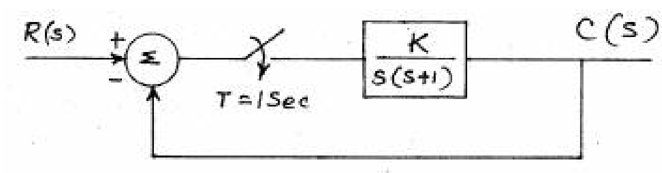
y(k)-0.4y(k-1)-0.61y(k-2)+0.87y(k-3)-0.22y(k-4)=x(k) 5 M

b) State the procedure for design of lead compensator using Root-Locus approach 5 M

7. A block diagram of a digital control system is shown below. Design a PID controller D(z), to eliminate the steady-state error due to a step input and simultaneously realizing a good transient response, and the ramp-error constant K_v should equal 5. 10 M



8.(a) Consider the digital system shown in Fig below 5 M



using Jury's stability test, find the range of values of K for which the system is stable.

(b) The pulse transfer function of digital control systems is given by 5 M

$$X(z) = \frac{5Z}{Z^2+3Z+2}$$

Obtain a state space representation for the system.

9. Describe the pulse transfer function. Derive the pulse transfer function of digital PID controller. 10 M

10. Determine the pulse transfer function of two cascaded systems, each described by the difference equation: y(k) = 0.5y(k-1)+r(k) 10 M

UNIT –IV

1.Find the state space representation of the following system: 10 M

$y(k + 2) – 3y(k + 1) + 2y(k) = 4^k$ and $y(0) = 0$; $y(1) = 1$.

Find the complete solution of the above system.

2. The pulse transfer function of digital control systems is given by 10 M

$$G(z)= \frac{5Z}{z^2+2z+2}$$

Obtain a state space representation for the system and draw the state diagram. Also obtain the state transition matrix.

3. For the following equation

$$Y(Z)/U(Z) = (Z+2)/(Z^2+1.2Z+0.2)$$

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Write Controllable Canonical, Observable Canonical and Diagonal Canonical form 10 M

4. Determine discrete state variable representations for the transfer functions. 10 M

   i) $G(z)=\frac{2+Z^{-1}}{1+Z^{-1}}$ ii) $G(z)=\frac{5z}{Z^2+2z+2}$

5. Consider the following 10 M

   $X(k+1)=\begin{bmatrix}0 & 1\\-2 & -3\end{bmatrix}X(k)+\begin{bmatrix}0\\1\end{bmatrix}(\ \ 1)^k$ $X(0)=\begin{bmatrix}1\\1\end{bmatrix}$

   y(k) = x1(k). Find the y(k) for k≥1.

6. Explain the design procedure of digital PID controller. 10 M

7. Obtain the Pulse Transfer function of the following 10 M

   $G(s) = \frac{1-e^{-Ts}}{s}\frac{1}{s(s+2)}$

8. Explain design and derive the Pulse Transfer function of the Digital PD Controller. 10 M

9. For the following System 10 M

   $P(Z)= Z^3-1.3Z^2-0.08Z+0.24=0$

   using Bilinear Transformation find the stability of the system.

10. (a) Explain the design procedure of digital control through bilinear transformation method. 5M

    (b)Explain a method based on state space to find the response between two consecutive sampling instants. 5M

UNIT –V

1. Derive the necessary condition for digital control system 10M

   X(k+1) = G X(k) + Hu(k)

   Y(k)=C X(k) to be output controllable and observable

2.a) Explain the concept of controllability and observability of discrete time control system. 3M

b) Derive the necessary condition for the digital control system 4M

X(k + 1) = AX(k) + Bu(k) and y(k) = CX (k) to be observable

c) Examine whether the discrete data system 3M

$X(k+1)= \begin{bmatrix} 0 & 1 \\ -2 & -2 \end{bmatrix} X(k) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} U(k)$ and $Y(k) = \begin{bmatrix} 1 & 0 \end{bmatrix} X(k)$ is

i) State controllable (ii) Output controllable and (iii) Observable

3.a) With a neat schematic diagram, explain the working of a reduced order observer. 5M

b) Consider the digital process with the state equations described by 5M

$X(k+1)= \begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix} X(k) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U(k)$ and $Y(k) = \begin{bmatrix} 2 & 0 \end{bmatrix} X(k)$ is

Design a full order observer which will observe the states x1(k) and x2(k) from the output C(k), having dead beat response.

4. Consider the single input digital control system 10M

$X(k+1)= \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X(k) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U(k)$

Determine, the state feed back matrix K such that the state feed back u(k) =-KX(k), places the closed loop system poles at 0.5 ±j0.5.

5. A digital process is described by the state equation 10M

$X(k+1)= \begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix} X(k) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U(k)$ and $Y(k) = \begin{bmatrix} 2 & 0 \end{bmatrix} X(k)$ is

Design the first-order observer so as to have a dead beat response.

6.a) With neat block diagram explain the full order observer. 5M

b) Consider the digital process with the state equations described by 5M

$X(k+1)= \begin{bmatrix} 0 & 0.0952 \\ -1 & 0.905 \end{bmatrix} X(k) + \begin{bmatrix} 0.00484 \\ 0.0952 \end{bmatrix} U(k)$ and $Y(k) = \begin{bmatrix} 1 & 0 \end{bmatrix} X(k)$ is

Design the first-order observer so as to have a dead beat response.

7. Consider the system defined by 10M

$X(k+1)= \begin{bmatrix} i & j \\ k & l \end{bmatrix} X(k) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} U(k)$ and $Y(k) = \begin{bmatrix} 0 & 1 \end{bmatrix} X(k)$ is

Determine the conditions on i, j, k and l for complete state controllability and complete observability.

8. (a) Derive the necessary condition for the digital control system 5M

$X(k + 1) = AX(k) + Bu(k)$

$C(k) = DX(k)$ to be controllable.

(b) Investigate the controllability and observability of the digital system 5M

$X(k+1)= \begin{bmatrix} -1 & 1 \\ 0 & -1 \end{bmatrix} X(k) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U(k)$ and $Y(k) = \begin{bmatrix} 1 & 1 \end{bmatrix} X(k)$ is

9. (a) Explain the pole-placement technique for design of digital controller. 5M

(b) Consider the single input digital control system 5M

$X(k+1) = AX(k) + Bu(k)$

$A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

Determine, the state feed back matrix K such that the state feed back $u(k) = -KX(k)$, places the closed loop system poles at $0.3 \pm j0.3$.

10. (a) With a neat schematic diagram, explain the design reduced order observer. 5M

(b) Consider the digital process with the state equations described by 5M

$X(k+1) = AX(k) + Bu(k)$

$y(k) = C\,X(k)$

$A = \begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ $C = \begin{bmatrix} 2 & 0 \end{bmatrix}$

Design a full order observer which will observe the states x1(k) and x2(k) from the output c(k), having dead beat response.

Prepared by: **N.Ramesh Raju**.