Academic Year :2018-2019
Department :EEE
Year/Semester :IV YEAR– II SEMESTER
Subject : **DIGITAL CONTROL SYSTEMS**

UNIT-1

1. **A)** What are the advantages of sampling process in control systems **[4M]**
   B) Give any one typical example of digital control system and explain its operation **[6M]**

2. **A)** What are the advantages and disadvantages of digital control system **[4M]**
   B) Explain about frequency domain characteristics of zero order hold **[6M]**

3. **A)** Write suitable block diagram and explain sample and hold circuit **[4M]**
   B) What are the different types of sampling operations **[6M]**

4. **A)** State and explain the sampling theorem for data reconstruction **[4M]**
   B) Explain the principle of operation of Zero order hold **[6M]**

5. **A)** Define the following fundamentals parameters of sample and hold circuit a) Acquisition time b) Aperture time c) Droop rate **[4M]**
   B) What are the advantages of sampling process in control system. Give the mathematical description of ideal sampling process **[6M]**

UNIT-2

1. **A)** What is the property of linearity of Z-transform **[4M]**
   B) Define Z transform. Calculate Z transform of the system having transfer function F(s) subject to step input sampled at 3Hz. $F(s)=\frac{1}{(1+2s)}$ **[6M]**

2. **A)** What are the limitations of Z transform **[4M]**
   B) Solve the differential equation using Z transform method $x(k+2)+5x(k+1)+6x(k)=0$ where $x(0)=0$ and $x(1)=1$ **[6M]**

3. **A)** State and explain shifting theorem of Z transform **[4M]**
   B) Obtain Z transform of $F(s)=\frac{s+}{s^2(s^2+2s+3)}$ **[6M]**

4. **A)** Obtain inverse Z transform of $F(Z)=\frac{z}{(Z^2+0.3Z+0.02)}$ **[4M]**

B) Solve for y(k) the equation is given by $y(k) = r(k) - r(k-1) - y(k-1)$, $k \geq 0$ and $r(k) = 1$; when k is even and $r(k) = 0$; when k is odd $y(-1) = r(-1) = 0$ **[6M]**

5. **A)** State initial and final value theorems of Z transform **[4M]**

B) Obtain inverse Z transform of the following in closed form $F(Z) = \frac{(3Z^2+2Z+1)}{(Z^2-3Z+2)}$ **[6M]**

UNIT-3

1. **A)** What are the different ways of state space representation **[4M]**

B) For a homogenous system given by $x(k+1) = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} x(k)$ obtain the state transition matrix $\phi(k)$ **[6M]**

2. **A)** Write the discrete time state equation of a pulse transfer function **[4M]**

B) Find the state model for following difference equation and also find its state transition matrix $y(k+2) + 3y(k+1) + 2y(k) = 2u(k+1) + u(k)$ assume initial conditions are zero **[6M]**

3. **A)** Explain the concepts of controllability and Observability **[4M]**

B) Explain the computation of state transition matrix **[6M]**

4. **A)** Write about Jordan canonical form **[4M]**

B) A discrete time system is described by differential equation as $y(k+2) + 3y(k+1) + 4y(k) = u(k)$ where $y(0) = 1$ and $y(1) = 1$ $T = 0.8\text{sec}$ describe the state model in canonical form **[6M]**

5. **A)** Write about observable canonical form **[4M]**

B) Consider discrete control system represented by transfer function G(Z)= $\frac{Z^{-1}(1+Z^{-1})}{(1+0.5Z^{-1})(1-0.5Z^{-1})}$ **[6M]**

UNIT-4

1. **A)** Write about mapping of left half s plane into Z plane **[4M]**

B) Explain about the relation between location of closed loop poles in the z-plane and system stability? **[6M]**

2. **A)** Determine the stability of the characteristic equations by using Jury's stability tests $5Z^2 - 2Z + 2 = 0$. **[4M]**

B) Construct jury stability test for the following characteristic equation $P(Z) = a_0Z^4 + a_1Z^3 + a_2Z^2 + a_3Z + a_4$ where $a_0 > 0$ write the stability conditions **[6M]**

3. **A)** Using jury stability test determine the stability of following discrete time systems $Z^3 + 3.3Z^2 + 4Z + 0.8 = 0$ **[4M]**

B) How do you map constant damping loci from s plane to Z plane **[6M]**

4. **A)** Using jury stability test determine the stability of following discrete time systems $Z^3 - 1.1Z^2 - 0.1Z + 0.2 = 0$ **[4M]**

B) Discuss the stability analysis of discrete control system using modified Routh stability **[6M]**

5. **A)** What are the conclusion from the general mapping between s and Z plane by Z transform

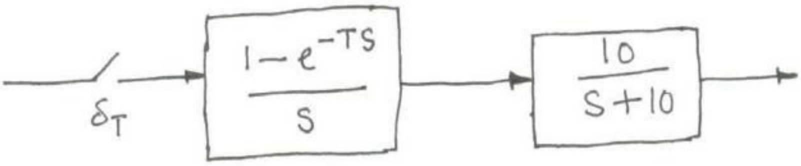
[4M]

B) Determine F(Z) where Z= e^{St} in terms of F(s) using this result explain the relationship between s plane and z plane **[6M]**

UNIT-5

1. **A)** What are the steady state specifications explain in brief **[4M]**
B) The closed loop transfer function for digital control system is given by $\frac{C(Z)}{R(Z)} = \frac{(Z+0.5)}{3(Z^2-Z+0.5)}$ find steady state errors and error constants due to step input **[6M]**

2. **A)** Write the design procedure of lead compensator in w plane **[4M]**
B) Consider transfer function shown below the sampling period T is assumed to be 0.1 sec obtain G(w)



[6M]

3. **A)** Write the design procedure of lag compensator in w plane **[4M]**
B) State the rules for the construction of root loci of a sampled data control system. **[6M]**

4. **A)** Write brief note on design procedure in w- plane **[4M]**
B) The open loop transfer function of a unity feedback digital control system is given as $K\frac{Z+0.5\ (Z+0.2)}{-Z+0.5)}$ Sketch the root loci of the system for 0 < K < ∞. **[6M]**

5. **A)** What do you understand by primary and complementary strips **[4M]**
B) Explain bounded - input, bounded - output stability of a system **[6M]**

UNIT-6

1. **A)** Explain the design steps for pole placement **[4M]**
B) Discuss the necessary condition for design of state feedback controller through pole placement **[6M]**

2. **A)** Write sufficient condition for arbitrary pole placement **[4M]**
B) Consider the system defined by $\dot{x} = Ax + Bu$ where $A = \begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ -1 & -5 & -6\end{bmatrix}$ $B = \begin{bmatrix}0\\0\\1\end{bmatrix}$ by using state feedback control u=-Kx it is desired to have closed loop poles at s=-2±j4 and s=-10 determine the state feedback gain matrix K **[6M]**

3. **A)** What do you mean by state feedback controller **[4M]**
B) A discrete time regulator system has equation $x(k+1) = \begin{bmatrix}2 & -1\\ -1 & 1\end{bmatrix}x(k) + \begin{bmatrix}4\\3\end{bmatrix}u(k)$ and $y(k) = \begin{bmatrix}1 & 1\end{bmatrix}x(k) + 7u(k)$ design a state feedback control algorithm with u(k)= -Kx(k) which places the closed loop characteristic root at ±j0.5 **[6M]**

4. A) State the necessary condition for the design of state feedback controller through pole placement **[4M]**

B) Consider a system defined by $\dot{x} = Ax + Bu$ and y=Cx where $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$ $B = \begin{bmatrix} 0 \\ 2 \end{bmatrix}$ $C = \begin{bmatrix} 1 & 0 \end{bmatrix}$ it is desired to have eigen values at -3.0 and -5.0 by using a state feedback control at u=-Kx determine necessary feedback gain matrix K and Control signal U. **[6M]**

5. **A)** What is ackermann's formula **[4M]**
B) Prove ackermann's formula for determination of state feedback gain **[6M]**