Code No: **R42021** **R10** **Set No. 1**

IV B.Tech II Semester Regular Examinations, April/May - 2014

DIGITAL CONTROL SYSTEMS

(Electrical and Electronics Engineering)

Time : 3 hours **Max. Marks: 75**

Answer any Five Questions

All Questions carry equal marks

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1 a) Explain about the shifting and scaling operator. [8]
b) Discuss briefly about the linear time invariant and causal systems. [7]

2 a) Write the mapping points between S-Plane and Z-plane. [7]
b) Find the z-transform of (i) unit step (ii) $f(t)=t\, e^{-at}$ [8]

3 a) Explain about the weighted resistor 3 bit D/A converter? [7]
b) Explain any examples of data control systems? [8]

4 a) What are the methods for computation of state transition matrix. Explain any one method? [7]
b) A discrete time system is described by the differential equation $y(k+2)+5y(k+1)+6y(k)=4U(k)$ assuming initial conditions are y(0) = 1, y(1) = 0, T = 1 sec. Find the state transition matrix. [8]

5 a) Explain the Duality between controllability and observability. [7]
b) Consider that a digital control system is described by the state equation. [8]
$x(k+1)=Ax(k)+Bu(k$
Where
$A=\begin{bmatrix} 1 & -2 & 0 \\ 3 & 2 & 1 \\ -1 & 1 & 4 \end{bmatrix}, B=\begin{bmatrix} 1 & 0 \\ -1 & 1 \\ 0 & 1 \end{bmatrix}$, Determine the controllability of the system.

6 a) Explain the following mapping between the S-Plane and the Z-Plane. [12]
(i) Primary strips and complementary Strips (ii) Constant frequency loci
(iii) Constant damping ratio loci
b) Explain the stability conditions of closed loop systems in the Z over in the S-plane. [3]

7 a) Write the transient response specifications? [7]
b) Explain the design procedure in the w-plane? [8]

8 a) Discuss the necessary conditions for design of state feedback controller through pole placement? [10]
b) Explain about the state observers? [5]

Code No: **R42021** **R10** **Set No. 2**

IV B.Tech II Semester Regular Examinations, April/May - 2014

DIGITAL CONTROL SYSTEMS

(Electrical and Electronics Engineering)

Time : 3 hours **Max. Marks: 75**

Answer any Five Questions

All Questions carry equal marks

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1 Explain in detail about the periodic and nonperiodic signals with a neat sketch? [15]

2 a) Solve the following difference equation [5]
$y(k+2)+3y(k+1)+2y(k)=0; y(-1)=-\frac{1}{2}, y(-2)=\frac{3}{4}$

b) Obtain the z transform of $f(t)=e^{-at}$ [5]

c) Find the inverse z-transform of F(Z) = $\frac{1}{Z(Z-0.2)}$ [5]

3 a) State and prove the sampling theorem? [7]

b) Derive transfer functions for the following data hold circuits. [8]
(i) Zero order hold circuit (ii) First order hold circuit

4 a) Write the controllable and diagonal canonical forms? [7]

b) Consider a discrete linear data control system, whose input-output relation is described by the difference equation $y(k+2)+2y(k+1)+y(k)=u(k)$ initial conditions are $x(0)=0\ and\ x(1)=1$. Test the state controllable and observable canonical forms? [8]

5 a) Explain the concepts of controllability and observability. [7]

b) Investigate the controllability and observability of the digital system. [8]
$x(k+1)=\begin{bmatrix}-1 & 1\\ 0 & -1\end{bmatrix}x(k)+\begin{bmatrix}0\\1\end{bmatrix}u(k)$ and $y(k)=\begin{bmatrix}1 & 1\end{bmatrix}x(k)$

6 a) List the difference between the Jury stability test and stability analysis using bilinear transformation coupled with routh stability criterion? [7]

b) Consider the discrete time unity feedback control system (T=1 sec) whose open loop pulse transfer function is given by [8]

$$G(z)=\frac{K(0.3679Z+0.2642)}{(Z-0.3679)(Z-1)}$$

Determine the range of K for stability by use of the Jury stability test.

7 a) Discuss about the response of a linear time invariant discrete time system to a sinusoidal input? [7]

b) Consider the system defined by $x(kT)=u(kT)+ax\big((k-1)T\big),\ 0<a<1$ [8]
Where u(kT) is the input and x(kT) the output. Obtain the steady state output x(kT), when the input u(kT) is the sampled sinusoidal.

8 Derive the necessary and sufficient conditions for design of state feedback controller through pole placement? [15]

Code No: **R42021** **R10** **Set No. 3**

IV B.Tech II Semester Regular Examinations, April/May - 2014

DIGITAL CONTROL SYSTEMS

(Electrical and Electronics Engineering)

Time : 3 hours **Max. Marks: 75**

Answer any Five Questions
All Questions carry equal marks
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1 Discuss in detail about the continuous and discrete time signals with neat sketches? [15]

2 a) Obtain the Z-transform of the following [8]
(i) $x(t) = \frac{1}{a}(1 - e^{-at})$ (ii) $x(t) = t^2 e^{-at}$ where 'a' is constant

b) Consider $x(z)$ where $x(z) = \frac{2z^3+z}{(z-2)^2(z-1)}$ obtain the inverse Z-transform of $x(z)$. [7]

3 a) What are the various types of analog to digital converters? Explain successive approximation type analog to digital converters with neat schematic diagram? [8]
b) Describe the sample and hold operations? [7]

4 a) Write the state transition matrix and its properties? [7]
b) Obtain the state transition matrix of the following discrete time system [8]
$x(k+1) = Gx(k) + Hu(k)$
$y(k) = Cx(k)$
Where
$G = \begin{bmatrix} 0 & 1 \\ -2 & -2 \end{bmatrix}, H = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, C = \begin{bmatrix} 1 & 0 \end{bmatrix}$

5 a) Explain the test for controllability and observability. [7]
b) Given the system [8]
x (k+1)=Ax (k)+Bu(k)
y(k)=c x(k)
Where $A = \begin{bmatrix} 0 & 1 \\ -1 & -3 \end{bmatrix}, B = \begin{bmatrix} 1 \\ 2 \end{bmatrix}, C = \begin{bmatrix} 1 & 1 \end{bmatrix}$
Determine the state controllability of the system.

6 a) State and explain the jury stability test. [8]
b) Using Jury's stability criterion find the range of K, for which the characteristic equation $z^3 + Kz^2 + 1.5Kz - (K+1) = 0$ is closed loop stable. [7]

7 a) Explain the relation between the bilinear transformation and the w plane? [7]
b) Discuss the review of phase lag, lead and lag-lead compensator? [8]

8 a) Explain the sufficient conditions for design of state feedback controller through pole placement? [7]
b) Derive the ackerman's formula? [8]

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IV B.Tech II Semester Regular Examinations, April/May - 2014

DIGITAL CONTROL SYSTEMS

(Electrical and Electronics Engineering)

Time : 3 hours **Max. Marks: 75**

Answer any Five Questions

All Questions carry equal marks

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1 a) Explain about the discrete time signals with a neat sketch? [8]

b) Describe about the nonperiodic signals with a neat sketch? [7]

2 a) State and prove the following Z-Transform theorems [7]

(i) Shifting theorem (left & right) (ii) Initial value theorem

(iii) Final value theorem

b) Find the Z-transform of the following [8]

(i) $f(t) = e^{-at}\sin\omega t$ (ii) $f(s) = \frac{4}{s^2(s+2)}$

3 a) What are the advantages of sampling process in control systems? [5]

b) Explain any two types of digital to analog converters with a neat circuit? [10]

4 a) What are the state space representation forms and explain them. [8]

b) Consider the following system. [7]

$$\frac{Y(z)}{U(Z)} = \frac{Z+1}{Z^2+1.3Z+0.4}$$

Obtain the state space representation forms of controllable and observable canonical forms.

5 a) Derive the necessary condition for the digital control system [7]

X(K+1) = AX(K)+Bu(K)

C(k) = DX(K) to be observable.

b) Examine whether the discrete data system [8]

$$x(k+1) = \begin{bmatrix} 0 & 1 \\ -2 & -2 \end{bmatrix} x(k) + \begin{bmatrix} 1 \\ -1 \end{bmatrix} u(k)$$

$$y(k) = \begin{bmatrix} 1 & 0 \end{bmatrix} x(k)$$

Is (i) state controllable (ii) output controllable and (iii) observable.

6 a) Discuss the stability analysis of discrete control system using (i) Routh stability criteria (ii) Bilinear transformation [7]

b) Using Jury's stability criterion, determine the stability of the following discrete time systems [8]

(i) $z^3 + 3.3z^2 + 4z + 0.8 = 0$ (ii) $z^3 - 1.1z^2 - 0.1z + 0.2 = 0$

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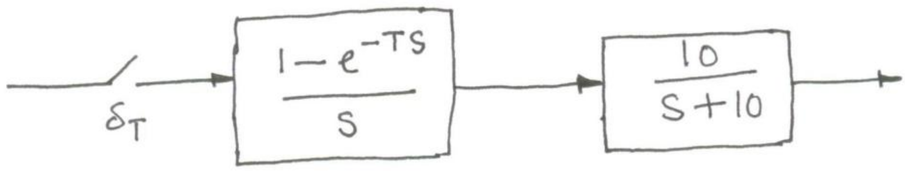
7 a) Explain about the digital PID controllers with neat sketch? [10]

b) Consider the transfer function system shown. The sampling period T is assumed to be 0.1 sec. obtain G(w).



[5]

8 a) Explain the concept of state feedback controllers? [5]

b) Consider the system $x(k+1) = Gx(k) + Hu(k)$

$$G = \begin{bmatrix} 0 & 1 \\ -0.16 & -1 \end{bmatrix}, H = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

Determine a suitable state feedback gain matrix 'k' such that the system will have the closed loop poles at $z = 0.5 \pm j0.5$

[10]