Code No: RR411005 **RR** **Set No. 2**

IV B.Tech I Semester Examinations,November 2010
DIGITAL CONTROL SYSTEMS
Common to Electronics And Control Engineering, Electronics And Instrumentation Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Determine which of the following digital transfer functions are physically realizable
   (a) $G(z) = \frac{10\left[1+0.2z^{-1}+0.5z^{-2}\right]}{z^{-1}+z^{-2}+1.5z^{-3}}$
   (b) $G(z) = \frac{\left[1.5z^{-1}-z^{-2}\right]}{\left[1+z^{-1}+2z^{-2}\right]}$
   (c) $G(z) = \frac{[z+1.5]}{[z^3+z^2+z+1]}$
   (d) $\mathrm{G(Z)} = 0.1\mathrm{z} + 1 + \mathrm{z}^{-1}$ [4× 4]

2. Obtain the control law for the system $X(k+1) = \begin{bmatrix} 0.8 & 1 \\ 0 & 0.5 \end{bmatrix} X(k) + \begin{bmatrix} 1 \\ 0.5 \end{bmatrix} u(k)$ to ensure that the closed lop poles lie within a circle of radius $1/\alpha; (\alpha = 5,)$ in addition to minimization of the performance index $J = \sum\limits_{k=0}^{\infty} [x_1^2 + u^2]$ for the system. [16]

3. (a) Explain the steady state Kalman filters.
   (b) Design a first-order observer for the system
   X(k+1) = AX(k)+Bu(k) and Y(k) = CX(k)
   where $A = \begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix}$; $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ C= [2 0].
   Design observer for deadbeat response. [8+8]

4. Find the state variable models for the following system represented by the difference equation
   (a) y(k+3)+5y(k+2)+7y(k+1)+3y(k)=0
   (b) y(k+2)+3y(k+1)+2y(k)=5r(k+1)+3r(k) [8+8]

5. For the state equation

$$\dot{X} = AX \quad A = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix}$$

Find the initial condition vector X(0) which will excite only the mode corresponding to the eigen value with the most negative real part. [16]

6. Discuss Liapunov stability analysis in detail, explaining the terms Positive Definiteness, Negative Definiteness, Positive Semi definiteness, Negative Semi definiteness, Indefiniteness of scalar functions and Liaponov functions. [16]

7. Obtain the output expression between sampling instants for the following system configuration.

   T = 1Sec.

   Given G(s) = $\frac{1}{s+2}$given the figure 7. [16]

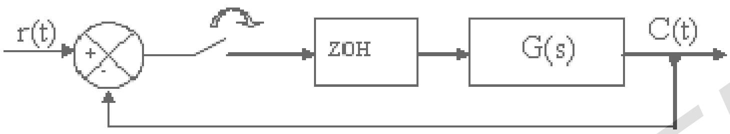

Figure 7

8. Consider the following continuous control system
   $\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} -1 & 1 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

   y(t) = x_1(t)

   The control signal u(k) is now generated by processing the signal u(t) through a sampler and zero order hold. Study the controllability and observability properties of the system under this condition. Determine the values of the sampling period for which the discretised system may exhibit hidden oscillation. [16]

⋆⋆⋆⋆⋆

Code No: RR411005 **RR** **Set No. 4**

IV B.Tech I Semester Examinations,November 2010
DIGITAL CONTROL SYSTEMS
Common to Electronics And Control Engineering, Electronics And Instrumentation Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
⋆ ⋆ ⋆ ⋆ ⋆

1. Determine which of the following digital transfer functions are physically realizable
   (a) $G(z) = \frac{10\left[1+0.2z^{-1}+0.5z^{-2}\right]}{z^{-1}+z^{-2}+1.5z^{-3}}$
   (b) $G(z) = \frac{\left[1.5z^{-1}-z^{-2}\right]}{\left[1+z^{-1}+2z^{-2}\right]}$
   (c) $G(z) = \frac{[z+1.5]}{[z^3+z^2+z+1]}$
   (d) $\mathrm{G(Z)} = 0.1\mathrm{z} + 1 + \mathrm{z}^{-1}$ [4× 4]

2. Find the state variable models for the following system represented by the difference equation
   (a) y(k+3)+5y(k+2)+7y(k+1)+3y(k)=0
   (b) y(k+2)+3y(k+1)+2y(k)=5r(k+1)+3r(k) [8+8]

3. Obtain the control law for the system $X(k+1) = \begin{bmatrix} 0.8 & 1 \\ 0 & 0.5 \end{bmatrix} X(k) + \begin{bmatrix} 1 \\ 0.5 \end{bmatrix} u(k)$ to ensure that the closed lop poles lie within a circle of radius $1/\alpha; (\alpha = 5,)$ in addition to minimization of the performance index $J = \sum_{k=0}^{\infty} [x_1^2 + u^2]$ for the system. [16]

4. Obtain the output expression between sampling instants for the following system configuration.
   T = 1Sec.
   Given G(s) = $\frac{1}{s+2}$given the figure 7. [16]

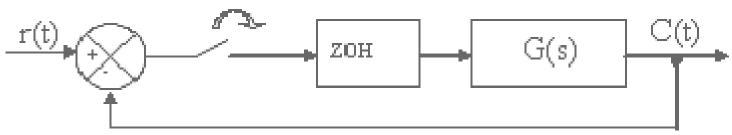

Figure 7

5. (a) Explain the steady state Kalman filters.
   (b) Design a first-order observer for the system
   X(k+1) = AX(k)+Bu(k) and Y(k) = CX(k)

where $A = \begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix}; B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ C= [2 0].

Design observer for deadbeat response. [8+8]

6. Discuss Liapunov stability analysis in detail, explaining the terms Positive Definiteness, Negative Definiteness, Positive Semi definiteness, Negative Semi definiteness, Indefiniteness of scalar functions and Liaponov functions. [16]

7. For the state equation

   $$\dot{X} = AX \; A = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix}$$

   Find the initial condition vector X(0) which will excite only the mode corresponding to the eigen value with the most negative real part. [16]

8. Consider the following continuous control system

   $$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} -1 & 1 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

   y(t) = x_1(t)

   The control signal u(k) is now generated by processing the signal u(t) through a sampler and zero order hold. Study the controllability and observability properties of the system under this condition. Determine the values of the sampling period for which the discretised system may exhibit hidden oscillation. [16]

⋆⋆⋆⋆⋆

Code No: RR411005 **RR** **Set No. 1**

IV B.Tech I Semester Examinations,November 2010
DIGITAL CONTROL SYSTEMS
Common to Electronics And Control Engineering, Electronics And Instrumentation Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Discuss Liapunov stability analysis in detail, explaining the terms Positive Definiteness, Negative Definiteness, Positive Semi definiteness, Negative Semi definiteness, Indefiniteness of scalar functions and Liaponov functions. [16]

2. Obtain the output expression between sampling instants for the following system configuration.

   T = 1Sec.

   Given G(s) = $\frac{1}{s+2}$given the figure 7. [16]

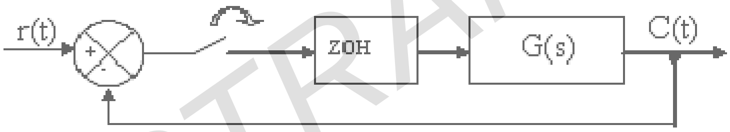

Figure 7

3. Determine which of the following digital transfer functions are physically realizable

   (a) $G(z) = \frac{10\left[1+0.2z^{-1}+0.5z^{-2}\right]}{z^{-1}+z^{-2}+1.5z^{-3}}$
   (b) $G(z) = \frac{\left[1.5z^{-1}-z^{-2}\right]}{\left[1+z^{-1}+2z^{-2}\right]}$
   (c) $G(z) = \frac{[z+1.5]}{[z^3+z^2+z+1]}$
   (d) G(Z) = $0.1z + 1 + z^{-1}$ [4× 4]

4. For the state equation

   $$\dot{X} = AX \; A = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix}$$

   Find the initial condition vector X(0) which will excite only the mode corresponding to the eigen value with the most negative real part. [16]

5. (a) Explain the steady state Kalman filters.

   (b) Design a first-order observer for the system
   X(k+1) = AX(k)+Bu(k) and Y(k) = CX(k)
   where $A = \begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix}$; $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ C= [2 0].
   Design observer for deadbeat response. [8+8]

6. Find the state variable models for the following system represented by the difference equation

   (a) y(k+3)+5y(k+2)+7y(k+1)+3y(k)=0

   (b) y(k+2)+3y(k+1)+2y(k)=5r(k+1)+3r(k) [8+8]

7. Consider the following continuous control system

   $$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} -1 & 1 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

   y(t) = x_1(t)

   The control signal u(k) is now generated by processing the signal u(t) through a sampler and zero order hold. Study the controllability and observability properties of the system under this condition. Determine the values of the sampling period for which the discretised system may exhibit hidden oscillation. [16]

8. Obtain the control law for the system $X(k+1) = \begin{bmatrix} 0.8 & 1 \\ 0 & 0.5 \end{bmatrix} X(k) + \begin{bmatrix} 1 \\ 0.5 \end{bmatrix} u(k)$ to ensure that the closed lop poles lie within a circle of radius $1/\alpha; (\alpha = 5,)$ in addition to minimization of the performance index $J = \sum_{k=0}^{\infty} [x_1^2 + u^2]$ for the system. [16]

⋆⋆⋆⋆⋆

Code No: RR411005 **RR** **Set No. 3**

IV B.Tech I Semester Examinations,November 2010
DIGITAL CONTROL SYSTEMS
Common to Electronics And Control Engineering, Electronics And Instrumentation Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. For the state equation

$$\dot{X} = AX \quad A = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix}$$

Find the initial condition vector X(0) which will excite only the mode corresponding to the eigen value with the most negative real part. [16]

2. Obtain the control law for the system $X(k+1) = \begin{bmatrix} 0.8 & 1 \\ 0 & 0.5 \end{bmatrix} X(k) + \begin{bmatrix} 1 \\ 0.5 \end{bmatrix} u(k)$ to ensure that the closed lop poles lie within a circle of radius $1/\alpha; (\alpha = 5,)$ in addition to minimization of the performance index $J = \sum_{k=0}^{\infty} [x_1^2 + u^2]$ for the system. [16]

3. Find the state variable models for the following system represented by the difference equation
   (a) y(k+3)+5y(k+2)+7y(k+1)+3y(k)=0
   (b) y(k+2)+3y(k+1)+2y(k)=5r(k+1)+3r(k) [8+8]

4. (a) Explain the steady state Kalman filters.
   (b) Design a first-order observer for the system
   X(k+1) = AX(k)+Bu(k) and Y(k) = CX(k)
   where A = $\begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix}$; B = $\begin{bmatrix} 0 \\ 1 \end{bmatrix}$ C= [2 0].
   Design observer for deadbeat response. [8+8]

5. Discuss Liapunov stability analysis in detail, explaining the terms Positive Definiteness, Negative Definiteness, Positive Semi definiteness, Negative Semi definiteness, Indefiniteness of scalar functions and Liaponov functions. [16]

6. Determine which of the following digital transfer functions are physically realizable
   (a) $G(z) = \frac{10\left[1+0.2z^{-1}+0.5z^{-2}\right]}{z^{-1}+z^{-2}+1.5z^{-3}}$
   (b) $G(z) = \frac{\left[1.5z^{-1}-z^{-2}\right]}{[1+z^{-1}+2z^{-2}]}$

(c) $G(z) = \frac{[z+1.5]}{[z^3+z^2+z+1]}$

(d) $G(Z) = 0.1z + 1 + z^{-1}$ [4× 4]

7. Obtain the output expression between sampling instants for the following system configuration.

   T = 1Sec.

   Given $G(s) = \frac{1}{s+2}$ given the figure 7. [16]

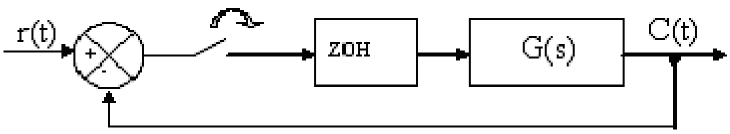

Figure 7

8. Consider the following continuous control system

   $$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} -1 & 1 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

   $y(t) = x_1(t)$

   The control signal u(k) is now generated by processing the signal u(t) through a sampler and zero order hold. Study the controllability and observability properties of the system under this condition. Determine the values of the sampling period for which the discretised system may exhibit hidden oscillation. [16]

⋆⋆⋆⋆⋆