Code No: R05322201 **R05** **Set No. 2**

III B.Tech II Semester Examinations,December 2010
DIGITAL AND OPTIMAL CONTROL SYSTEMS
Instrumentation And Control Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What are the major theoretical approaches for optimal control design
   (b) Explain the same in detail. [8+8]

2. Obtain the inverse z- transform of the following in the closed form:
   (a) $F_1(z) = \frac{0.368z^2+0.478z+0.154}{z^2(z-1)}$
   (b) $F_2(z) = \frac{2z^3+z}{(z-1)^2(z-1)}$
   (c) $F_3(z) = \frac{z+2}{z^2(z-2)}$. [6+5+5]

3. Consider the control system defined by
   x(k+1) = G x(k) + H u(k)
   y(k) = C x(k) + D
   and the pulse transfer function F(z) can be given as
   $F(z) = C(zI - G)^{-1} H + D$
   Prove that, if the system is completely state controllable and completely observable, then there is no pole-zero cancellation in the pulse transfer function F(z). [16]

4. Derive the necessary and sufficient condition for state observation for a system having following state and output equations.
   $X(k+1) = GX(k) + Hu(k)$
   $y(k) = CX(k)$
   Where G is a 'n×n' non singular matrix. [16]

5. (a) Determine the inverse of the matrix (zI-G), where

$$G = \begin{bmatrix} 0.1 & 0.1 & 0 \\ 0.3 & -0.1 & -0.2 \\ 0 & 0 & -0.3 \end{bmatrix}$$

   (b) Also obtain the state transition matrix. [8+8]

6. (a) Consider the system described by
   y(k) - 0.6 y(k-1) - 0.81 y(k-2) + 0.67 y(k-3) - 0.12 y(k-4) = x(k)
   where x(k) is the input and y(k) is the output of the system. Determine the stability of the system.
   (b) Consider the following characteristic equation
   $z^3 + 2.1 z^2 + 1.44 z + 0.32 = 0$
   Determine whether or not any of the roots of the characteristic equation lie outside the unit circle centered at the origin of the z - plane. [8+8]

7. With suitable diagram, explain the fixed end-point problem and derive the necessary conditions of variational calculus. [16]

8. Consider an nth order single input system $x(k+1) = Ax(k) + bu(k)$ and feed back control of $u(k) = -KX(k) + r(k)$ where 'r' is the reference input signal. Show that the zeros of the system are invariant under the state feed back. [16]

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Code No: R05322201 **R05** **Set No. 4**

III B.Tech II Semester Examinations,December 2010
DIGITAL AND OPTIMAL CONTROL SYSTEMS
Instrumentation And Control Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. Consider an nth order single input system $x(k+1) = Ax(k) + bu(k)$ and feed back control of $u(k) = -KX(k) + r(k)$ where 'r' is the reference input signal. Show that the zeros of the system are invariant under the state feed back. [16]

2. Derive the necessary and sufficient condition for state observation for a system having following state and output equations.
$X(k+1) = GX(k) + Hu(k)$
$y(k) = CX(k)$
Where G is a 'n×n' non singular matrix. [16]

3. With suitable diagram, explain the fixed end-point problem and derive the necessary conditions of variational calculus. [16]

4. (a) Determine the inverse of the matrix (zI-G), where

$$G = \begin{bmatrix} 0.1 & 0.1 & 0 \\ 0.3 & -0.1 & -0.2 \\ 0 & 0 & -0.3 \end{bmatrix}$$

   (b) Also obtain the state transition matrix. [8+8]

5. Obtain the inverse z- transform of the following in the closed form:

   (a) $F_1(z) = \frac{0.368z^2+0.478z+0.154}{z^2(z-1)}$

   (b) $F_2(z) = \frac{2z^3+z}{(z-1)^2(z-1)}$

   (c) $F_3(z) = \frac{z+2}{z^2(z-2)}$. [6+5+5]

6. (a) What are the major theoretical approaches for optimal control design

   (b) Explain the same in detail. [8+8]

7. (a) Consider the system described by
y(k) - 0.6 y(k-1) - 0.81 y(k-2) + 0.67 y(k-3) - 0.12 y(k-4) = x(k)
where x(k) is the input and y(k) is the output of the system. Determine the stability of the system.

   (b) Consider the following characteristic equation
$z^3 + 2.1\ z^2 + 1.44\ z + 0.32 = 0$
Determine whether or not any of the roots of the characteristic equation lie outside the unit circle centered at the origin of the z - plane. [8+8]

8. Consider the control system defined by
   x(k+1) = G x(k) + H u(k)
   y(k) = C x(k) + D
   and the pulse transfer function F(z) can be given as
   $F(z) = C(zI - G)^{-1} H + D$
   Prove that, if the system is completely state controllable and completely observable, then there is no pole-zero cancellation in the pulse transfer function F(z). [16]

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Code No: R05322201 **R05** **Set No. 1**

III B.Tech II Semester Examinations,December 2010
DIGITAL AND OPTIMAL CONTROL SYSTEMS
Instrumentation And Control Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Consider the system described by
   y(k) - 0.6 y(k-1) - 0.81 y(k-2) + 0.67 y(k-3) - 0.12 y(k-4) = x(k)
   where x(k) is the input and y(k) is the output of the system. Determine the stability of the system.

   (b) Consider the following characteristic equation
   $z^3 + 2.1\, z^2 + 1.44\, z + 0.32 = 0$
   Determine whether or not any of the roots of the characteristic equation lie outside the unit circle centered at the origin of the z - plane. [8+8]

2. (a) Determine the inverse of the matrix (zI-G), where

$$G = \begin{bmatrix} 0.1 & 0.1 & 0 \\ 0.3 & -0.1 & -0.2 \\ 0 & 0 & -0.3 \end{bmatrix}$$

   (b) Also obtain the state transition matrix. [8+8]

3. Obtain the inverse z- transform of the following in the closed form:

   (a) $F_1(z) = \frac{0.368z^2+0.478z+0.154}{z^2(z-1)}$

   (b) $F_2(z) = \frac{2z^3+z}{(z-1)^2(z-1)}$

   (c) $F_3(z) = \frac{z+2}{z^2(z-2)}$. [6+5+5]

4. Derive the necessary and sufficient condition for state observation for a system having following state and output equations.
   $X(k+1) = GX(k) + Hu(k)$
   $y(k) = CX(k)$
   Where G is a 'n×n' non singular matrix. [16]

5. With suitable diagram, explain the fixed end-point problem and derive the necessary conditions of variational calculus. [16]

6. Consider an n^{th} order single input system $x(k+1) = Ax(k) + bu(k)$ and feed back control of $u(k) = -KX(k) + r(k)$ where 'r' is the reference input signal. Show that the zeros of the system are invariant under the state feed back. [16]

7. (a) What are the major theoretical approaches for optimal control design

   (b) Explain the same in detail. [8+8]

8. Consider the control system defined by
   x(k+1) = G x(k) + H u(k)
   y(k) = C x(k) + D
   and the pulse transfer function F(z) can be given as
   $F(z) = C(zI - G)^{-1} H + D$
   Prove that, if the system is completely state controllable and completely observable, then there is no pole-zero cancellation in the pulse transfer function F(z). [16]

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Code No: R05322201 **R05** **Set No. 3**

III B.Tech II Semester Examinations,December 2010
DIGITAL AND OPTIMAL CONTROL SYSTEMS
Instrumentation And Control Engineering

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Determine the inverse of the matrix (zI-G), where

$$G = \begin{bmatrix} 0.1 & 0.1 & 0 \\ 0.3 & -0.1 & -0.2 \\ 0 & 0 & -0.3 \end{bmatrix}$$

   (b) Also obtain the state transition matrix. [8+8]

2. Consider the control system defined by
   x(k+1) = G x(k) + H u(k)
   y(k) = C x(k) + D
   and the pulse transfer function F(z) can be given as
   $F(z) = C(zI - G)^{-1} H + D$
   Prove that, if the system is completely state controllable and completely observable, then there is no pole-zero cancellation in the pulse transfer function F(z). [16]

3. Derive the necessary and sufficient condition for state observation for a system having following state and output equations.
   $X(k+1) = GX(k) + Hu(k)$
   $y(k) = CX(k)$
   Where G is a 'n×n' non singular matrix. [16]

4. (a) Consider the system described by
   y(k) - 0.6 y(k-1) - 0.81 y(k-2) + 0.67 y(k-3) - 0.12 y(k-4) = x(k)
   where x(k) is the input and y(k) is the output of the system. Determine the stability of the system.

   (b) Consider the following characteristic equation
   $z^3 + 2.1 z^2 + 1.44 z + 0.32 = 0$
   Determine whether or not any of the roots of the characteristic equation lie outside the unit circle centered at the origin of the z - plane. [8+8]

5. (a) What are the major theoretical approaches for optimal control design
   (b) Explain the same in detail. [8+8]

6. With suitable diagram, explain the fixed end-point problem and derive the necessary conditions of variational calculus. [16]

7. Obtain the inverse z- transform of the following in the closed form:

   (a) $F_1(z) = \frac{0.368z^2+0.478z+0.154}{z^2(z-1)}$

(b) $F_2(z) = \frac{2z^3+z}{(z-1)^2(z-1)}$

(c) $F_3(z) = \frac{z+2}{z^2(z-2)}$. [6+5+5]

8. Consider an nth order single input system $x(k+1) = Ax(k) + bu(k)$ and feed back control of $u(k) = -KX(k) + r(k)$ where 'r' is the reference input signal. Show that the zeros of the system are invariant under the state feed back. [16]

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