R09

Code No: C5405

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.TECH I SEMESTER EXAMINATIONS APRIL/MAY-2012
DIGITAL CONTROL SYSTEMS
(POWER ELECTRONICS AND ELECTRIC DRIVES)

Time: 3hours **Max.Marks:60**

Answer any five questions
All questions carry equal marks
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1.a) Explain the complete block diagram of the Digital Control System.
b) Define sampling? Mention the advantages, applications and limitations of the sampling in digital control Systems.

2.a) Prove Initial Value and Final Value theorems with an example in digital control Systems.
b) Obtain the Inverse z-transform for the following using partial fraction method.

$$x(z) = 5/(z-2)(z-4)$$

c) State the limitations of Z-transform method.

3.a) Obtain the z-transform for the following
(i) f (t)= sin wt.
(ii) unit-step function $\mathbf{u_s}$ **(t)** which is defined as

$u_s(t) = 1 \quad t > 0; \qquad u_s(t) = 0 \quad t < 0$

b) Solve the following difference equation using z-transform method

$x(k+2) - 1.5x(k+1) + x(k) = 2\,u(k)$ Where x (0) = 0, x (1) = 1.

4.a) Examine the stability of the following equation using Jury-Stability test.

$$y(k) - 0.4\,y(k-1) - 0.61\,y(k-2) + 0.87\,y(k-3) - 0.22\,y(k-4) = x(k)$$

Where x (k) is input and y (k) is output.
b) State the procedure for design of lead compensator using Root-Locus approach.

5.a) Obtain the Pulse Transfer function of the following

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

b) Explain design and derive the Pulse Transfer function of the Digital PD Controller.

6.a) For the following equation

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

Write Controllable Canonical, Observable Canonical and Diagonal Canonical form.
b) Consider the discrete-time state equation

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \end{bmatrix} = \begin{bmatrix} 0 & 2 \\ -0.28 & -2 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix}$$

Obtain the State Transitition Matrix ψ (k).

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7. Consider the following system

$$x(k+1) = G\,x(k) + H\,u(k)$$

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

Where

$$G = \begin{bmatrix} 0 & -0.32 \\ 2 & -2 \end{bmatrix} \qquad H = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \qquad C = \begin{bmatrix} 0 & 1 \end{bmatrix}$$

Design a Full-order State Observer.

8. a) Consider the system defined by

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \end{bmatrix} = \begin{bmatrix} i & j \\ k & l \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(k)$$

$$y(k) = \begin{bmatrix} 0 & 1 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix}$$

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

b) For the following System

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

Using Bilinear Transformation find the stability of the system.

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