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Code No: A5405

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.TECH I SEMESTER EXAMINATIONS, APRIL/MAY-2012

DIGITAL CONTROL SYSTEMS

(POWER ELECTRONICS&ELECTRIC DRIVES)

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

Answer any five questions

All questions carry equal marks

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1.a) With suitable diagram explain any method of digital to analog conversion.

b) What are the different types of sampling operations? Explain each of them.

c) Derive the transfer function of zero order hold device.

2.a) The signal f(t) = 5 Sin(20πt)+2Π($\left(\frac{t-0.14}{0.16}\right)$, where Π (x) is an unit pulse signal defined by $\Pi(x)=\begin{cases}1 & if \quad |x|\le \frac{1}{2}\\ 0 & otherwise\end{cases}$ is sampled at 25 samples per second.

Determine the Z-transform of f(kT) for 0≤k≤8.

b) Find the inverse Z-Transform of the following:

(i) F(z) = $\frac{\left(1-e^{-\omega T}\right)z}{(z-1)\left(z-e^{-\omega T}\right)}$ 'ω' is a positive constant; and T is the sampling period ,

(ii) F(z) = $\frac{3z^2+2z+1}{\left(z^2-3z+2\right)}$.

3.a) Obtain the state representation of the following pulse transfer function

$$G(z)=\frac{4z^3-12z^2+13z-7}{\left((z-1)^2(z-2)\right)}$$

b) Prove that a discrete time system obtained by zero order hold sampling of an asymptotically stable continuous time system is also asymptotically stable.

4.a) State and explain the Liapunov stability theorems for linear digital control systems.

b) A digital control system is described by the state equation

$$X(k+1)=\begin{bmatrix}0.5 & 1\\ -1 & -1\end{bmatrix}X(k)+\begin{bmatrix}1\\ 1\end{bmatrix}u(k)$$

Find the Liapunov function and determine its stability with u(k)=0.

Contd…..2

5.a) Explain the correlation between time response and root locations in the s – plane and the z-plane.

b) Consider the closed – loop transfer function of the system is given by

$$\frac{C(z)}{R(z)} = \frac{0.4986(z+0.7453)}{z^2 - 1.262z + 0.5235}$$

Draw the pole – zero configurations of the given system. Also find the maximum overshoot and peak time.

6.a) Explain the concept of controllability and observability of discrete time control system.

b) Derive the necessary condition for the digital control system $X(k+1) = AX(k) + Bu(k)$ and $y(k) = CX(k)$ to be observable

c) Examine whether the discrete data system

$$X(k+1) = \begin{bmatrix} 0 & 1 \\ -2 & -2 \end{bmatrix} X(k) + \begin{bmatrix} 1 \\ -1 \end{bmatrix} u(k) \quad \text{and} \quad y(k) = [1 \quad 0]X(k) \text{ is}$$

(i) State controllable (ii) Output controllable and (iii) Observable

7.a) With a neat schematic diagram, explain the working of a reduced order observer.

b) Consider the digital process with the state equations described by

$$X(k+1) = \begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix} X(k) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(k) \quad \text{and} \quad y(k) = [2 \ \ 0]X(k)$$

Design a full order observer which will observe the states $x_1(k)$ and $x_2(k)$ from the output C(k), having dead beat response.

8.a) Consider the single input digital control system

$$X(k+1) = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} X(k) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(k)$$

Determine, the state feed back matrix K such that the state feed back $u(k) = -KX(k)$, places the closed loop system poles at $0.5 \pm j0.5$.

b) Explain the Euler Lagrange equation and its significances.

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