R09

Code No: C3702

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M.Tech I Semester Examinations, March/April 2011

DIGITAL CONTROL SYSTEMS

(CONTROL ENGINEERING)

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

Answer any five questions

All questions carry equal marks

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1. (a) What are the different types of sampling operations? Explain each of them.

   (b) What do you mean by the problem of aliasing? How to overcome these?

   (c) Explain the advantages and disadvantages of digital control systems.

2. (a) Obtain the solution of the following difference equation in terms of x(0) and x(1):

   x(k+2)+(**a**+**b**)x(k+1) +**ab**x(k) = 0

   where **a** and **b** are constants and k= 0, 1, 2, …..

   (b) Find the z-transforms of the following:

   (i) x(k) = $9k(2^{k-1}) - 2^k + 3$, k=0, l, 2, … …, assume x(k) =0 for k<0.

   (ii) $x(k) = \sum_{h=0}^{k} a^h$, where a is a constant.

3. The feed forward pulse Transfer function is given by $G(z) = \frac{Kz}{(z-1)} \frac{(1-e^{-T})}{(z-e^{-T})}$. Draw the root locus for the values of (i) T=0.5, (ii) T=1.0, (iii) T=2.0. Determine the value of K at breakaway and breakin points of above root locii.

4.(a) Consider the digital system shown in Fig below

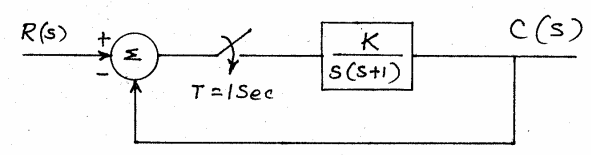


Fig P4 (a)

Using Jury's stability test, find the range of values of K for which the system is stable.

(b) The pulse transfer function of digital control systems is given by

$$G(z) = \frac{5z}{z^2 + 3z + 2}$$

Obtain a state space representation for the system.

Contd…2

5. Obtain a state space representation of the system given below. The sampling period T is 1 sec. Also obtain the state transition matrix.

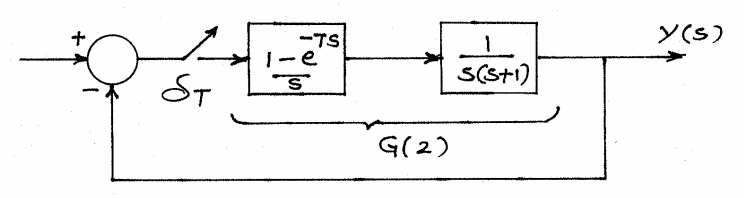


Fig P 5.

6. A block diagram of a digital control system is shown in Fig. P6. Design a PID controller to eliminate the steady-state error due to a step input and simultaneously realizing a good transient response, and the ramp-error constant K_v should equal 5. The controlled process is represented by the transfer function $G_P(s) = \frac{10}{(s+1)(s+2)}$ and T= 0.1.

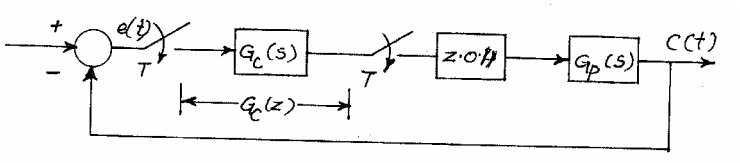


Fig. P6

7.(a) Explain any two methods of pole-placement for design of digital controller.
(b) Consider the single input digital control system

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

where $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

Determine, the state feed back matrix K such that the state feed back u(k) =-KX(k), places the closed loop system poles at 0.3 ±j0.3.

8.(a) With a neat schematic diagram, explain the design procedure of full order observer.
(b) Consider the digital process with the state equations described by

X(k + 1) = GX (k) + HBu(k)

y(k) = C X(k)

Where $G = \begin{bmatrix} 0 & 1 \\ -1 & 1 \end{bmatrix}$, $H = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, $C = \begin{bmatrix} 2 & 0 \end{bmatrix}$.

Design a first order observer which will observe the state $x_2(k)$ from the output c(k), having dead beat response.

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