Code No.: 7116

VASAVI COLLEGE OF ENGINEERING *(Autonomous)*, **HYDERABAD**
M.E. I Year (EEE) I-Semester (Make Up) Examinations, May-2015
(Power Systems & Power Electronics)

Digital Control Systems

Time: **3** hours | Max. Marks: **70**

*Note: Answer **ALL** questions in **Part-A** and any **FIVE** questions from **Part-B***

Part-A (10 X 2=20 Marks)

1. Find the inverse z-transform of $\dfrac{10z}{(z-1)(z-2)}$.
2. What are the different types of sampling operations?
3. Describe the principle of pulse transfer function.
4. State Complex differentiation and Partial differentiation theorem.
5. Write the stability conditions in the z-plane.
6. Define asymptotic stability.
7. What is cascade compensation?
8. What is the information that can be obtained from frequency response plots?
9. Write the state feedback control law.
10. How to determine the marginal stability using Jury method?

Part- B (5 X 10 = 50 Marks)

11. (a) With the help of suitable circuit explain the principle of operation of sample and hold devices. Derive the transfer function of zero order hold circuit. (6)
    (b) Calculate the inverse z-transform of following transfer function (4)

$$X(z) = \frac{z^2}{(z-1)^2(z-e^{-at})}$$

12. (a) Explain the mapping between S-plane and Z-plane with primary strips and complementary strips. (5)
    (b) For the sampled data system of fig.1, find the response to unit step input, given $G(s)=\dfrac{1}{s+1}$. (5)

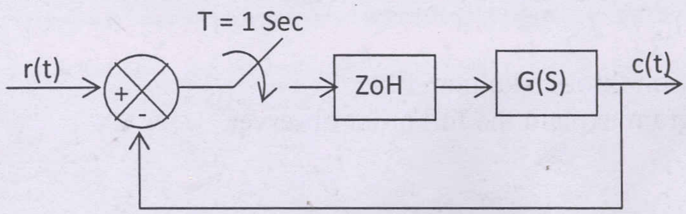

Figure:1

Contd ---2--

13. (a) Find the state transition matrix and write its properties. (4)

(b) Determine the state controllability and observability of the system described by

$$\begin{bmatrix} \frac{dx_1}{dt} \\ \frac{dx_2}{dt} \\ \frac{dx_3}{dt} \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$

$$y = \begin{bmatrix} 4 & 5 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

(6)

14. (a) Discuss Liapunov stability analysis for discrete time system. (4)

(b) Determine the stability of the equilibrium state for the system defined by the equations.

$$x_1 (k+1) = x_2 (k) + 0.2x_2 (k) + 0.4$$
$$x_2 (k+1) = 0.5x_1 (k) - 0.5$$

(6)

15. A block diagram of a digital control system is shown in Fig. 2. 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 $G_p(s) = \dfrac{10}{(s+1)(s+2)}$ and T= 0.1Sec. (10)

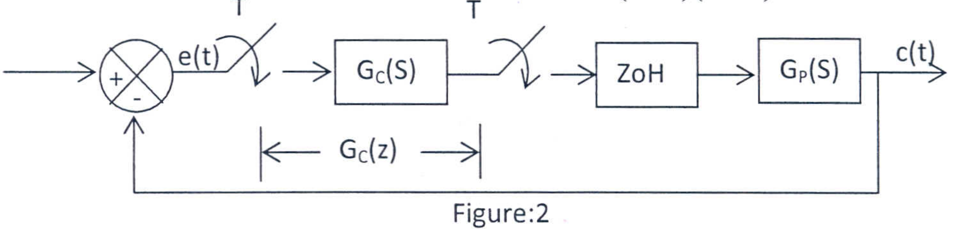

Figure:2

16. A discrete time regulator system has the plant equation (10)

$$X(k+1) = \begin{bmatrix} 2 & -1 \\ -1 & 1 \end{bmatrix} X(k) + \begin{bmatrix} 4 \\ 3 \end{bmatrix} u(k)$$

$$y(k) = \begin{bmatrix} 1 & 1 \end{bmatrix} X(k) + 7u(k)$$

Design a state feedback control algorithm with u(k) = - K x(k) which places the closed loop characteristic roots at $+j\frac{1}{2}, -j\frac{1}{2}$.

17. (a) Explain state estimation through kalman filter (6)

(b) With neat block diagram explain the full order observer. (4)

*****