Code No: OR411056 **OR**

IV B.Tech I Semester Supplementary Examinations, April/May 2005
DIGITAL CONTROL SYSTEMS
(Electronics & Instrumentation Engineering)

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

Answer any FIVE Questions
All Questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Given the transfer function $G(z) = \frac{4(z-1)(z^2+1.2z+1)}{(z+0.1)(z^2-0.3z+0.8)}$

   Obtain

   (a) a series realization diagram and

   (b) a parallel realization diagram.

   Using pure delay elements z^{-1}.

2. Find the state variable models for the following system represented by the difference equation

   (a) y(k+3)+5y(k+2)+7y(k+1)+3y(k)=0

   (b) y(k+2)+3y(k+1)+2y(k)=5r(k+1)+3r(k)

3. Consider the system defined by,

$$\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \end{bmatrix} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(k)$$

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

   Determine the condition on a, b, c and d for complete state controllability and complete observability.

4. (a) Show that the following quadratic form is positive definite.
   $V(x) = 10x_1^2+4x_2^2+x_3^2+2x_1x_2-2x_2x_3-4x_1x_3$

   (b) State and explain Liapunovs main stability theorem.

   (c) Consider the system described by $\dot{x}_1 = x_2-x_1(x_1^2+x_2^2)$; $\dot{x}_2 = -x_1-x_2(x_1^2+x2^2)$. Determine the stability. Also show that X = 0 is the only equilibrium state.

5. (a) What are the properties of dead beat response system?

   (b) Explain in detail, how a digital controller for deadbeat performance can be obtained.

6. Consider the system given by

$$\begin{bmatrix} x_1 & (k+1) \\ x_2 & (k+2) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -0.16 & -1 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(k)$$

   Determine the state feedback gain matrix such that when the controls signal is given by u(k) = - KX(k) the closed loop system exhibits the dead beat response to an initial state x(0). Assume that the control signal u(k) is unbounded.

7. (a) Discuss briefly Kalman Filtering algorithm and explain the various recursive relations.
   (b) With neat block diagram explain the full order observer
8. What is a state regulator? Explain the steps involved in the design of state regulator.

⋆ ⋆ ⋆ ⋆ ⋆