Roll No ....

MEIC - 103

M.E./M.Tech., I Semester

Examination, June 2013

Discrete Data and Non Linear Control

Time : Three Hours

Maximum Marks : 70

Note : 1. *Attempt any five questions.*
2. *All questions carry equal marks.*
3. *Wherever mentioned the signal 1(t) means unit step function of time and 1(k) means unit sequence*

1. A certain second order discrete-time dynamics is given by $y(k+2) - 1.44y(k+1) + 0.44y(k) =$
$0.1u(k+1) + 0.008u(k)$. Let $y(k) = x_1(k)$
$x_1(k+1) = 0.6x_1(k) + x_2(k) + b_1u(k)$
$x_2(k+1) = a_{21}x_1(k) + a_{22}x_2(k) + b_2u(k)$
Determine a_{21}, a_{22}, b_1 and b_2 to complete the state space description. Calculate the eigen-values and eigen-vectors.

2. Find the inverse z - transform of the following by residue theorem method:

a) $F(z) = \dfrac{z(z+0.02)}{(z-1)(z^2-0.44z+0.46)}$

b) $F(z) = \dfrac{2z(z+0.08)}{(z-1)(z^2+0.56z+0.6)}$

3. a) Show that $A^k = PD^kP^{-1}$

b) If $A = \begin{bmatrix} 0.6 & 0.2 \\ 0.72 & 0.64 \end{bmatrix}$, then compute A^k by using the relation given in (a)

4. The state space description of a second order discrete-time system is given by
$$x(k+1) = \begin{bmatrix} 0.7 & 0.6 \\ 0.18 & 0.64 \end{bmatrix} x(k) + \begin{bmatrix} 0.2 \\ 0.24 \end{bmatrix} u(k) \text{ and } y(k) = [1\ 0]\,x(k)$$
Form a feedback control system as $e(k) = y_R(k) - y(k)$ and $u(k) = Ke(k)$ with $K = 4$. Determine the closed loop state vector solution when the reference input $y_R(k) = 1(k)$. Use z - transformation method.

5. Show how the stability analysis of a third-order type-1 system having relay with dead zone type nonlinear element is explained. Draw neat Nyquist diagram to show the analysis.

6. Explain the ON-OFF control of liquid-level system with neat drawing of its complete layout. Discuss only the one-point control.

7. A continuous-time second order system dynamics is given by $\dot{x} = \begin{bmatrix} -2 & 1 \\ -8 & 4 \end{bmatrix} x + \begin{bmatrix} 0.5 \\ 4 \end{bmatrix} u$ and the output $y = [1\ \ 0]x$.
Discretise the system with $T = 0.01$ second. Apply feedback control as $e = y_R - y$ and $u = Ke$ with $K = 10$. Obtain the closed loop poles.

8. Consider Q. 4. Apply Lyapunov method to find the range of gain K for closed loop stability.

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