Code :R5322204 **R5**

III B.Tech II Semester(R05) Supplementary Examinations, April/May 2011
DIGITAL & OPTIMAL CONTROL SYSTEMS
(Instrumentation & Control Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE questions
All questions carry equal marks

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1. Obtain the inverse Z-transform of the following in the closed form.
   (a) $F_1(z) = \frac{0.368z^2+0.478z+0.154}{z^2(z-1)}$
   (b) $F_2(z) = \frac{2z^3+z}{(z-1)^2(z-1)}$
   (c) $F_3(z) = \frac{z+2}{z^2(z-2)}$

2. A regulator system has a plant, described by
   $\frac{Y(s)}{U(s)} = \frac{10}{(s+1)\,(s+2)\,(s+3)}$
   Obtain the discrete-time state variable model.

3. Discuss Liapunov stability analysis for discrete time system and determine the stability of the equilibrium state for the system defined by the equations
   $$x_1(k+1) = x_2(k) + 0.2x_2(k) + 0.4$$
   $$x_2(k+1) = 0.5x_1(k) - 0.5$$

4. (a) Give the advantage of using w transformation for the design of discrete data systems.
   (b) What can you say about root sensitivity of a system with dead beat response?

5. Explain the design steps for pole placement by state feedback for single input system in detail with a suitable example.

6. (a) Sate and explain an infinite-time state regulator problem.
   (b) The system $\dot{x} = -x + u$
   is to be transferred from x(0) = 5 to x(1) = 0 such that $J = \int u^2 dt$ is minimized. Find the optimal control.

7. (a) State and explain the Pontryagin's minimum principle.
   (b) Find the points in the three-dimensional euclidean space that minimizes the function
   $f(x_1, x_2, x_3) = x_1^2 + x_2^2 + x_3^2$
   and lie on the intersection of the surfaces
   $$x_3 = x_1x_2 + 5$$
   $$x_1 + x_2 + x_3 = 1$$

8. (a) Derive the relations required for obtaining an observable realization algorithm of a given transfer matrix T(s).
   (b) Obtain state space controllable realization of a system with transfer matrix.
   $$T(s) = \begin{bmatrix} 2(s-1) & s+1 \\ 4 & -s \end{bmatrix} \begin{bmatrix} s+4 & 2(s+1) \\ 0 & s^2-s+4 \end{bmatrix}^{-1}$$

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