I – 994

Seat No.	

B.E. (Electrical) (Semester – VII) (New) Examination, 2010
DIGITAL CONTROL SYSTEM (Elective – I)

Day and Date : Tuesday, 7-12-2010 Max. Marks : 100
Time : 2.30 p.m. to 5.30 p.m.

***Instruction** : Attempt **any three** questions from **each** Section.*

SECTION – I

1. a) Derive with necessary mathematical equations the describing function for Backlash nonlinearity. **9**

   b) State and prove the multiplication of two sequences property of z-transform. **8**

2. a) A linear second order servo is described by the equation $\ddot{e} + 2\xi\omega_n\dot{e} + \omega^2_n e = 0$
   Where $\xi = 0.15$ $\omega_n = 1$ rad/sec $e(o) = 1.5$ & $\dot{e}(o) = 0$.
   Determine the singular point, construct the phase trajectory using the method of isoclines. **9**

   b) Comment on the Lyapunov functions and stability criterion. **8**

3. a) Find the system response in terms of
      i) Zero input response
      ii) Zero state response
      iii) Total responce.
   The system difference equation is given by $y(n) = 1.5\,y(n-1) - 0.5\,y(n-2) + x(n)$ with initial conditions $y(-1) = 4$ and $y(-2) = 10$ and $x(n) = (0.25)^n$. **8**

   b) With the help of frequency response curves explain the characteristics of ZOH. **8**

P.T.O.

4. Write short notes on **(any two)** : **16**

   a) Jury's stability criterion.

   b) Designing using frequency response method.

   c) Steady state errors and error constants.

SECTION – II

5. a) A linear time in variant system is described by the following state model. **9**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 2 \end{bmatrix} u$$

and $y = [1\ 0\ 0] \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$

Transform this state model into a canonical state model. Also compute the state transition matrxi e^{At}.

   b) Obtain the pulse transfer function of the system if **8**

$$a = \begin{bmatrix} -2 & 1 & 0 \\ 0 & -3 & 1 \\ -3 & -4 & -5 \end{bmatrix} \quad H = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

$c = [0\ 1\ 0]$

6. a) Comment on contollability and explain pole placement designing. **8**

   b) Consider a linear system described by the transfer function **9**

$$\frac{Y(S)}{O(S)} = \frac{10}{S(S+1)\ (S+2)}$$

Design a feedback controller with a state feedback so that the closed loop poles are placed at $-2,\ -1 \pm j1$.

7. a) Explain state observer. **8**

b) Consider the continuous time system given by

$$G(S) = \frac{Y(S)}{U(S)} = \frac{2S + 9}{S^3 + 8S^2 + 12S + 9}$$

obtain the controllable canonical form of state space. **8**

8. Write short notes on **(any two)** : **16**

a) State space representation of digital system .

b) Non linearity presented in physical systems.

c) Explain delta method for phase plane.