Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.TECH (EE)/SEM-1/PSM-101/2010-11

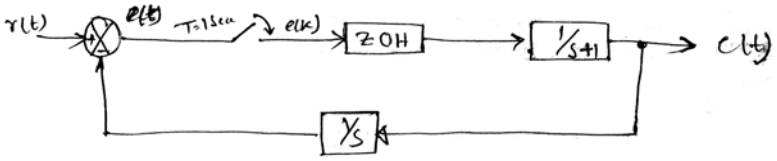
2010-11
ADVANCED CONTROL SYSTEM

Time Allotted : 3 Hours *Full Marks* : 70

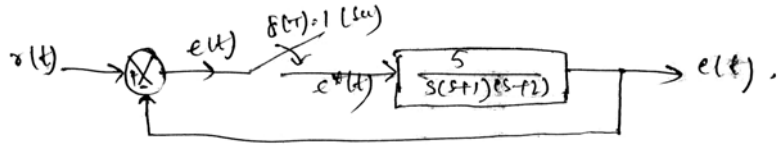
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions 5 × 14 = 70

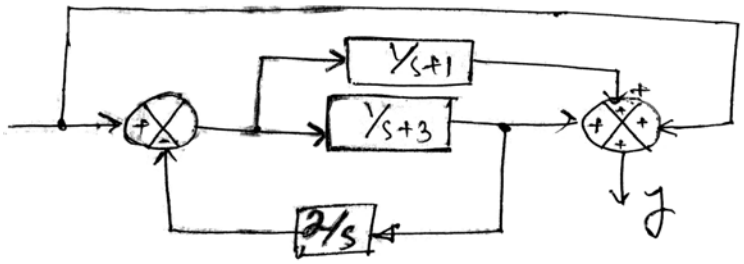
1. a) For the sampled-data control system shown in Fig. find the output c(k) for r(t) = unit step 7



b) Consider the sampled data system of Fig. Determine its characteristic equation in the z-domain and ascertain its stability via the bilinear transformation. 7



2. a) Block diagram representation of a linear time-invariant system is given in Fig. Check whether the system is completely observable. 7



b) A discrete-time system has the transfer function

$$T(z) = \frac{4z^3 - 12z^2 + 13z - 7}{(z-1)^2\,(z-2)}$$

Determine the state model of the system in

(i) Phase variable form

(ii) Jordan Camonical form. 7

3. a) State and prove Cayley Hamilton theorem. 7

b) Find $[SI - A]^{-1}$ using Leverrier Fedeev algorithm whose

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & -2 & 0 \\ -2 & -3 & -1 \end{bmatrix}$$ 7

4. a) The plant is given by $\dot{x}$ = Ax + Bu where

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

The system uses uses the state feedback control law u = – Kx, Let us choose the desired closed loop poles at S = – 2 + j4, S = – 2 – j4, S = – 10. Determine the state feedback gain. 7

b) Explain Lag. Lead, & Lag-lead compensator. 7

5. a) Given plan

$$Gp(s) = \frac{40}{2s^3 + 10s^2 + 82s + 10}$$

H (s) = 1

Find and Kp, Ti, Td and transfer function of the PID controller, using Ziegler Nichols tuning. 7

b) Explain the effects of proportional, integral & derivative control actions and system performance. 7

6. a) State the stability theorem of Liapunov for non-linear system. 4

b) Consider the dynamics of the system represented by

$$\begin{bmatrix} \dot{x} \\ \dot{x} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

i) Formulate the Liapunovs function to test the Asymptotic stability. 5

ii) Determine the asymptotic stability by using the Liapunov's second method. 5

7. a) Is the system represented by $\dot{7} = mx + c$ a linear system ? If not how can it be linearized ? 1 + 3

   b) Using method of isocline draw the phase trojectory for the system $\ddot{\theta} + \theta = 0$ 5

   c) Derive the describing function for "Dead-zone nonlinearity". 5