(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0315 Roll No.

B.Tech

(SEM VII) ODD SEMESTER THEORY EXAMINATION 2009-10

DIGITAL CONTROL ENGINEERING

Time : 3 Hours] *[Total Marks : 100*

Note : *Attempt all questions.*

1 Attempt any **four** parts of the following : 5×4

(a) With the help of a neat schematic diagram explain the working principle of a dual slope type ADC.

(b) Find the *z*-transform of the following sequence in closed form :

$$f(k) = e^{-k} \sin 2k$$

(c) Find the *z*-transform of the function whose Laplace transform is given as

$$F(s) = \frac{2(s+1)}{s(s+5)}$$

(d) Find the inverse *z*-transform of

$$F(z) = \frac{z(z+1)}{(z-1)(z^2 - z + 1)}$$

(e) For the system shown below in **fig. 1** find the output at the sampling instants $c(kt)$. The input is a unit impulse and the sampling period is $0.1\,s$.

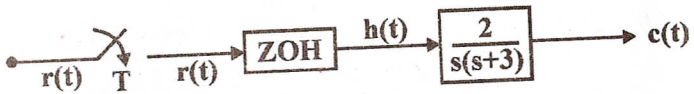

Fig. 1

(f) With the help of suitable diagrams explain the principle of operation of a $R-2R$ type DAC.

2 Attempt any **four** parts of the following : 5×4

(a) Solve the following linear difference equation using z-transforms

$$2c(k+2)-0.1c(k+1)-0.2c(k)=r(k+1)+r(k)$$

where $r(k)=$ unit step sequence and $c(0)=0$

and $c(1)=0$.

(b) By means of Jury's stability test, determine the stability of the sampled data control system with the following characteristic equation :

$$2z^4+z^3+z^2+z+1=0$$

(c) For the sampled data control system shown below determine $\frac{c(z)}{R(z)}$ if possible. Else determine $c(z)$.

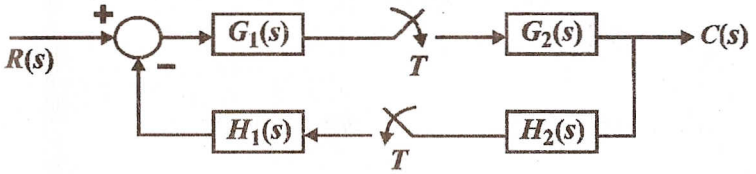

Fig. 2

(d) If $Q(z)=z^3-4z^2+5z-2=0$ represents a characteristic equation and $T=2s$, then apply the Routh stability criterion to determine if any of the roots of the characteristic equation lie outside the unit circle.

(e) Map the following s-plane values into the z-plane for $T=1\,s$ and $0.001\,s$. Give the z-plane values in both polar and rectangular co-ordinates :

(i) $s_1=-0.5+j\,0.5$ (ii) $s_2=-2$

(f) Briefly explain the design of w-plane.

3 Attempt any **two** parts of the following : 10×2

(a) Write the state equations and output equations of the following difference equation

$$c(k+4)+2c(k+2)-c(k-1)c(k)=5u(k)$$

(b) Decompose the following transfer function by parallel decomposition. Also draw the state diagram and write the discrete state equations in vector-matrix form.

$$\frac{c(z)}{R(z)}=\frac{z-0.1}{(z-0.5)(z-0.8)}$$

(c) Given the state equation $x(k+1) = Ax(k)$

find the state transition matrix $\phi(k)$ when

$$A = \begin{bmatrix} 0 & 1 \\ 0.5 & 1 \end{bmatrix}$$

4 Attempt any **two** parts of the following : **10×2**

(a) Let $A = \begin{bmatrix} 0 & 1 \\ -1 & 2 \end{bmatrix}$; $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$

Find the state - feedback G such that the Eigen values of $A–BG$ are at 0 and 0.3

(b) Investigate the controllability and observability of the following system :

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

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

(c) Write short notes on the following :

(i) Liapanov stability analysis

(ii) Stochastic optimal state estimation.

5 Attempt any **two** parts of the following : **10×2**

(a) Discuss the important specifications of a sample and hold circuit. With the help of suitable diagrams describe its principle of operation.

(b) Using the assembly language of 8085 μp, develop the program for a digital PID controller.

(c) Describe digital quantisation. How does it affect the operation of a digital control system ?-Discuss.