



Printed Pages : 4

TIC702

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

PAPER ID : 0315

Roll No.

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**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

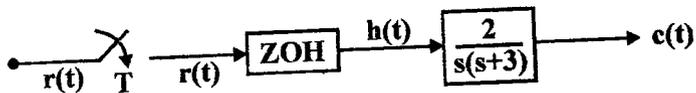
$$F(s) = \frac{2(s+1)}{s(s+5)}$$

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

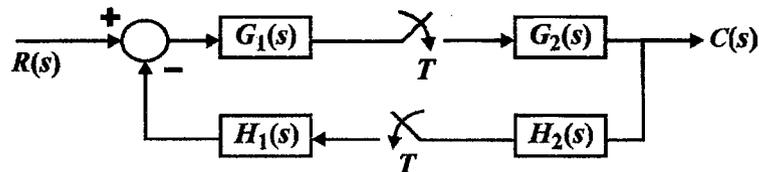
where  $r(k)$  = unit step sequence and  $c(0) = 0$

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  $T = 1s$  and  $0.001s$ . Give the z-plane values in both polar and rectangular co-ordinates :
- (i)  $s_1 = -0.5 + j0.5$     (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  $\mu p$ , develop the program for a digital PID controller.
- (c) Describe digital quantisation. How does it affect the operation of a digital control system ?-Discuss.

