



SF-7781

**B. E. - IV (Sem. VIII) (Inst. & Ctrl.) Examination**  
**May / June - 2011**  
**Modern Digital Control Systems**

Time : 3 Hours]

[Total Marks : 100

**Instructions :**

(1)

नीचे दृष्टावेक निशानीवाणी विगतो उत्तरवही पर अवश्य कप्रवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="text" value="B. E. - 4 (SEM. 8) (I.C.)"/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="MODERN DIGITAL CONTROL SYSTEMS"/>	<input type="text"/>
Subject Code No. : <input type="text" value="7"/> <input type="text" value="7"/> <input type="text" value="8"/> <input type="text" value="1"/>	Section No. (1, 2,.....) : <input type="text" value="NIL"/>
Student's Signature	

- (2) Answer the two sections in separate answer books.
- (3) Use of non programmable calculators is allowed.
- (4) Assume suitable data if required.
- (5) Black figures to the right indicate full marks.
- (6) Draw neat diagrams and use mathematical expressions whenever required.

1 Attempt any five : 10

- (a) Find the  $z$  transform of the sequence  $f(k) = \left(\frac{1}{2}\right)^k$  for  
 $k = 0, 1, 2$
- (b) Prove that  $z = 1$  corresponds to  $s = 0$
- (c) State the stability criteria for  $z$  domain and explain in brief.
- (d) Find  $F(z)$  if  $F(s) = \frac{1}{s+1}$
- (e) Obtain the  $z$  transform of  $G^k$  where  $G$  is an  $n \times n$  constant matrix.

2 (a) Derive the transfer function of zero order hold. 10

(b) Show that 10

$$Z\left(\sum_{h=0}^k x(h)\right) = \frac{1}{1-z^{-1}} X(z)$$

$$Z\left(\sum_{h=0}^{k-1} x(h)\right) = \frac{z^{-1}}{1-z^{-1}} X(z)$$

(c) Obtain the z transform of 5

$$X(s) = \frac{1-e^{-Ts}}{s} \frac{1}{s+1}$$

OR

2 (a) Derive the relationship  $z = e^{Ts}$  where  $T$  is the sampling interval. 10

(b) Derive the pulse transfer function of digital PID controller using z transform. 10

(c) Obtain the discrete equivalent of the following continues time state space equation : 5

$$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \end{pmatrix} = \begin{pmatrix} 0 & 1 \\ 0 & -2 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + \begin{pmatrix} 0 \\ 1 \end{pmatrix} u$$

$$y = (1 \ 0) \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$$

OR

(c) For the interest payment problem : 5

$$p(k+1) = (1+R)p(k) - U,$$

where,  $p(k)$  = amount owed at the end of the kth period.

$R$  = monthly rate of interest %

$U$  = monthly payment (constant)

Solve above equation for  $U$ .

<b>3</b>	(a) Brief about state space analysis. Also discuss the state transition matrix.	<b>8</b>
	(b) Prove that the zero order hold transfer function is not having pole at origin in laplace domain.	<b>7</b>
<b>4</b>	(i) What is describing function ?	<b>2</b>
	(ii) List the methods for constructing the trajectories.	<b>2</b>
	(iii) Give an example of positive definite function.	<b>2</b>
	(iv) Define equilibrium state of a system.	<b>2</b>
	(v) List different types of nonlinearity.	<b>2</b>
<b>5</b>	Explain the following : (any two)	<b>20</b>
	(i) Stability in the sense of Liapunov	
	(ii) The describing function analysis of non linear system	
	(iii) Isocline method of phase trajectory construction	
<b>6</b>	(a) Explain linearization of a non linear system in detail.	<b>10</b>
	(b) Explain delta method of trajectory construction.	<b>10</b>
<b>OR</b>		
	(b) List different types of nonlinearity and derive an expression for any one of them.	<b>10</b>

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