

**B. TECH.****THEORY EXAMINATION (SEM-VI) 2016-17  
DIGITAL CONTROL SYSTEM****Time : 3 Hours****Max. Marks : 100****Note : Be precise in your answer. In case of numerical problem assume data wherever not provided.****SECTION-A****1 Attempt the following :****(10×2=20)**

- a) Explain state space representation of digital Control System.
- b) Design a controller from continuous to digital system.
- c) Explain acquisition time for sample and hold operation.
- d) Write shifting property of Z transform.
- e) If  $X(z) = 2+3Z^{-1}+4Z^{-2}$  then find the initial and final value of the corresponding sequence.
- f) State Cayley-Hamilton theorem.
- g) Calculate the pulse transfer function of zero order hold whose transfer function is

$$G_{ho}(s) = \frac{1 - e^{-Ts}}{s}$$

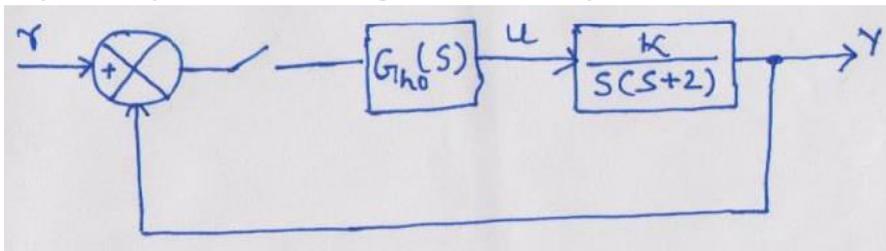
- h) Find out the equilibrium points of the following nonlinear system.

$$\begin{aligned} x_1(k+1) &= x_1(k) - x_1^3(k) \\ x_2(k+1) &= -x_2(k) \end{aligned}$$

- i) Write Euler-Lagrange equation.
- j) Define Asymptotic Stability.

**SECTION-B****2 Attempt any five of the following:****(10×5=50)**

- a) (i) Draw the basic digital control system and explain the function of each block.  
(ii) Discuss the relationship between Laplace transform and Z transform.
- b) (i) Explain the Concepts of controllability and observability.  
(ii) Describe the sample and hold operations.
- c) A plant is described by the transfer function shown in the below block diagram. With the help of Jury stability test find the range of K for the system to be stable.



- d) (i) Write the Controllability and Observability conditions for Pulse Transfer Function.  
(ii) Explain the relation between bilinear transformation and W-plane.

- e) Explain Jury stability criteria. Calculate the stability of the characteristic equation given below by using jury stability criteria:  
 $F(z) = z^3 - 1.25z^2 - 1.375z - 0.25 = 0$
- f) Find the pulse transfer function of the zero order hold and the relation between  $G(s)$  and  $G(z)$ .
- g) Explain the principle of optimality and dynamic programming.
- h) Explain the design procedure in the W-plane.

### SECTION-C

**Attempt any two of the following :**

**(15×2=30)**

- 3 Find the optimal control  $u^0(k)$ ,  $k = 0, 1, 2, \dots, 10$ , such that the performance index

$$J = \frac{1}{2} \sum_{k=0}^{10} [x^2(k) + 2u^2(k)]$$

Is minimized, subject to the equality constraint

$$x(k+1) = x(k) + 2u(k)$$

- i. The initial state is  $x(0) = 1$  and the final state is  $x(11) = 0$
  - ii. The initial state is  $x(0) = 1$  and the final state  $x(11)$  is free.
- 4 (i) find the Z transform of the sequence  $f(k) = (1/2)^k$   
(ii) compute the state transition matrix using Caley Hamilton Theorem for the given A.

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

- 5 State and explain Liapunov stability criteria and test the stability of the discrete-data system described by  
 $X_1(k+1) = -0.5 X_1(k)$   
 $X_2(k+1) = -0.5 X_2(k)$