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# 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 continous 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.

$$x_1(k+1) = x_1(k) - x_1^3(k)$$
$$x_2(k+1) = -x_2(k)$$

i) Write Euler-Lagrange equation.

j) Define Asymptotic Stability.

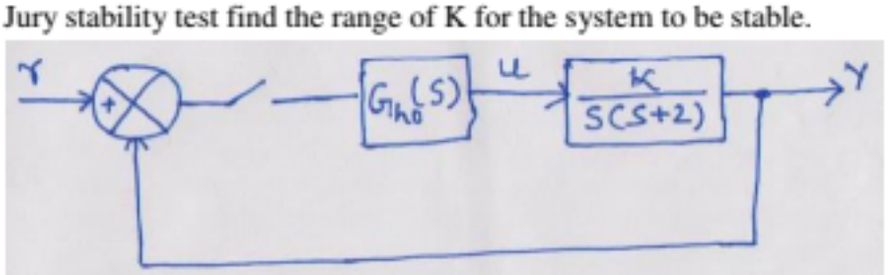
### SECTION-B

**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.

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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,.....10, such that the performance index

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

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

$X_1(k+1) = -0.5\, X_1(k)$

$X_2(k+1) = -0.5X_2(k)$

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