Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: AE407

Course Name: DIGITAL CONTROL SYSTEM

Max. Marks: 100 Duration: 3 Hours

(Semi log graphs to be provided)

PART A

Answer any two full questions, each carries 15 marks. Marks

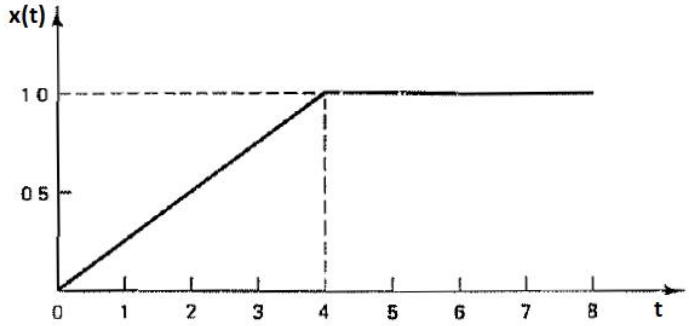
1 a) With a block diagram, discuss the basic elements of a discrete -data control system. Also mention its advantages over the analog control system. (6)

b) With suitable block diagram, explain the sample and hold circuit. (5)

c) Illustrate the digital control system with a step motor control. (4)

2 Explain Mathematical modelling of the sampling process. Also plot the amplitude spectrum of the sampler output without aliasing. (15)

3 a) Find the z-transform of x(t) shown in figure. Assume sampling period T=1s. (6)



b) Solve the difference equation: (9)

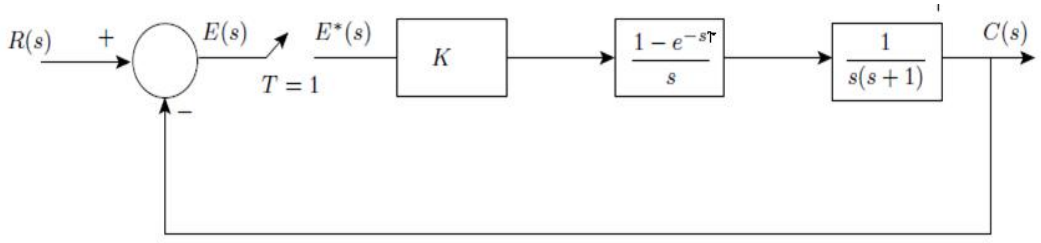
$$2x(k) - 2x(k-1) + x(k-2) = u(k)$$

Where $x(k)=0$; $k<0$ and $u(k) = \begin{cases} 1, & k = 0,1,2,.... \\ 0, & k < 0 \end{cases}$

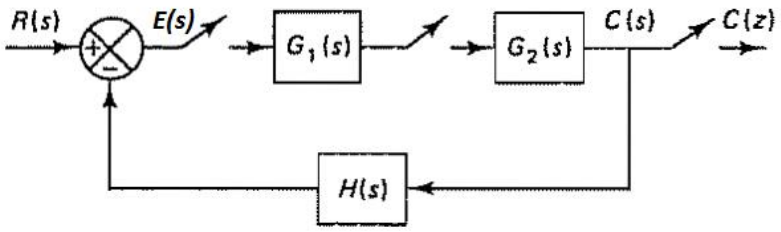
PART B

Answer any two full questions, each carries 15 marks.

4 Determine the pulse transfer function of the closed loop system given below for a sampling time of 1s and open loop gain K=1. (15)



5 a) Obtain the Pulse transfer function of the given closed loop system. (10)



b) Discuss in detail about the stability of a system in the z plane. (5)

6 Draw the Bode plot and determine the phase margin and gain margin for the following system with open loop transfer function (sampling period T = 0.2 s) (15)

$$G(z) = \frac{2(0.01873z + 0.01752)}{z^2 - 1.8187z + 0.8187}$$

PART C

Answer any two full questions, each carries 20 marks.

7 a) For the following system obtain the state transition matrix. (10)

$$x(k+1) = Gx(k) + Hu(k)$$
$$y(k) = Cx(k) + Du(k)$$
$$G = \begin{bmatrix} 0 & 1 \\ -0.16 & -1 \end{bmatrix}; \quad H = \begin{bmatrix} 1 \\ 1 \end{bmatrix}; \quad C = \begin{bmatrix} 1 & 0 \end{bmatrix}; \quad D = [0]$$

b) Obtain the state space representation and block diagram of the following pulse-transfer function system in diagonal canonical form. (10)

$$G(z) = \frac{z^3 + 8z^2 + 17z + 8}{(z+1)(z+2)(z+3)}$$

8 a) Derive the expression for Transfer function from State variable model represented by (10)

$$x(k+1) = Gx(k) + Hu(k)$$
$$y(k) = Cx(k) + Du(k)$$

b) Write the state space representation of a linear time invariant discrete time control system. Explain various matrices in the representation. Draw its block diagram representation. How does this state space equations change if it is a time varying system? (10)

9 a) Comment on the state variable analysis of a discrete time system response between the sampling instants. (5)

b) Consider a linear discrete-data control system whose input-output relation is described by the difference equation y(k+2) + 2y(k+1) + y(k) = u(k+1) + u(k). Check the system for (i) State controllability (ii) Output controllability (iii) Observability (15)

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