Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

Course Code: AE407

Course Name: -DIGITAL CONTROL SYSTEM

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks.

Marks

1 a) What are the merits and demerits of digital control system? (3)

b) With suitable timing diagram explain the following characteristics of a sample and hold device. (7)
(i) Acquisition time (ii) Aperture time (iii) Settling time

c) Obtain the expression for the transfer function of a polygonal hold system. (5)

2 With suitable diagrams explain how data reconstruction is done in zero order hold and first order hold. Derive transfer functions for each. (15)

3 a) Find the inverse z transform of $X(z) = \dfrac{2z^3 + z}{(z-2)^2(z-1)}$ (6)

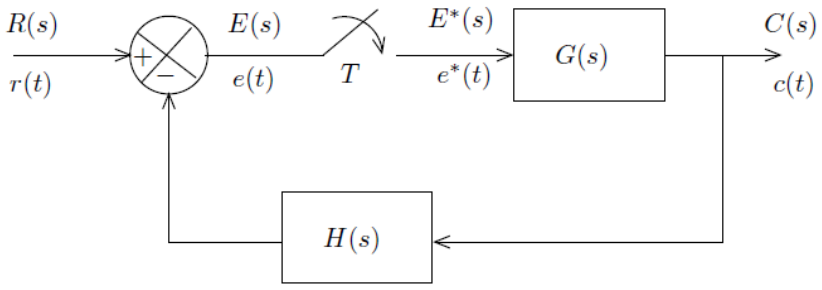
b) Describe the mapping of the following locus from s-plane to z-plane (9)

i. Constant damping loci
ii. Constant frequency loci
iii. Constant damping ratio loci

PART B

Answer any two full questions, each carries 15 marks.

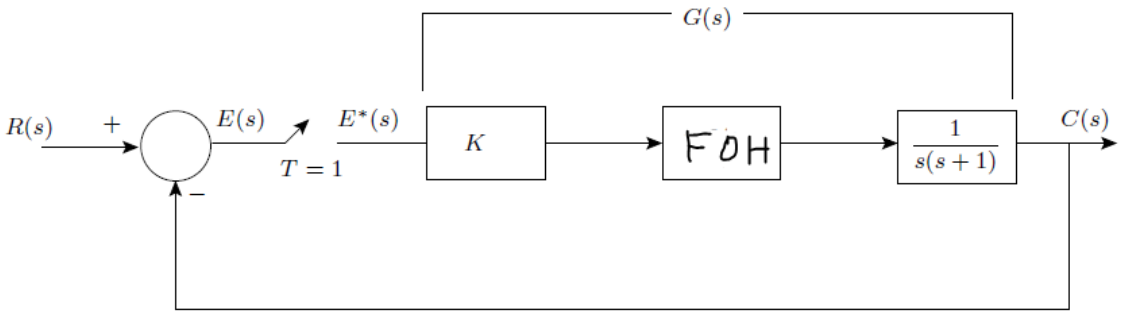
4 a) Obtain the Pulse transfer function of the given closed loop system. (10)



b) Derive the expression for pulse transfer function of an LTI system with sampled data input (5)

5 Determine the pulse transfer function of the closed loop system given below for a (15)

sampling time of 1s and open loop gain K=1.



6 a) What do you mean by gain margin and phase margin? Explain (5)

b) Derive the expression for acceleration error constant and velocity error constant of a Type 1 digital system (10)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Using nested programming method, obtain the state equation and output equation for the following system $\frac{Y(z)}{U(z)} = \frac{z^{-1} + 5z^{-2}}{1 + 4z^{-1} + 3z^{-2}}$ (10)

b) Write the state space representation of a linear time invariant discrete time control system. Explain various matrices in the representation. Prove that this representation is not unique. (10)

8 a) Explain in detail the procedure for state regulator design using pole placement method for a digital control system (10)

b) Derive the expression for state transition matrix using z-transform method (10)

9 a) Determine whether the following systems are completely state controllable (8)

i. $\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} 2 \\ 3 \end{bmatrix} u(k)$

ii. $\begin{bmatrix} x_1(k+1) \\ x_2(k+1) \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1(k) \\ x_2(k) \end{bmatrix} + \begin{bmatrix} 2 \\ 0 \end{bmatrix} u(k)$

b) Explain the effects of finite word length and quantization on controllability and closed-loop placement. (12)

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