Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

EIGHTH SEMESTER B.TECH DEGREE EXAMINATION, MAY 2019

Course Code: EE462

Course Name: Design of Digital Control Systems

Max. Marks: 100 Duration: 3 Hours

(Use of semilog sheet is permitted)

PART A

Answer all questions, each carries 5 marks. Marks

1 Derive the transfer function and obtain the frequency response characteristics of zero order hold (5)

2 List the factors effecting the choice of sampling rate while discretization (5)

3 How can a PID controller be configured as a lag compensator? (5)

4 Explain in brief about direct design method of Ragazzini. (5)

5 Explain the Z transform approach to find out the state transition matrix for linear time invariant discrete time systems (5)

6 Derive the expression for pulse transfer function matrix (5)

7 What is mean by stabilizability and reachability of a digital control system? (5)

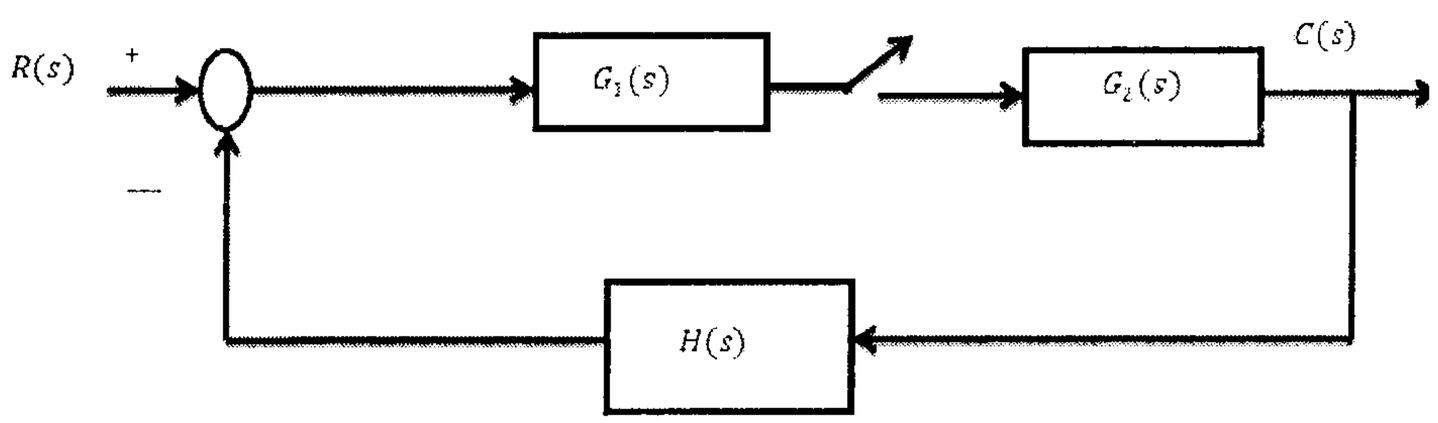
8 Explain Loss of controllability and observability due to sampling (5)

PART B

Answer any two full questions, each carries 10 marks.

9 Explain a digital control system with the help of block diagram. Also give an example for digital control system (10)

10 Find out $C(Z)$ for the given system (10)



11 a) Obtain the Z transform of $x(t) = \begin{cases} e^{-at}, & t \geq 0 \\ 0, & t < 0 \end{cases}$ (5)

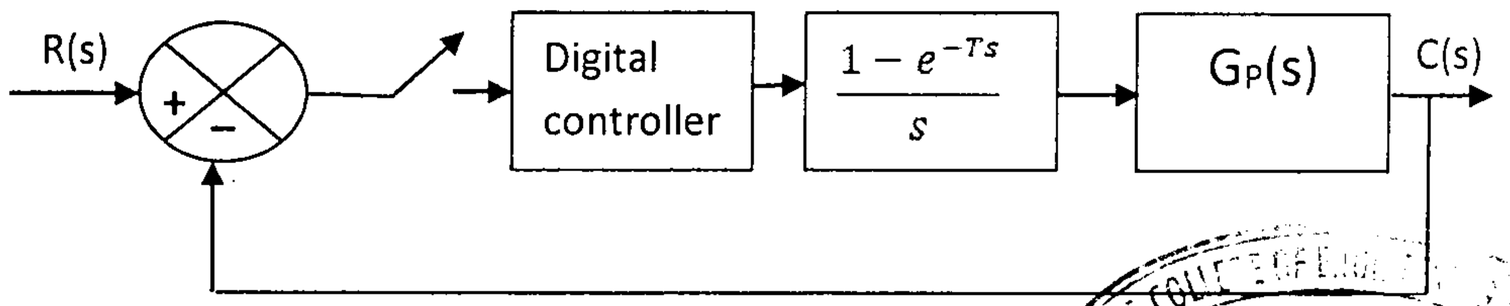
b) What is pulse transfer function? Obtain the pulse transfer function of a closed loop discrete time system (5)

PART C

Answer any two full questions, each carries 10 marks.

12 Consider the bode diagram approach in the w plane, design a digital controller for the system shown in the figure. The design specifications are that the phase margin to be 50°, the gain margin to be at least 10 dB and the static velocity error constant be 20 sec^{-1}. T = 0.1 sec. Plant transfer function is (10)

$$G_p(s) = \frac{K}{s(s+0.5)}$$



13 a) What is dead beat response (3)

b) Explain the design steps used for design of dead beat controller (7)

14 a) Write the design steps for the design of lag compensator based on frequency response method (5)

b) What are the design steps involved in the design of compensator using root locus method. (5)

PART D

Answer any two full questions, each carries 10 marks.

15 A discrete time system has state equation given by (10)

$(k+1) = \begin{bmatrix} 0 & 1 \\ -10 & -7 \end{bmatrix} x(k)$. Use Cayley-Hamilton theorem to find out its state transition matrix

16 (a) Differentiate between Controllability and observability (4)

(b) Commend upon the controllability and reachability of the given system (6)

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

17 a) What is state transition matrix? Explain (5)

b) Derive the state controllability matrix for the system given by (5)

$$x\big((k+1)T\big) = Gx(kT) + Hu(kT)$$

$$y(kT) = Cx(kT)$$

Assume that $u(kT)$ is constant for $kT \leq t \leq (k+1)T$