APJ ABDULKALAM TECHNOLOGICAL UNIVERSITY

08 PALAKKAD CLUSTER

Q. P. Code: PE0819252C - III **(Pages: 3)** **Name: ....**

Reg. No:....................

SECOND SEMESTER M.TECH. DEGREE EXAMINATION JUNE 2019

Branch: Electrical Engineering **Specialization: Power Electronics**

08EE6252C Digital Control Systems

Time: 3 hours **Max. marks: 60**

Answer all six questions.

Modules 1 to 6: Part 'a' of each question is compulsory and answer either part 'b' or part 'c' of each question.

(graph sheets may be provided.)

Q.no.	Module 1	Marks
1.a	Obtain the frequency response of a first order hold circuit.	3
	Answer b or c	
b	i. Find the z transform of $y[k] = \Sigma^{k}_{h=1} x(h)$. ii. Given $X(s) = 1/\{s^2(s+1)\}$. Find X(z) by convolution integral method.	6
c	Draw series and parallel realisation diagrams of $G(z) = 4(z-1)(z^2 + 1.2z + 1) / \{(z + 0.1)(z^2 - 0.3z + 0.8)\}$	6

Q.no	Module 2	Marks
2.a	Examine the stability of the system with characteristic equation $F(z) = z^3 - 1.3z^2 - 0.08z + 0.24 = 0$	3
	Answer b or c	
b	Establish the relationship between system type and steady state errors in response to basic input signals, for a chosen discrete system.	6
c	How will you convert the transient specifications of a continuous system, to the z plane? Consider at least three specifications and explain.	6

Q.no	Module 3	Marks
3.a	How the sampling period affects the performance of a discrete time system?	3
	Answer b or c	
b	State the procedure for designing a lag compensator in the frequency domain.	6
c	Design a digital lead compensator for the system shown in Figure 3.1. Desired specifications are phase margin 55 degrees, gain margin at least 10 dB and the static velocity error constant be 5/ sec. Sampling period be 0.1 sec. Given	6

$G(s) = 1/(s\,(s+2))$

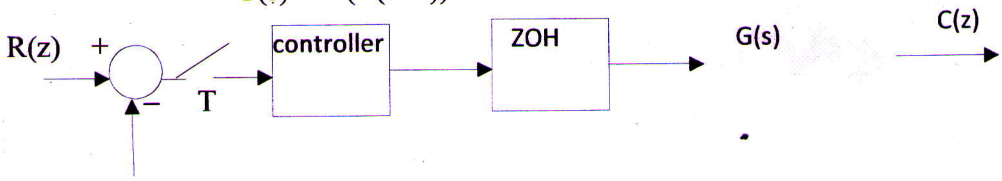

Figure 3.1.

Q.no.	Module 4	Marks
4.a	With an example show that the pulse transfer function can be transformed into a Jordan canonical form of state model.	3
	Answer b or c	
b	Obtain a discrete time state model of the continuous system $d^2y/dt^2 = u$. Also obtain the pulse transfer function.	6
c	Obtain a state space representation of the system with pulse transfer function $G(z) = (z^3 + 8z^2 + 17z + 8) / \{(z+1)(z+2)^2\}$ such that the system matrix has non zero diagonal elements. Then obtain the initial state x(0) in terms of y(0), y(1), y(2) and u(0), u(1), u(2).	6

Q.no.	Module 5	Marks
5.a	Explain a procedure to transform a system matrix into diagonal form.	4
	Answer b or c	
b	Find the state transition matrix of the discrete time system x[k+1] = G x[k] + H u[k]; y[k] = C x[k] where G = [0, 1; -0.16, -1], H = [1;1], C = [1, 0]. Also obtain x[k] and y[k] when u[k] = 1 for k = 0, 1, 2 .... Given x[0] =[1;-1].	8
c	Obtain a discrete time state model of dx/dt = - x(t) + u (t-1.5). Assume that the sampling period is 1 sec. Obtain the pullse transfer function also.	8

Q.no.	Module 6	Marks
6.a	Explain the condition for complete state controllability of a discrete time system. What do you mean by controllability matrix?	4
	Answer b or c	
b	Consider the system x(k+1) = G x(k) + H u(k) with G = [0, -0.16; 1, -1], H= [0 1]^T, C= [0 1]. Determine a full order observer such that the desired eigen values of the observer matrix are at $z = 0.5 \mp j0.5$.	8
c	Consider the standard discrete system state model with single input single output. Prove that if the system is completely state controllable and observable, then there is no pole zero cancellation in the pulse transfer function.	8