APJ ABDULKALAM TECHNOLOGICAL UNIVERSITY

08 PALAKKAD CLUSTER

Q. P. Code : PE0819252C - I **(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	Derive the Laplace transform of a sampled signal in terms of its continuous signal. Explain the properties of the spectrum of a sampled signal.	3
	Answer b or c	
b	Consider a discrete control system with feed forward gains of $G_1(s)$ and $G_2(s)$ connected in cascade with a sampler in between them. The feedback gain matrix is H(s). Derive the pulse transfer function of the system. Explain a procedure to obtain the same, from the given parameters.	6
c	Consider the digital filter defined by $G(z) = 4(z - 1)(z^2 + 1.2z + 1) / \{(z + 0.1)(z^2 - 0.3z + 0.8)\}$. Draw standard and parallel realisation diagrams. Obtain the corresponding state models. Compare them also.	6

Q.no	Module 2	Marks
2.a	What is Jury's stability criterion. Compare with Routh's criterion for discrete systems.	3
	Answer b or c	
b	Obtain the steady state error coefficients and corresponding errors of the system with open loop transfer function G(z).	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	Derive the transfer function of a digital PID controller. Compare with the continuous one.	3
	Answer b or c	
b	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 $G(s) = 1/(s\,(s+2))$	6

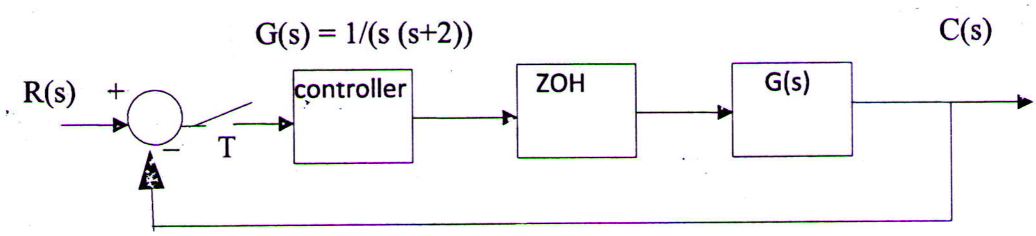

Figure 3.1.

c	Consider the system shown in Figure 3.1. Design a digital controller such that the dominant closed loop poles of the system will have a damping ratio of 0.5. There should be 8 samples per cycle of damped sinusoidal oscillations. The sampling period is 0.2 sec. Given $G(s) = 1/(s\,(s+1))$.	6

Q.no.	Module 4	Marks
4.a	Derive the relationship between state and transfer function models of a discrete time system.	3
	Answer b or c	
b	Obtain a state space representation of the system shown in Figure 4.1. The sampling period is T= 1 sec. $G(s) = 1/(s\,(s+1))$.	6

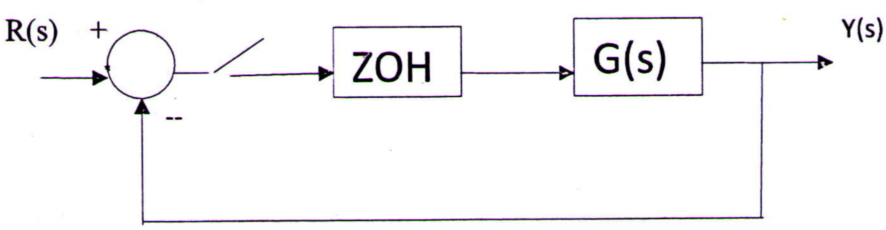

Figure 4.1.

c	Obtain a state space representation of the system with pulse transfer function $G(z) = (z^3 + 8z^2 + 17z + 8) / \{(z+1)(z+2)(z+3)\}$ such that the system matrix is diagonal. 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	Compare jordan canonical form and canonical form of state models of LTIV discrete time systems. What are the advantages of these forms?	4
	Answer b or c	
b	Obtain the discrete time state and output equations and the pulse transfer function of the following continuous time system with transfer function G(s) = 1/{s (s+1)}. Sampling period is T = 1 sec.	8
c	Consider the system G(s) = 1/{s (s+1)}. Obtain expressions for the state and output at t = kT+ ΔT, with T= 1 sec and ΔT =0.5 sec.	8

Q.no.	Module 6	Marks
6.a	Explain the concept of controllability and observability of a discrete time system.	4
	Answer b or c	
b	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
c	Consider the system x(k+1) = G x(k) + H u(k) with G = [0, 1; -0.16, -1], H= [0 1]^T. Determine a suitable feedback matrix K such that the system will have the closed loop poles at $z = 0.5 \mp j0.5$. Verify your answer by any other method also.	8

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