Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SIXTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), MAY 2019

Course Code: EE304

Course Name: ADVANCED CONTROL THEORY

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 5 marks. Marks

1		Compare the effects of P, PI and PID controllers on the closed loop system performance in terms of rise time, peak overshoot, settling time, steady state error and stability.	(5)
2		What are the effects of Lag and Lead compensators on the system performance?	(5)
3		Explain the terms (i) state (ii) state variables (iii) state vector (iv) state space (v) state trajectory of a system.	(5)
4		What is pulse transfer function? Derive the transfer function of a ZOH circuit.	(5)
5		State any five characteristics of Nonlinear systems.	(5)
6		Define Describing function. Explain how describing function can be used for stability analysis of nonlinear systems.	(5)
7		Define Singular point. Explain the nature of Eigen values of system matrix for any five types of singular points.	(5)
8		Explain Liapunov second method of stability for nonlinear systems.	(5)

PART B

Answer any two full questions, each carries 10 marks.

9		A unity feedback system has an open loop transfer function G(S) = K/[S(1+2S)]. Design a suitable lag compensator so that phase margin is 40^o and the velocity error constant is 5.	(10)
10		Design a lead compensator for a unity feedback system with open loop transfer function G(S) = K/[S(S+8)] to satisfy the following specifications. (1) Percentage overshoot = 9.5% (2) Natural frequency of oscillation=12 rad/sec (3) Velocity error constant ≥ 10.	(10)
11	a)	Explain the Ziegler-Nichols method of tuning a PID controller.	(6)
	b)	What is meant by series compensation and feedback compensation in control systems?	(4)

PART C

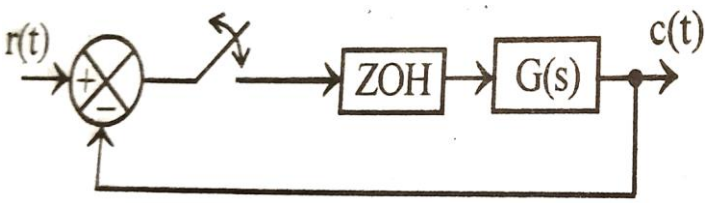
Answer any two full questions, each carries 10 marks.

12 a) Define controllability and observability of a system and check whether the system $\frac{Y(s)}{U(s)} = \frac{1}{(s+1)(s+2)}$ is controllable or not. (6)

b) Check the stability of the sampled data control system shown below (4)

$z^3-0.2z^2-0.25z+0.05=0$

13 Determine the pulse transfer function of the discrete time control system shown in figure for a sampling time of T=1 sec. Also find the response to unit step input. The transfer function of the system is G(s) = 1/(s+1). (10)



14 a) Derive the state model of an R-L-C series circuit (3)

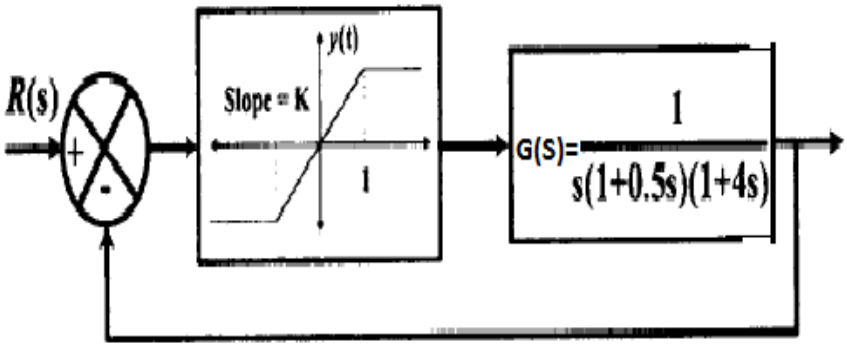
b) Consider a linear system described by the transfer function Y(s)/U(s) =10/[S(S+1)(S+2)]. Design a feedback controller with a state feedback so that the closed loop poles are placed at -2, -1±j1. (7)

PART D

Answer any two full questions, each carries 10 marks.

15 Derive the Describing function of saturation with Dead-zone nonlinearity. (10)

16 Consider a unity feedback system shown in figure having a saturating amplifier with a gain K. Determine the maximum value of K for the system to be stable. What would be the frequency and nature of limit cycle for a gain of K=2.5? (10)



17 A linear second order system is described by the equation (10)

$\ddot{e} + 2\delta\omega_n\dot{e} + \omega_n^2 e=0$

Where $\delta = 0.15$, $\omega_n = 1$rad/sec, e(0)=1.5, and $\dot{e}(0) = 0$

Determine the singular point and state the stability by constructing the phase trajectory using the method of isoclines.

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