

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

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|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| 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.

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| 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° 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) |

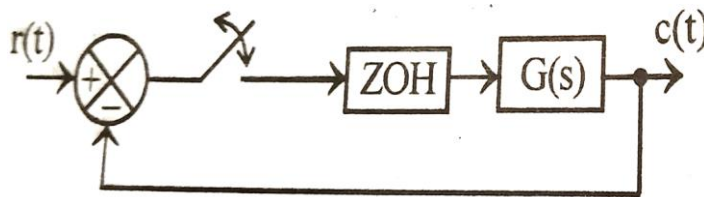
PART C

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)

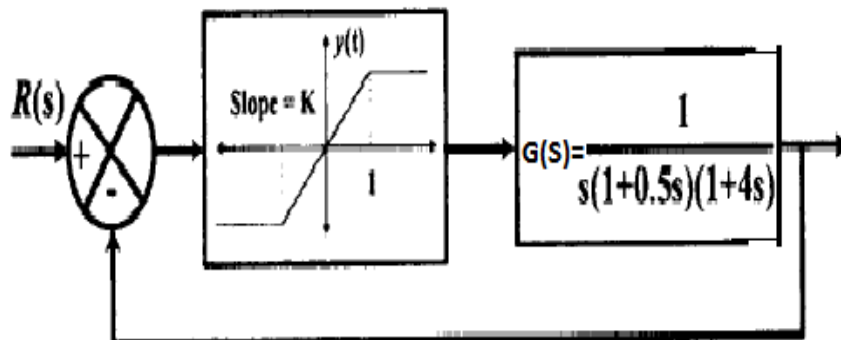
b) Consider a linear system described by the transfer function $Y(s)/U(s) = 10/[S(S+1)(S+2)]$. Design a feedback controller with a state feedback so that the closed loop poles are placed at $-2, -1 \pm j1$. (7)

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 $\ddot{e} + 2\delta\omega_n\dot{e} + \omega_n^2e = 0$ (10)

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

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