Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(S), MAY 2019

Course Code: AE405

Course Name: ADVANCED CONTROL THEORY

(Normal graph sheets will be supplied)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Explain state trajectory of LTI System (5)

b) Obtain the solution to non homogeneous state equation $\dot{X} = AX + BU$ using Laplace transform approach. (10)

2 a) Explain the terms state space, state, state variable and state vector (5)

b) Explain different types of singularities in phase plane analysis. (10)

3 a) List out the Limitations of Transfer function approach (5)

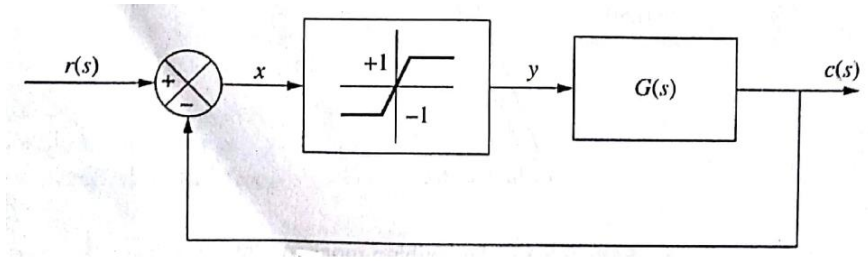
b) A second order system is represented by the differential equation $\ddot{e} + 2\zeta\omega_n\dot{e} + \omega_n^2 e = 0$ where $\zeta = 0.15$, $\omega_n = 1$ rad/sec, Find out the singularity associated with the system (5)

c) List out the advantages and disadvantages of Phase Plane analysis method (5)

PART B

Answer any two full questions, each carries 15 marks.

4 a) For the system shown in figure the relay with saturation type nonlinearity is connected with a plant having G(s)=1/s(s+1)(s+2).Determine whether the limit cycles excists. (10)



b) Explain the merits and demerits of Describing Function Method (5)

5 a) Using $V(x) = x_1^2 + x_2^2$ study the stability of the origin of the system (10)

$$\dot{x_1} = -x_1 + 3x_1^2 x_2, \qquad \dot{x_2} = -x_2$$

b) Explain stability concept based on Lyapunov Direct Method Why it is called so? (5)

6 a) A system is described by the following $\dot{x} = Ax$ where $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$. (10)
Assume matrix Q to be identity matrix, solve for matrix P in the equation $A^TP+PA = -Q$. Find the Liapunov's function $V(x)$.

b) Explain the Describing Function of Relay with saturation (5)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Find the z transform of x(t)= Cos(ω t) for $0 \leq t$
= 0 for t <0 (8)

b) Find the Inverse z transform by Partial Fraction Expansion Method (12)

$X(Z) = \frac{(1-e^{-aT})z}{(z-1)(z-e^{-aT})}$

8 a) Draw the Discrete Root Locus of the following system GH(z) $= \frac{z}{(z-1)(z-0.7)}$ (10)

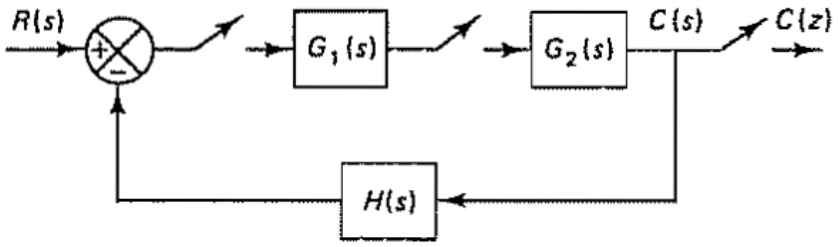
b) A system is represented by the equation, (10)

$$\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ -8 & -6 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

$$C = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

Check Controllability and Observability

9 a) Obtain the Pulse transfer function of the given closed loop system. (10)



b) Explain the effect of Pole zero cancellation on Controllability and Observability (10)

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