Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

Course Code:AE405

Course Name: ADVANCED CONTROL THEORY

(Provide normal graph sheets)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks.

Marks

1 a) Sketch the block diagram and signal flow graph of general form of state equation. (5)

b) Obtain the state model of the system whose transfer function is given as $\frac{Y(s)}{U(s)} = \frac{10}{s^3 + 4s^2 + 2s + 1}$ (10)

2 a) Compute the state transition matrix for a system represented by the state equation $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$ by Laplace transform method. (10)

b) The response of a system is $y = ax + b\frac{dx}{dt}$. Test whether the system is linear or non linear. (5)

3 a) What is singular point? How the singular points are classified? (7)

b) Describe atleast four nonlinearities with necessary characteristics. (8)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Derive the describing function of a saturation non linearity. (10)

b) Explain the advantages and disadvantages of describing function method. (5)

5 a) Determine the stability of the system described by $\dot{X} = AX$, where $A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$ by Lyapunov theorem and determine a suitable Lyapunov function. (10)

b) Explain Lyapunov stability theorem. (5)

6 a) How stability analysis is performed with the help of describing function? (7)

b) A non linear system is represented by the state equation $\dot{x}_1 = -x_1 + 0.5x_2$ and $\dot{x}_2 = x_1 + x_1x_2 - x_2^2$. Check whether the equilibrium state of the system is stable using first method of Lyapunov. (8)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Explain the effect of Pole zero cancellation on Controllability and Observability with an example. (10)

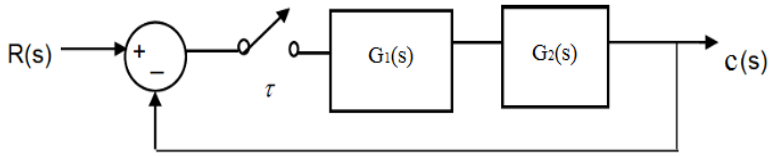
b) A linear system is represented by a state model $\dot{X} = \begin{bmatrix} -2 & -2 & 0 \\ 0 & 0 & 1 \\ 0 & -3 & -4 \end{bmatrix} X + \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 2 \end{bmatrix} U$ (10)

$Y = \begin{bmatrix} 1 & 3 & 1 \\ 1 & 2 & 0 \end{bmatrix} X$. Check whether the system is completely observable.

8 a) Find the z transform of $x(t) = \text{Sin}(\omega t)$ for $0 \le t$
$= 0$ for $t < 0$ (8)

b) Find the inverse Z transform of $X(z) = \dfrac{3 + 2z^{-1} + z^{-2}}{1 - 3z^{-1} + 2z^{-2}}$ (8)

c) Obtain the Pulse transfer function of the given closed loop system. (4)



9 a) Sketch the Discrete Root Locus of the system given by $G(z) = \dfrac{k(z+1)}{(z-1)(z-0.2)}$ (10)

b) Check whether the system represented by the following state equation is completely controllable $\dot{X} = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} X + \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} U$ (10)

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