Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

M.Tech S1 (R,S) Exam Dec 2020

Cluster: **Kollam**

Branch: Electrical and Electronics Engineering

Specialisation: Industrial Instrumentation and Control/Power Systems

02EE6131/02EE6231 DYNAMICS OF LINEAR SYSTEMS

Time: 3 Hrs Max. Marks: 60

Instructions: *Answer **All** Questions from **Part A.***

*Answer **Two Full** questions from **Part B**.*

PART A

1. **(a)** What will be the effect of addition of compensating poles and Compensating zeros of Lag and Lead compensator to a system? Explain the effect in frequency domain design approach. (5 marks)

(b) Which compensator will be designed to improve the steady state performance of a system? Explain (4 marks)

2. **(a)** Explain basic concept of Liapunov stability analysis. With the help of graphical representation explain Asymptotic stability and instability in the sense of Liapunov (5 marks)

(b) Check stability of the equilibrium point of $\dot{X} = -g(X)$, where $g(X) = X$. Apply Liapunov stability theorem by properly choosing a Liapunov Function. (4 marks)

3. **(a)** What is the significance of Jordan Canonical form in determining Controllability of a system? (4 marks)

(b) What is Detectability? Is the given system Stabilizable? Justify your answer

$$\begin{bmatrix} \dot{X}_1 \\ \dot{X}_2 \\ \dot{X}_3 \end{bmatrix} = \begin{bmatrix} 4 & 0 & 0 \\ 0 & 5 & 0 \\ 0 & 0 & -2 \end{bmatrix} \begin{bmatrix} X_1 \\ X_2 \\ X_3 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} U$$ (5 marks)

4. Derive the state error equation in the design of type 1 servo system when plant has no integrator.

What is the significance of state error equation in the design of linear state feedback controller for type 1 servo system when plant has no integrator?

(9 marks)

(4 x 9=36)

PART B

5. **(a)** A plant is given by $\dot{X} = AX + BU$ and Y=CX, Where

$$A = \begin{bmatrix} 0 & 1 \\ 20 & 0 \end{bmatrix} \; ; \; B = \begin{bmatrix} 0 \\ 1 \end{bmatrix} \; ;$$
$$C = [1 \quad 0]$$

In design of Observed state feedback Controller, the linear state feedback controller gain is given by $K = [28 \quad 4]$

Find the observer gain , so that the desired closed loop poles for observer are S= -8, -8 (6 marks)

(b) Derive the transfer function of observed state feedback controller and obtain the transfer function of the above Observed state feedback Controller

(6 marks)

6. **(a)** Explain the direct transfer function approach in design of Observer-Controller

(8 marks)

(b) Write short notes on Observability and Controllability in MIMO systems with an example (4 marks)

7. **(a)** A system is given by $\dot{X} = AX + BU$ and Y=CX, Where $A = \begin{bmatrix} -2 & 1 \\ 1 & -4 \end{bmatrix}$;

$B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, $C = [1 \quad 0]$

Design a full order observer without using Ackerman's Formulae, So that the desired eigen values for observer are $\mu_1 = -6$, $\mu_2 = -6$ (7 marks)

(b) Explain a Multi Input Multi Output system with the help of an example.

(5 marks)

(2 x 12=24)

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