Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER – VI (NEW).EXAMINATION – WINTER 2016

Subject Code: 2161707 **Date: 22/10/2016**

Subject Name: Control System Design

Time: 10:30 AM to 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Derive the state space model for RLC network. **07**

(b) Define compensation. Explain difference between lead compensation, lag compensation and lead-lag compensation. **07**

Q.2 **(a)** For an aircraft position control having open loop transfer function G(s)= K/s(s+3)(s+6). Design the suitable compensator having w_n (natural frequency)= 2rad/sec, damping ratio = 0.5 and K_v>=10sec^{-1} **07**

(b) Design suitable compensated bode plot for unity feedback system to meet the following performance specifications. Phase Margin>=35° for the system G(s)=10/s^2(0.2s+1). **07**

OR

(b) Design the compensator using Root locus for the system defined as G(s)=k/s^2. Which would satisfy the following specifications **07**
Settling Time <=4sec and Peak overshoot=20%. Draw the uncompensated and compensated root locus.

Q.3 **(a)** Design the controllability and observability for the system given below: **07**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 6 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

(b) Design the state feedback controller for the system given below using Ackermann formulae with poles s= -1+2j, -1-2j. **07**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -3 & 1 \\ -2 & 1.5 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 4 \end{bmatrix} u$$

OR

Q.3 **(a)** Design state feedback controller with observer technique with for system below with desired poles s= -10, -10. **07**

$$\mathbf{A} = \begin{bmatrix} 0 & 20.6 \\ 1 & 0 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, \quad \mathbf{C} = \begin{bmatrix} 0 & 1 \end{bmatrix}$$

(b) Find the controllability and observability for the system given below: **07**

$$\mathbf{A} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}, \quad \mathbf{C} = \begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$$

Q.4	**(a)**	Explain the control of uncertain parameter in robust control system.	**07**
	(b)	Explain dead beat response and narrate the design process for it.	**07**
		OR	
Q.4	**(a)**	Define robust control system with system sensitivity. Explain how analyze the robustness of the system.	**07**
	(b)	Explain robust PID Controller.	**07**
Q.5	**(a)**	Explain Lyapunov stability for linear system.	**07**
	(b)	Explain Linear Quadratic Regulator.	**07**
		OR	
Q.5	**(a)**	Explain optimal control system.	**07**
	(b)	Explain Internal Model Design.	**07**

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