Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI EXAMINATION – SUMMER 2025

Subject Code:3161707 **Date:30-05-2025**

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.**

			MARKS
Q.1*	**(a)**	Derive state space model of series RLC circuit.	**03**
	(b)	Check for observability of a system having following coefficient A = [0 1;-2 -3], B = [0;1] (semicolon represents new row of matrix so A is square matrix and B is column vector).	**04**
	(c)	Explain controllable canonical form with suitable example.	**07**
Q.2	**(a)**	Discuss about the advantages of state space method over conventional method.	**03**
	(b)	Give the design steps of lag compensator in frequency domain.	**04**
	(c)	Obtain the time response of the system of Q.1 (b) for unit step input.	**07**
		OR	
	(c)	Derive the Ackermann's formula for second order system.	**07**
Q.3	**(a)**	What is state-transition matrix? Give its properties.	**03**
	(b)	Obtain the transfer function for the control system having state space model as A = [0 1; 0 1], B = [0; 1], C = [1 0].	**04**
	(c)	Describe the parameters that are used to analyze the robustness of control systems.	**07**
		OR	
Q.3	**(a)**	Discuss the various Uncertainties in Parameter variation for robust control system design.	**03**
	(b)	Write steps to design a lead-lag compensator for a given system in frequency domain.	**04**
	(c)	Derive the state space model of the double integrator system.	**07**
Q.4	**(a)**	The open-loop transfer function of a unity feedback control system is given by $$G(s) = \frac{K}{s\,(1 + 0.2s)}$$ Design a suitable compensator in frequency domain for $K_v = 10$ and PM= 50^o.	**03**
	(b)	Find the state transition matrix for the matrix A given in Q.1(b).	**04**
	(c)	Derive the transfer function of lead compensator using electrical network.	**07**
		OR	
Q.4	**(a)**	Write a short note on Internal Model design.	**03**
	(b)	Discuss about systems with prefilter.	**04**
	(c)	Write a short note on the design of robust PID controlled system.	**07**

Q.5	**(a)**	The open loop transfer function of a unity feedback system is Design a suitable lag compensator using root locus technique for velocity constant $\geq$ 5 and damping ratio = 0.707. $$G(s)H(s) = \frac{K}{s(s+4)(s+5)}$$	**03**
	(b)	Explain positive definite and negative semi definite function.	**04**
	(c)	Discuss about Lyapunov's stability criteria.	**07**
		OR	
Q.5	**(a)**	Describe the design of dead beat response with example.	**03**
	(b)	Discuss about the considerations to be kept in mind while designing the robust control system	**04**
	(c)	Explain LQR and Riccatti equation.	**07**

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