Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2161707 **Date: 27/04/2017**

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		**Short Questions (2 marks each)**	**14**
	1	Comment on stability of LTI system.	
	2	State properties of State Transition Matrix	
	3	Derive transfer function of RLC circuit.	
	4	Prove that the Eigen values of system matrix A are roots of characteristics equations.	
	5	How to find transfer function if the state space model of a system is given?	
	6	Comment on gain margin.	
	7	Comment on phase margin.	
Q.2	**(a)**	State Ackermann's formula.	**03**
	(b)	What is controllable canonical form?	**04**
	(c)	Design a state feedback controller for which the state space mode is given by $\frac{dx}{dt} = Ax + Bu = \begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix} x + \begin{pmatrix} 0 \\ 1 \end{pmatrix} u$ and the desired closed loop poles are -4±4j. This is a state regulation problem.	**07**
		OR	
	(c)	Design a tracking control in state space for a system given by transfer function $\frac{Y(s)}{U(s)} = \frac{1}{s+3}$ for desired characteristics equation $s^2 + 5s + 25 = 0$. Assume that the reference is constant.	**07**
Q.3	**(a)**	State Liapunav stability criteria.	**03**
	(b)	Explain positive definite functions with example.	**04**
	(c)	Write short note on design of state observer and its importance.	**07**
		OR	
Q.3	**(a)**	Comment on diagonal canonical form.	**03**
	(b)	Give the general transfer function of lag compensator.	**04**
	(c)	Comment on gain margin and phase margin. Also write short note on the design of lead compensator in frequency domain with mathematical arguments.	**07**
Q.4	**(a)**	Comment on observable canonical form.	**03**
	(b)	Give the general transfer function for lead compensator.	**04**
	(c)	For a transfer function of a system $G(s) = \frac{K}{s(s+2)}$ design a lead compensator to achieve $K_v \geq 10$ and Phase Margin $\Phi M \geq 60^o$	**07**
		OR	
Q.4	**(a)**	Explain linear dependence and independence of vectors.	**03**
	(b)	Solve the state space equation with any method.	**04**
	(c)	For a transfer function of a system $G(s) = \frac{K}{s^2}$ design a lead	**07**

compensator so that settling time $t_s \leq 4\ sec$ and peak overshoot $\leq 20\%$. Use root locus technique.

Q.5	**(a)**	Comment on how to check the positive definiteness of a given function with suitable example.	**03**
	(b)	Comment on stability of inverted pendulum system.	**04**
	(c)	Discuss in detail about the tracking of constant reference for a given state space system.	**07**

OR

Q.5	**(a)**	Draw the block diagram of well known state space equation.	**03**
	(b)	Derive the model of separately excited DC motor.	**04**
	(c)	State algebraic Riccatti equation and write short note on LQR design.	**07**

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