Seat No.: _____

Enrolment No._____

GUJARAT TECHNOLOGICAL	UNIVERSITY

M.E –I st SEMESTER–EXAMINATION – JULY- 2012		
Subject code: 710703N	Date: 09/07/2012	
Subject Name: Modern Control System Time: 2:30 pm – 05:00 pm	Total Marks: 70	
 Instructions: Attempt all questions. Make suitable assumptions wherever necessary. Figures to the right indicate full marks. 		
Q.1(a) Explain why do we need state variable approach to control system analysis? How it is superior to classical approach?	(7)	
(b) Find the inverse of the given matrix $ \begin{bmatrix} 1 & 2 & 0 \\ 3 - 1 - 2 \\ 1 & 0 - 3 \end{bmatrix} $	(4)	
 (c) Show that every square matrix can be expressed as the sum of symmetric matrix 	tric (3)	
 Q.2 (a) Develop a state space model for the electric network shown in fig.1 ta V₁(t), V₂(t) and i(t) as the state variables. 	king (7)	
(b) Obtain the state space model for the mechanical system shown in fig.2 OR	2 (7)	
(b) The transfer function of a system is given by $\frac{Y(s)}{U(s)} = \frac{s^2 + 2s + 3}{s^4 + 2s^2 + 3s^2 + 5s + 7}$ Obtain the following state representation of this system in (a) Controllable canonical form (b) Observable canonical form	(7)	
 Q.3 (a) Explain the method of finding state controllability and output controllaboration of continuous time systems. (b) Consider the system described by the following \$\begin{bmatrix} x^1 \\ x^2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ -2 & -1 \end{bmatrix} & x^1 \\ x^2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ -2 & -1 \end{bmatrix} & x^1 \\ x^2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ -2 & -1 \end{bmatrix} & x^1 \\ x^2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ -2 & -1 \end{bmatrix} & x^1 \\ x^2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ -2 & -1 \end{bmatrix} & x^1 \\ x^2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ 1 & x^2 \end{bmatrix} & x^1 \\ 1 & y = [1 & 0] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} & y^1 \\ y_1 \\ y_2 \end{bmatrix} & y^1 \\ y_1 \end{bmatrix} &		
Q.3 (a) For the electrical network shown in fig.3 choose state variables as e_1 a and prove that system is uncontrollable (i.e. voltage across R_3 cannot be influenced by e_0) if $R_1C_1 = R_2C_2$	• •	

(b) The state variable model for a SISO system is given below $ \begin{bmatrix} x \\ 1 \\ x 2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -5 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \qquad y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} $ Determine the transfer function of the system	(5)
Q.4 (a) Find the state transition matrix for the state equation given below.	(\mathbf{f})
(a) Find the state transition matrix for the state equation given below $\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} -3 & 1 \\ 0 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$	(6)
 (b) Explain positive definite, negative definite, positive semi-definite and negative semi-definite scalar function with suitable illustrations OR 	(8)
Q.4	
(a) Prove that the system must be completely state controllable for arbitrary pole placement	(6)
(b) Design a state feedback controller given by the equation $\dot{\mathbf{x}} = A\mathbf{x} + B\mathbf{u}$ where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix}$ and $B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$ The desired closed loop pole locations are $s = -2 \pm j4$ and $s = -10$	(8)
0.5	
Q.5 (a) Explain the method of determining stability by applying Liapunov's	(6)
direct method (b) Apply Liapunov direct method to determine the stability of the system $\vec{x_1} = -2x_1 + 2x_1^2x_2 + 3x_2$ $\vec{x_2} = -x_1 - 2x_1^2x_2 - 3x_2$	(4)
Select V = $x_1^2 + (x_1 + x_2)^2$ as the Liapunov function	
(c) Explain the method of determining Liapunov function	(4)
(c) Explain the method of determining Erapunov function OR	(ד)
Q.5	
 (a) Apply Krasovski method to assess stability of the equilibrium point x(0) of the system given below 	(7)
$\dot{x_1} = -x_1, \qquad \dot{x_2} = x_1 - x_2 - \frac{x_2}{2}$	

 $\dot{x_1} = -x_1,$ $\dot{x_2} = x_1 - x_2 - \frac{x_2}{3}$ (b) What is an observer? With the help of block diagram explain full order (7) state observer. Also obtain the observer error equation.

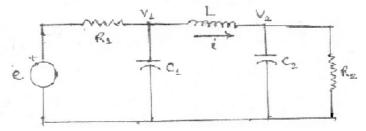


Fig 1

