Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – SUMMER • 2014

Subject code: 710301 **Date: 13-06-2014**

Subject Name: Control Engineering

Time: 02:30 pm - 05:00 pm **Total Marks: 70**

Instructions:

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

Q.1 **(a)** How pole placement is decided in state feedback? **07**

(b) State and prove Lyapunovôs stability theorem. **07**

Q.2 **(a)** Explain continuous time linear state regulator with appropriate plant. **07**

(b) Check the stability of the following system using R-H criteria **07**

(i) $3\partial^4 + 10\partial^3 + 5\partial^2 + 5\partial + 2 = 0$

(ii) $\partial^6 + \partial^5 + 3\partial^4 + 3\partial^3 + 2\partial^2 + 3\partial + 1 = 0$

OR

(b) Find the curve with minimum arc length between the point x(0)=0 and the curve, E(t) = t2 ï 10t +24. **07**

Q.3 **(a)** $\dot{x} = Ax + Bu$ $A = \begin{bmatrix} 1 & 0 & \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ $B = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 1 & 1 \end{bmatrix}$ For the system, design a linear state variable feedback such that the closed loop poles are located at -1, -2 and -3. Consider A and B as follows. **07**

(b) Write a short note on Full Order Observers. **07**

OR

Q.3 **(a)** If the system **07**

$\dot{x}(t) = Ax(t) + Bu(t)$

$y(t) = Cx(t) + Du(t)$

is controllable and b_i (Í 0) is the ith column of B, then prove that there exist a matrix K, such that the single input system $\dot{x} = (A + BK_i)\,x + b_i r_i$ is controllable.

(b) Write a short note on Optimal estimation for linear continuous time system. **07**

Q.4 **(a)** What is Dynamic programming? State and explain principle of causality and principle of invariant imbedding for optimal control system. **07**

(b) Define equilibrium point and discuss about stability at equilibrium point for linear time varying system **07**

OR

Q.4 **(a)** Derive the equations of Optimal control law, feedback gain algorithm and Optimal performance index for Discrete time Linear State Regulator problem. **07**

(b) Derive the equations for deadbeat control by state feedback. **07**

Q.5 **(a)** Why eigenvalues of matrix A have negative real parts to make linear system stable? Give your answer with necessary reasons. **07**

(b) Explain steepest descent method for optimal control problem. **07**

OR

Q.5 **(a)** Explain stochastic optimal linear regulator system in detail. **07**

(b) Give the formulation of variational calculus using Hamiltonian method. **07**

****