Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER I (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2712904 **Date:18/05/2016**

Subject Name: Control System Theory

Time:02:30 pm to 05:00 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) Explain Infinite Time Regulator Problem in detail. **07**

(b) Explain the State Regulator Problem in detail. **07**

Q.2 (a) Determine the transfer function for the following Matrix: **07**

A = $\begin{bmatrix} -3 & 1 \\ 0 & -1 \end{bmatrix}$, B= $\begin{bmatrix} 1 \\ 1 \end{bmatrix}$, C= [1 1], D= 0.

(b) Explain Preliminary Design consideration in time & frequency domain based on Root Locus. **07**

OR

(b) Explain the implementation of Digital PI Controller. **07**

Q.3 (a) Find state space representation of DC motor. **07**

(b) Diagonalize the following matrix A given below: **07**

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 3 & 0 & 2 \\ -12 & -7 & -6 \end{bmatrix}$$

OR

Q.3 (a) Explain Jury Stability Criterion in detail. **07**

(b) The Transfer function of a control system is given by **07**

$$\frac{Y(s)}{U(s)} = \frac{(S+2.5)}{s^2 + 1.5\,s - 2.5}$$

Determine whether the system is completely controllable or not?

Q.4 (a) Construct the state model for a system characterized by the differential equation, **07**

$$\frac{d^3y}{dt^3} + 10\frac{d^2y}{dt^2} + 17\frac{dy}{dt} + 9y = u$$

(b) Design sliding mode controller so that close loop system falls upon sliding line **07**

$$\begin{bmatrix} \dot{x}1 \\ \dot{x}2 \end{bmatrix} = \begin{bmatrix} 1 & 1 \\ -3 & -4 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u \quad \& \quad F = [1 \quad 0]\, x$$

OR

Q.4 (a) Explain Liapunov based stability analysis for Non-linear Systems. **07**

(b) Explain variable structure control with it's application. **07**

Q.5 (a) Explain lead-lag compensation based on Root locus approach. **07**

(b) Discuss the effect of load disturbance on control system with suitable Example. **07**

OR

Q.5 (a) Write a brief note on optimal control system. **07**

(b) Explain non-homogeneous state equations in time-domain. **07**

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