Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2013

Subject code: 712904N **Date: 06-01-2014**

Subject Name: Advance Control Theory

Time: 10.30 am – 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.**

Q.1 **(a)** Explain why do we need state variable approach to control system analysis? How it is superior to classical approach? **07**

(b) Define and discuss the concept of state, state variables, state vector and state space. **07**

Q.2 **(a)** Find out diagonal matrix for the following **07**

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

(b) Obtain e^{at} for the following matrix. **07**

$$A = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix}$$

OR

(b) Draw signal flow diagram & find out system space model for following closed loop transfer function **07**

$$\frac{C(s)}{R(s)} = \frac{10(S+4)}{S(S+1)(S+3)}$$

Q.3 **(a)** Explain the method of determining stability by applying Liapunov's direct method. **07**

(b) Explain the variable gradient method for the determination of Liapunov's function **07**

Q.3 **(a)** Explain the Krasovskii's theorem for the determination of asymptotic stability for the given nonlinear control system. **07**

(b) Apply variable gradient method to determine the stability of the system given below: **07**

$$\dot{x}_1 = -x_1 + 2x_1^2 x_2$$

$$\dot{x}_2 = -2x_2$$

Q.4 **(a)** Find Z transformation of Unit ramp function. **07**

(b) Prove that the system must be completely state controllable for arbitrary pole placement. **07**

Q.4 **(a)** Explain mapping from s- plane to z- plane with illustration. And discuss how stability of a system can be determined using z- plane. **07**

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

$$\begin{bmatrix} \dot{x}1 \\ \dot{x}2 \end{bmatrix} = \begin{bmatrix} -1 & -2 \\ 1 & -4 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \end{bmatrix} + \begin{bmatrix} 0 \\ 4 \end{bmatrix} u$$

Q.5 **(a)** What is an observer? With the help of block diagram explain full order state observer. Also obtain the observer error equation. **07**

(b) An armature controlled dc motor has constant field excitation. It is fed from a constant voltage source. The rotating parts have effective co-efficient moment of inertia J and frictional co-efficient f. The armature resistance and inductance is R and L respectively. For motor shaft output angular position, express the system performance in suitable variable form. **07**

Q.5 **(a)** Explain adaptive control system. **07**

(b) Explain Variable structure control with appropriate example. **07**

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