Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject code: 712904N **Date: 17-06-2013**

Subject Name: Advanced 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.**
4. **Notations used have usual meaning.**

Q.1 **(a)** Define and explain following terms, **07**

(1) State.
(2) State space.
(3) State variable.

(b) A system is having following matrix, **07**

$$A = \begin{bmatrix} 4 & 1 & -2 \\ 1 & 0 & 2 \\ 1 & -1 & 3 \end{bmatrix}$$

Find the eigenvalues and eigenvectors.

Q.2 **(a)** A control system has a transfer function given by, **07**

$$G(s) = \frac{s+3}{(s+1)(s+2)^2}$$

Obtain the state space model using parallel decomposition.

(b) Construct the Nyquist plot for a feedback control system whose open-loop transfer function is given by, **07**

$$G(s)H(s) = \frac{K(1+s)}{(1-s)}$$

And comment on the stability.

OR

(b) Draw the complete Nyquist plot for a system whose open-loop transfer function is, **07**

$$G(s)H(s) = \frac{K}{s(s+2)(s+10)}$$

Also determine the value of K for closed loop system is stable.

Q.3 **(a)** For the system represented in state space as follows: **07**

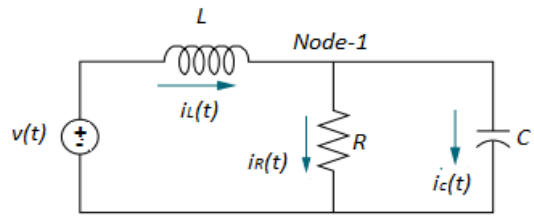
$$\dot{x} = \begin{bmatrix} 1 & 3 \\ -4 & -6 \end{bmatrix} x + \begin{bmatrix} 1 \\ 3 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 4 \end{bmatrix} x$$

Convert the system to one where the new state vector, z, is

$$z = \begin{bmatrix} 3 & -2 \\ 1 & -4 \end{bmatrix} x$$

(b) For the following electrical network find the state space representation. **07**



OR

Q.3 **(a)** Explain the mapping between s plane and z plane. **07**

(b) Find the z-transform of the discrete ramp function. **07**

$$g(k) = k\,,\ k \geq 0$$
$$g(k) = 0\,,\ k < 0$$

Q.4 **(a)** Write a brief note on Phase plane Analysis with suitable example. **07**

(b) Obtain a transfer function of a system if, **07**

$$\dot{x} = \begin{bmatrix} -5 & -1 \\ 3 & -1 \end{bmatrix} x + \begin{bmatrix} 2 \\ 5 \end{bmatrix} u$$
$$y = \begin{bmatrix} 1 & 2 \end{bmatrix} x$$

OR

Q.4 **(a)** Explain Variable structure control in control system with appropriate example. **07**

(b) Determine the controllability and observability of the following system, **07**

$$\dot{x} = \begin{bmatrix} -1 & 1 & 2 \\ 0 & -1 & 5 \\ 0 & 3 & -4 \end{bmatrix} x + \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix} u$$
$$y = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix} x$$

Q.5 **(a)** Determine the stability of following system with closed loop transfer function, **07**

$$T(s) = \frac{10}{s^5 + 2s^4 + 3s^3 + 6s^2 + 5s + 3}$$

(b) Obtain state space representation of field controlled DC motor. **07**

OR

Q.5 **(a)** Write a short note on Optimal Control system. **07**

(b) Explain state observer and its design procedure with illustration. **07**

****