Seat No.: ________ Enrolment No.____________

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER 2012

Subject code: 712904N **Date: 16-01-2013**

Subject Name: Advanced Control Theory

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 marks.**
4. **Notations used have usual meaning.**

Q.1 **(a)** Find state space transformation of series RLC network energized through step input. **07**

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

$$G(s)H(s) = \frac{s+2}{(s+1)(1-s)}$$

And comment on stability of the system.

Q.2 **(a)** Write a brief note on optimal control system. **07**

(b) Construct signal flow graph and state model for a system whose transfer function is, $\dfrac{C(s)}{R(s)} = \dfrac{s^2+3s+3}{s^3+2s^2+3s+1}$ **07**

OR

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

$$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{d\ y}{dt} + 6y = u$$

Give the block diagram representation of the state model.

Q.3 **(a)** Explain variable structure control. Discuss, Where it is used? **07**

(b) Consider the dynamical system characterized by, **07**

$$\dot{x}_1 = x_2$$

$$\dot{x}_2 = x_3$$

$$\dot{x}_3 = -12x_2 - 7x_3 + u$$

Determine whether the system is controllable.

OR

Q.3 **(a)** Find Z transformation of Unit ramp function. **07**

(b) Find $x(kT)$ if $X(z)$ is given by the sampled time function of, **07**

$$X(z) = \frac{10z}{(z-1)(z-2)}$$

Q.4 **(a)** Explain phase plan technique with appropriate example. **07**

(b) Find Eigen value and Eigen vector of the system having, **07**

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

OR

Q.4 **(a)** Find the state transition matrix Φ(t) for, **07**

$$\dot{x} = \begin{bmatrix} -2 & 1 & 0 \\ 0 & -2 & 1 \\ 0 & 0 & -2 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

(b) A linear time variant system is characterized by the homogeneous state equation, **07**

$\dot{x} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \end{bmatrix} x$ with initial condition $x^T(0) = \begin{bmatrix} 1 & 0 \end{bmatrix}$

Compute the solution of the homogeneous equation.

Q.5 **(a)** Explain lyapunov based stability analysis with suitable example. **07**

(b) The system represented in state space **07**

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

$$y = \begin{bmatrix} 0 & 0 & 1 \end{bmatrix} x$$

Design state observer so that eigen values are at -4, $-3 \pm j1$.

OR

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

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

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