**Seat No.: _____** **Enrolment No._____**

# GUJARAT TECHNOLOGICAL UNIVERSITY

## ME Semester –I Examination Feb. - 2012

**Subject code: 712904N** **Date: 21/02/2012**
**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)** Obtain state variable representation of an armature controlled DC motor. **07**

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

**Q.2** **(a)** The transfer function of the system is given as, **07**

$$\frac{Y(s)}{U(s)} = \frac{s+3}{s^3+5s^2+8s+4}$$

Obtain the state variable model of the system.

**(b)** The transfer function of a system is given by, **07**

$$\frac{Y(s)}{U(s)} = \frac{2}{s^3+6s^2+11s+6}$$

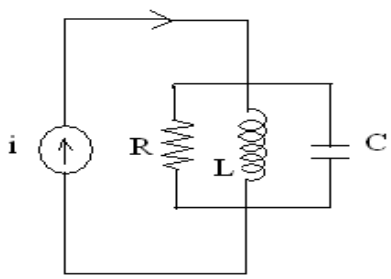
Find controllability of system

**OR**

**(b)** Obtain $e^{At}$ for the system, **07**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 2 & 3 \\ 0 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

**Q.3** **(a)** Obtain state space model for parallel RLC network energized through step input current source. **07**




**(b)** Draw nyquist plot for system, **07**

$G(s)H(s) = \dfrac{1}{s^2(s+a)}$, $a > 0$. And find the stability of system.

**OR**

**Q.3** **(a)** For given plant, **07**

$$\frac{Y(s)}{U(s)} = \frac{10}{(s+1)(s+2)}$$

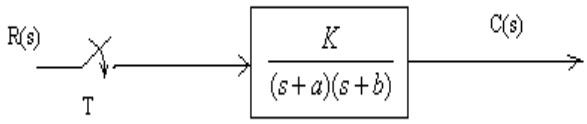
Design state feedback for the plant represented in cascade form to yield a 15% overshoot with a settling time of 0.5 second.

**(b)** Obtain the response of the states of following system, **07**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} -1 & 0 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u,$$

Where $u$ is the unit step occurring at t=0 and $x^T(0) = [1 \quad 0]$

**Q.4** **(a)** Obtain the pulse transfer function of the system shown as, **07**



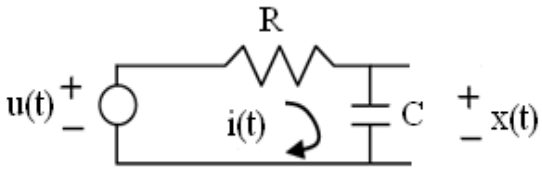

**(b)** For system described by, **07**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Determine the stability of this state using liapunov criteria.

**OR**

**Q.4** **(a)** Discuss about asymptotic stability of RC network, **07**




**(b)** Explain phase plane method with suitable example. **07**

**Q.5** **(a)** Discuss variable structure control with its merits and demerits. State its application. **07**

**(b)** Design full order observer for the system, **07**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u, \qquad y = [0 \quad 1] \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

Such that desired eigen values of the observer matrix are $\mu_1 = -10$, $\mu_2 = -10$

**OR**

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

**(b)** Find the eigen values and eigen vector for, **07**

$$\dot{x} = \begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix} x$$

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