Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E –Ist SEMESTER–EXAMINATION – JULY- 2012

Subject code: 712904N **Date: 11/07/2012**

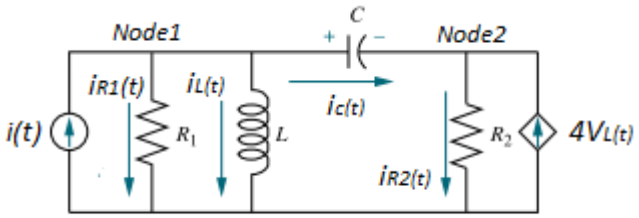
Subject Name: Advanced Control Theory

Time: 2:30 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 following Electric circuit as shown in fig. **07**



(b) Find the state space representation of the following system having transfer function, **07**

$$\frac{C(s)}{R(s)} = \frac{24}{s^3 + 9s^2 + 26s + 24}$$

Q.2 **(a)** Discuss the effect of load disturbance on control system with suitable example. **07**

(b) Draw the Nyquist plot for, **07**

$G(s)H(s) = \dfrac{k(s+3)}{s(s-1)}$ And hence comment on stability.

OR

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

$$G(s)H(s) = \frac{5}{s(1-s)}$$

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

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

$$\dot{x} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -2 & -5 & -7 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

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

Transform the system to a new set of state variables z, where the new state variables are related to the original state variables x, as follows:

$z_1 = 2x_1$, $z_2 = 3x_1 + 2x_2$ and $z_3 = x_1 + 4x_2 + 5x_3$

OR

Q.3 **(a)** Find Z transformation of following functions. **07**

(i) Unit step

(ii) Unit ramp

(b) Find the sampled time function of, **07**

$$F(z) = \frac{0.5z}{(z-0.5)(z-0.7)}$$

Q.4 **(a)** Explain how stability is determined in Z-plane. **07**

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

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

OR

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

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

(b) Determine whether the following system is controllable. **07**

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

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

(b) Write a brief note on phase plane technique. **07**

OR

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

(b) Write a brief note on optimal control system **07**

****