

NIRMA UNIVERSITY
INSTITUTE OF TECHNOLOGY
B. Tech. Semester - III (Electrical), July 2010
2EE209: NETWORK ANALYSIS & SYNTHESIS

HANDOUT 3
INITIAL CONDITIONS

Contents:

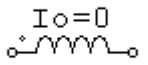
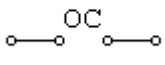
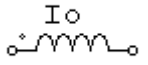
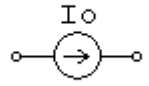
- 1. Introduction to Initial Conditions**
- 2. Importance of initial conditions**
- 3. Initial conditions in various elements such as resistor, capacitor and inductor at $t=0+$ and at $t=\infty$**

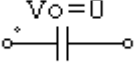
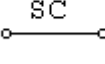
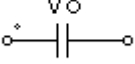
The instant at which the network equilibrium is changed is denoted as $t=0$. The conditions existing at this instant are known as **initial conditions**.

Initial values of quantities such as voltage and current can be determined after switching i.e. at $t=0+$ if the values of these quantities are known prior to switching i.e. at $t=0$

Importance of Initial Conditions:

- To evaluate constants in differential equations
- To know the behavior of the elements at the instant of switching.
- To know the elements individually and in combination which is essential in network analysis.

Initial Conditions in Elements	Equivalent circuit at $t=0+$	Comments
		No change in value as current instantaneously changes with the change in voltage.
		Current can't change instantaneously so it acts as OC immediately after switching i.e. at $t=0+$ as initial current was zero.
		Current can't change instantaneously so it acts as a current source at $t=0+$ as initial current is not zero.

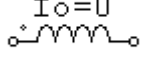
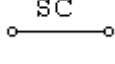
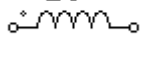
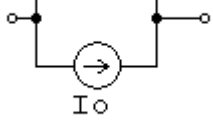
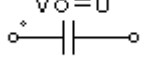
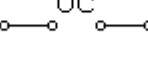
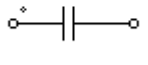
$V_0 = 0$ 		Voltage can't change instantaneously so it acts as SC immediately after switching i.e. at $t=0+$ as initial voltage was zero.
V_0 	V_0 	Voltage can't change instantaneously so it acts as a voltage source at $t=0+$ as initial voltage is not zero.

Final Conditions: ($t=\infty$)

When an element in a network remains for sufficiently long time, quantity attains steady state where derivatives become zero so from basic relationships of $V_L=0$ and $I_C=0$, at $t=\infty$ so inductor acts as SC and capacitor as OC at $t=\infty$

$$V_L = L \frac{di}{dt}$$

$$I_C = C \frac{dv}{dt}$$

Initial Conditions in Elements	Equivalent circuit at $t=\infty$
R 	R 
$I_0 = 0$ 	
I_0 	
$V_0 = 0$ 	
V_0 	V_0 