Paper 1, TDC Part-1
Chapter– 1, Introduction to Passive Elements
Inductor Lecture 5

By:

Mayank Mausam

Assistant Professor (Guest Faculty)

Department of Electronics

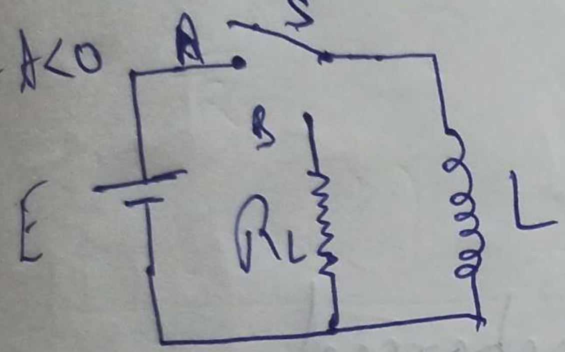
L.S. College, BRA Bihar University,

Muzaffarpur, Bihar

Introduction to Passive Elements- Inductor

Discharging of Inductor :->

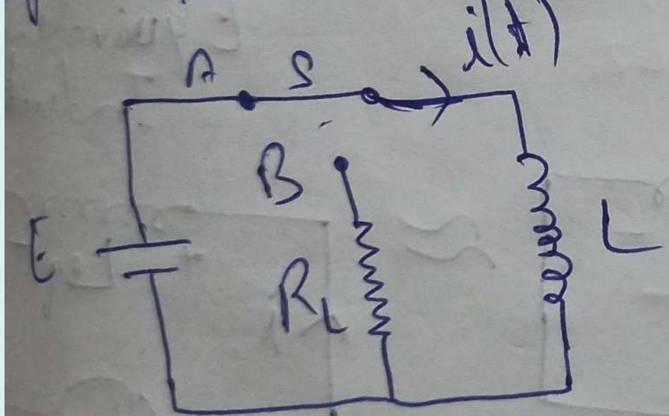
for $t<0$



At $t \leq 0$ the ckt is open & switch S is at open condition.

Now at $t = 0$ we have closed the switch then we have current

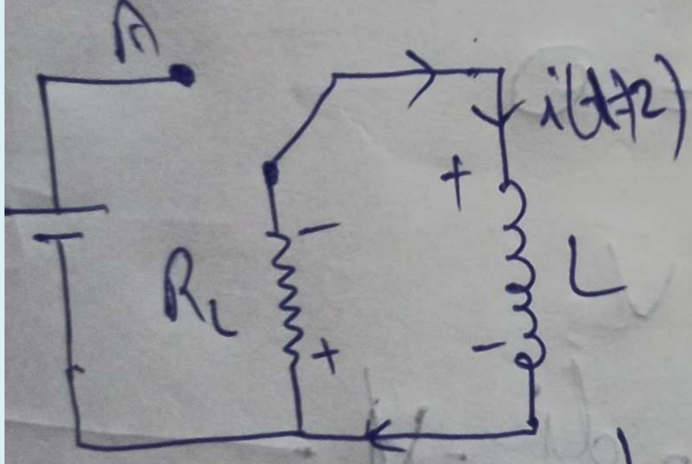
for $t \geq 0$



So $i(t) = \frac{E}{L} t$

Introduction to Passive Elements- Inductor

Now at $t = 2(s)$ the switch S is moved to position B the we have,



at $t = 2s$, R_L is connected across the inductor with initial current $i(t = 2s)$ which has been inherited by inductor L.

For this new case we can say,

$\cancel{L\frac{di(t)}{dt} + R_L\, i(t) = 0}$ $\quad L\frac{di}{dt} + R_L\, i = 0$

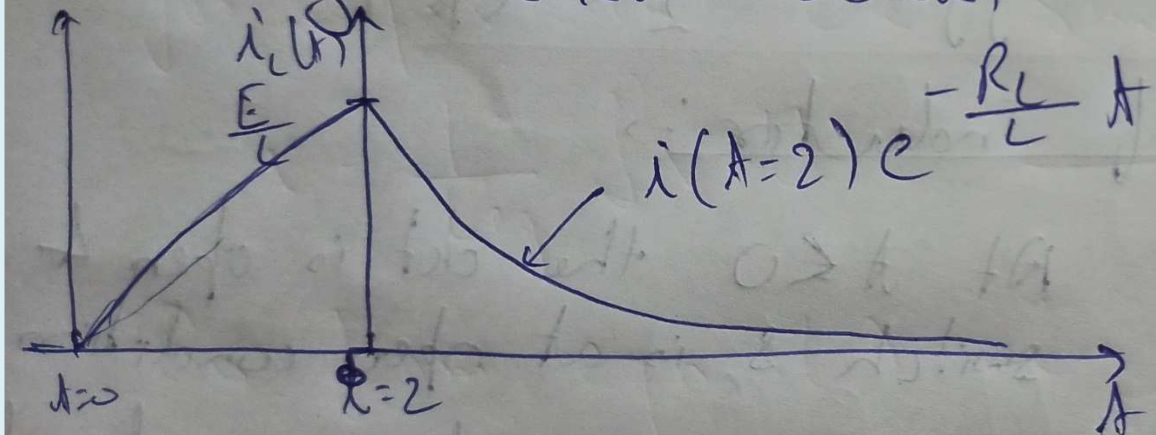
Introduction to Passive Elements- Inductor

or, $$\frac{di}{dt} + \frac{R_L}{L} i = 0$$

As done previously we get

$$i_L(t) = i(t=2)\, e^{-\frac{R_L}{L} t}$$

So this inductor current will decay, exponentially as shown below,



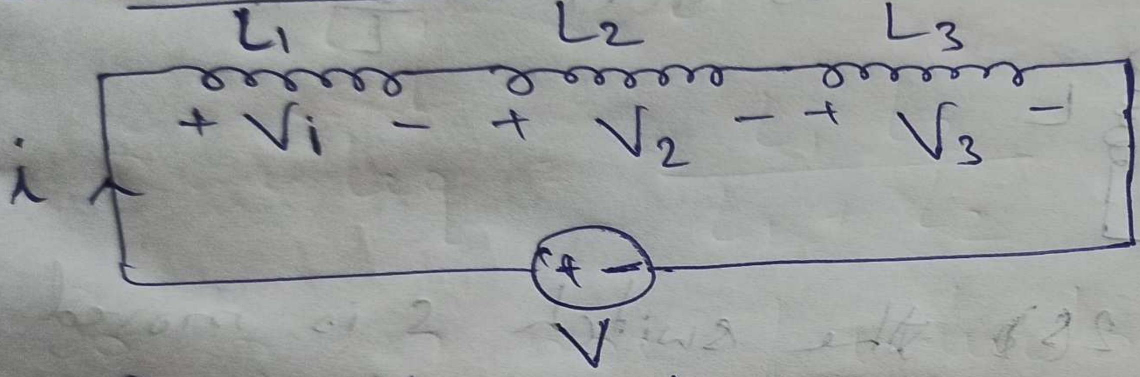
So this way inductor get discharged.

Introduction to Passive Elements- Inductor

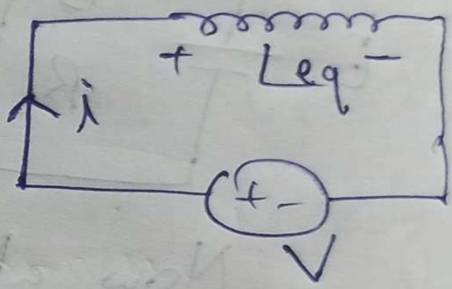
Series & Parallel Combination of Inductance

~~Series~~ Connection

Equivalent Inductance



$\approx$



As we know by KVL

$-V + V_1 + V_2 + V_3 = 0$

or, $V_1 + V_2 + V_3 = V$

$L_1\frac{di}{dt} + L_2\frac{di}{dt} + L_3\frac{di}{dt} = V$ —————— (i)

Also ~~for~~ equivalent ckt. shown in

Introduction to Passive Elements- Inductor

We have,

$$L_{eq}\frac{di}{dt} = V \qquad \text{———— (ii)}$$

from eq.n (i) & (ii) we can write

$$L_{eq}\frac{di}{dt} = L_1\frac{di}{dt} + L_2\frac{di}{dt} + L_3\frac{di}{dt}$$

or, $$L_{eq}\frac{di}{dt} = (L_1 + L_2 + L_3)\frac{di}{dt}$$

or, $$L_{eq} = L_1 + L_2 + L_3$$

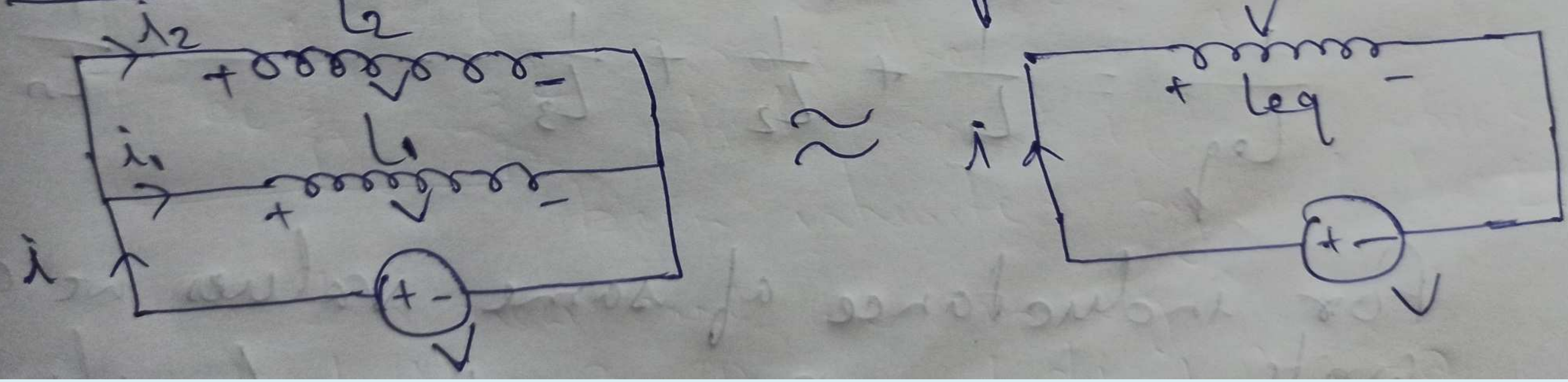
So in series combination of inductances the equivalent inductance is the sum of all inductance connected in series.

Introduction to Passive Elements- Inductor

Let n inductances with respective inductance of L_1, L_2, L_3 ---- L_n are connected in series then the equivalent inductance ~~of the~~ is given by,

$$L_{eq} = L_1 + L_2 + L_3 + \text{----} + L_n$$

Parallel Connection of Inductance



Introduction to Passive Elements- Inductor

As we know as per KCL we have. and there is no initial current, i.e.

$i = i_1 + i_2$ $\qquad$ $i(t=0) = 0$

$$i = \frac{1}{L_1}\int v\,dt + \frac{1}{L_2}\int v\,dt \qquad \text{(i)}$$

for equivalent ckt shown

$$i = \frac{1}{L_{eq}}\int v\,dt \qquad \text{(ii)}$$

So from eqn. (i) & (ii) we have

$$\frac{1}{L_{eq}}\int v\,dt = \frac{1}{L_1}\int v\,dt + \frac{1}{L_2}\int v\,dt$$

Introduction to Passive Elements- Inductor

or $\frac{1}{L_{eq}} = \frac{1}{L_1} + \frac{1}{L_2}$

or $L_{eq} = \frac{L_1 L_2}{L_1 + L_2}$

So for n nos of inductors conducted in parallel we ~~have~~ can give equivalent inductance as,

$$\frac{1}{L_{eq}} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3} \cdots\cdots \frac{1}{L_n}$$

For inductance of same values we can write,

$\frac{1}{L_{eq}} = \frac{n}{L}$ or, $L_{eq} = \frac{L}{n}$ when n = any +ve integers.

Introduction to Passive Elements - Inductor

For any query contact- 9771474020

Thank You

To be Contd..