Paper 1, TDC Part-1
Chapter– 1, Introduction to Passive Elements
Inductor Lecture 3

By:

Mayank Mausam

Assistant Professor (Guest Faculty)

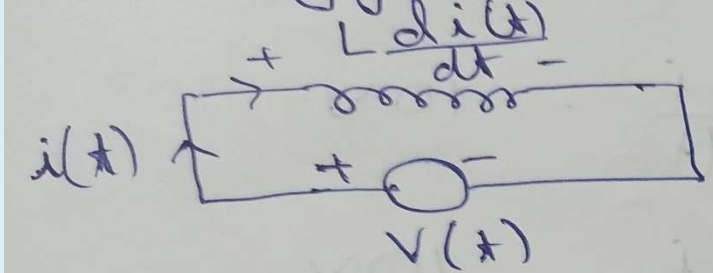
Department of Electronics

L.S. College, BRA Bihar University,

Muzaffarpur, Bihar

Introduction to Passive Elements- Inductor

Energy Stored in Inductor



$$p(t) = L\frac{di(t)}{dt} \times i$$

Energy supplied to the inductor in time "dt" ($dt \to 0$)

$$dw = L\frac{di}{dt} \times i \times dt = L\,i\,di$$

So energy supplied to inductor

$$w = L\int_0^I i\,di = \frac{1}{2}LI^2$$

This energy is stored in magnetic field (magnetic lines of force). Therefore what energy has been supplied by voltage source is not lost.

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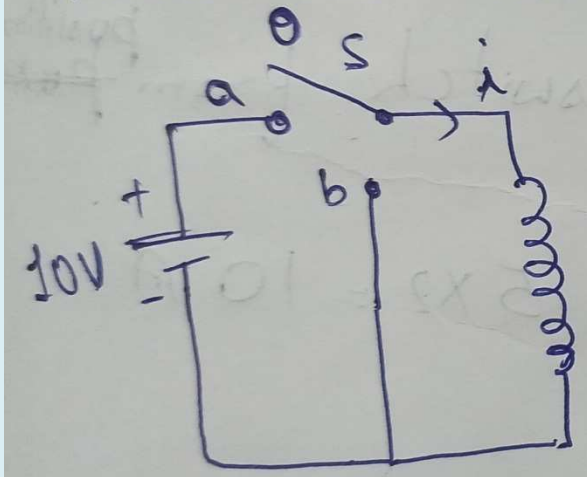
So

2A $L = 0.5$ H → then

$$W = \frac{1}{2} L I^2 = \frac{1}{2} \times 0.5 \times 2^2 = 1 \text{ Joule}$$

Now let us look



Before $t < 0$ the switch is open i.e. it at position '0'. At at $t = 0$ the switch moved to the position 'a' then we have $i(0^-) = 0 = i(0) = i(0^+)$

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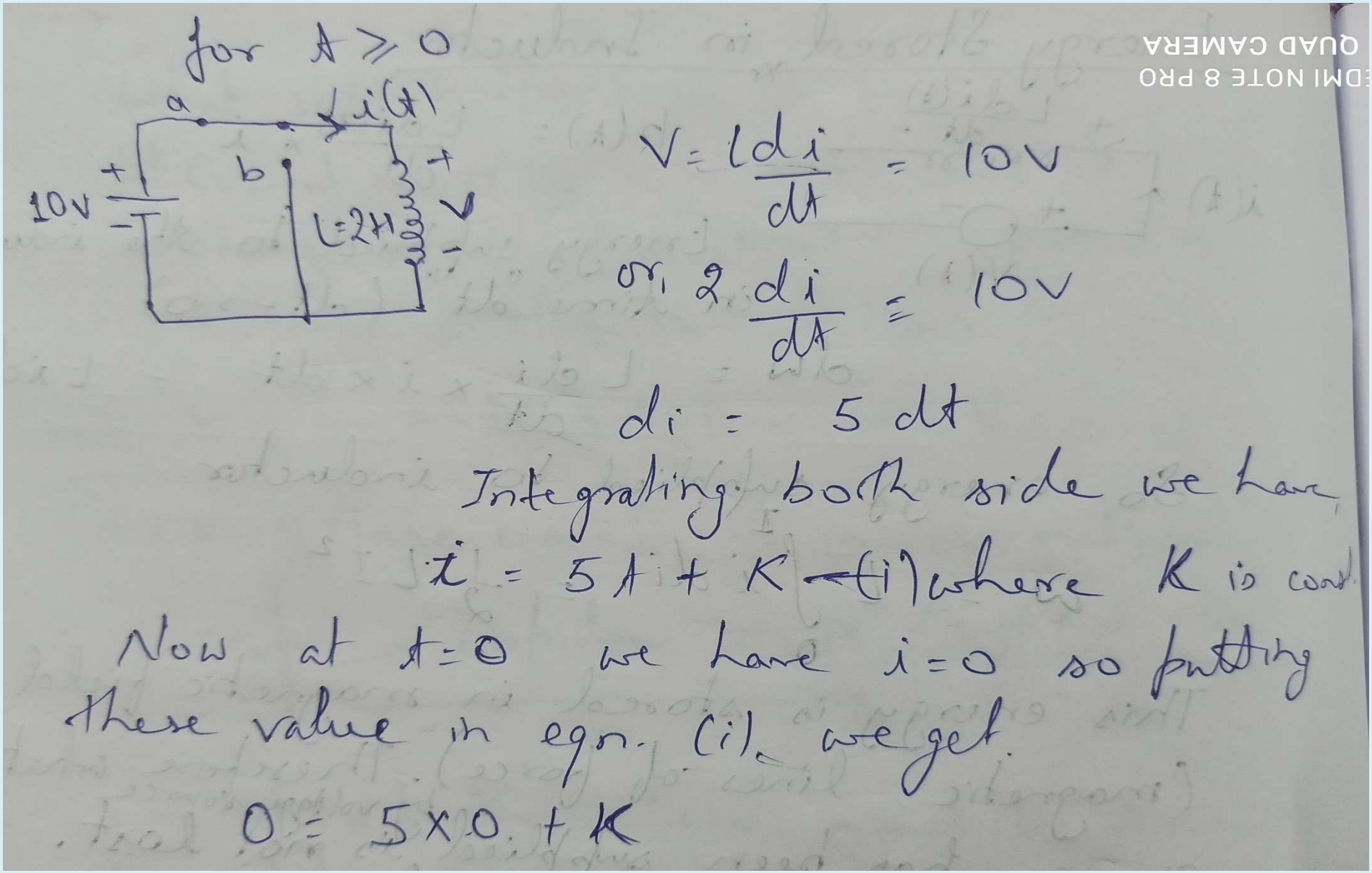

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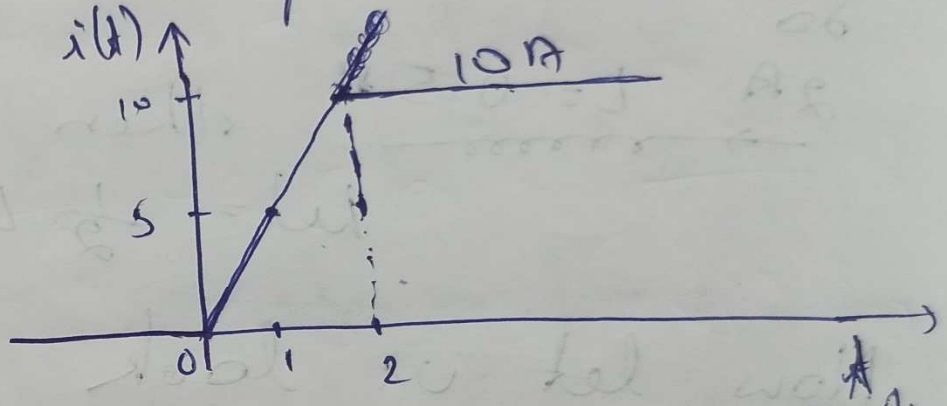
$0 = 5 \times 0 + K$

$K = 0$

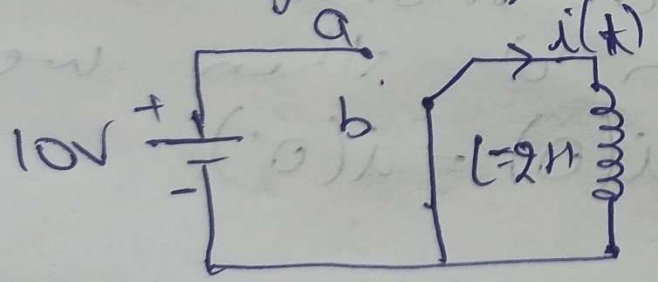
So, $i = 5t$ → Slope



Now at $t = 2s$ move the switch from position 'a' to 'b'

at $t = 2s$ we have $i = 5 \times 2 = 10A$

and for $t \geq 2$



So $i(t = 2^-s) = 10A$

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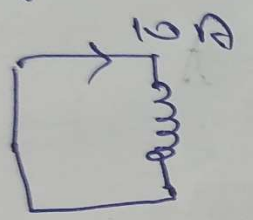
Now, $L\frac{di}{dt} = 0 \Rightarrow 2\frac{di}{dt} = 0$

this means i must be constant for $t \geq 2$

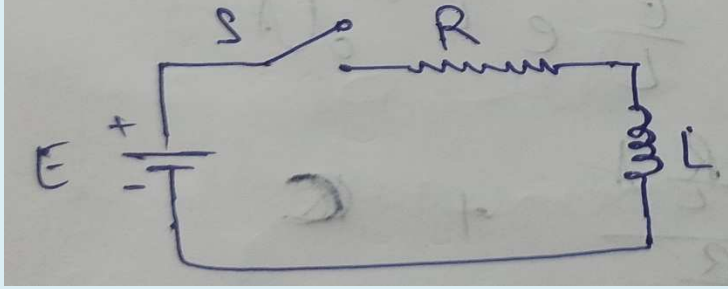
So for $t > 2$



Energy stored in the inductor at $t \geq 2$

$$W = \frac{1}{2} \times L i^2 = \frac{1}{2} \times 2 \times 100 = 100\ J$$

R-L series Ckt:-



for $t < 0$ S → opened

So $i(0^-) = 0 = i(0)$

At $t = 0$ S is closed

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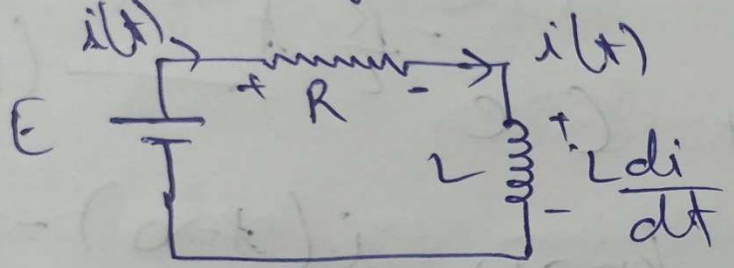
Ckt for $t \geq 0$



$i(0^+) = i(0) = i(0^-) = 0$

Now applying KVL in above ckt we have

$$-E + Ri + L\frac{di}{dt} = 0$$

or $Ri + L\frac{di}{dt} = E$ ⟶ 1st Order LDE

Dividing above eqn. by L on both side

$$\frac{di}{dt} + \frac{R}{L}i = \frac{E}{L} \quad \longrightarrow (A)$$

Here we get Integrating factor $e^{\frac{R}{L}t}$

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For any query contact- 9771474020

Thank You

To be Contd..