Paper 1, TDC Part-1
Chapter– 1, Introduction to Passive Elements
Inductor Lecture 2

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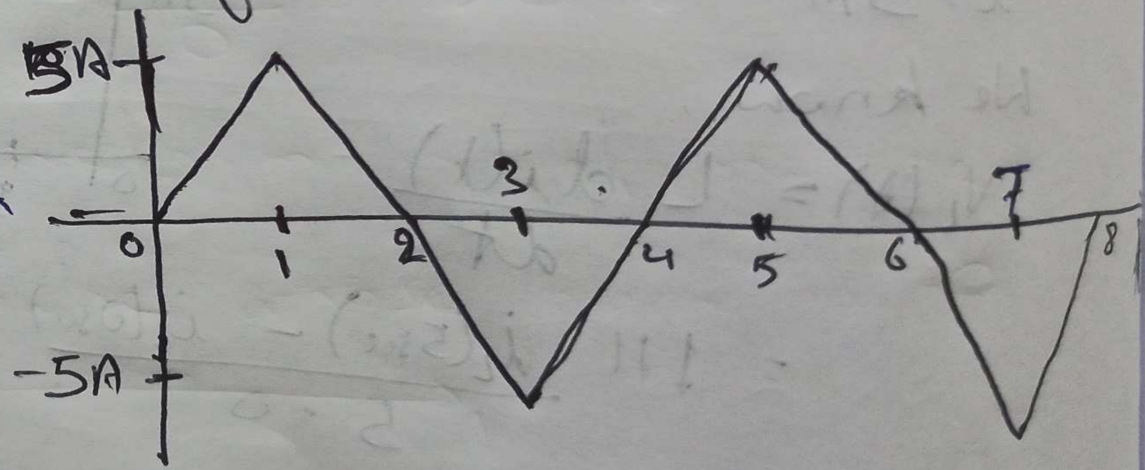
Introduction to Passive Elements

Nature of Current and Voltage waveform through the inductor

Suppose the current waveform shown below applied to a inductor with inductance 2 H. Then draw the voltage waveform.



As we know that the voltage ~~through~~ across any inductor is given by,

$$V_L(t) = L \frac{d\,i_L(t)}{dt}$$

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For 0 to 1 sec we have

$$V_L(t) = 2H \times \frac{i_L(1\,sec) - i_L(0\,sec)\,A}{1 - 0\ s} = \frac{2H[5-0]}{1}$$

$$= 10V$$

Now for 1 sec to 3 sec, we have

$$V_L(t) = 2H \times \frac{i_L(3\,sec) - i_L(1\,sec)\,A}{(3-1)\,s} = \frac{2H \times [-5-5]A}{2\,s}$$

$$= -10V$$

then for 3 sec to 5 sec, we have

$$V_L(t) = \frac{2H \times [i_L(5\,sec) - i_L(3\,sec)]}{(5-3)\,s} = \frac{2H \times [5-(-5)]A}{2s}$$

$$= 10V$$

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then for 5s to 7s we have same condition as for (1s to 3s) so, we have

$$V_L(t) = -10V$$

and at last for 7s to 8s,

$$V_L(t) = 2H \times \frac{i_L(8s) - i_L(7s)}{(8-7)s} = \frac{2H \times [+0 - (-5)]A}{1s}$$

$$= 2 \times 5V = +10V$$

So the nature of waveform is,

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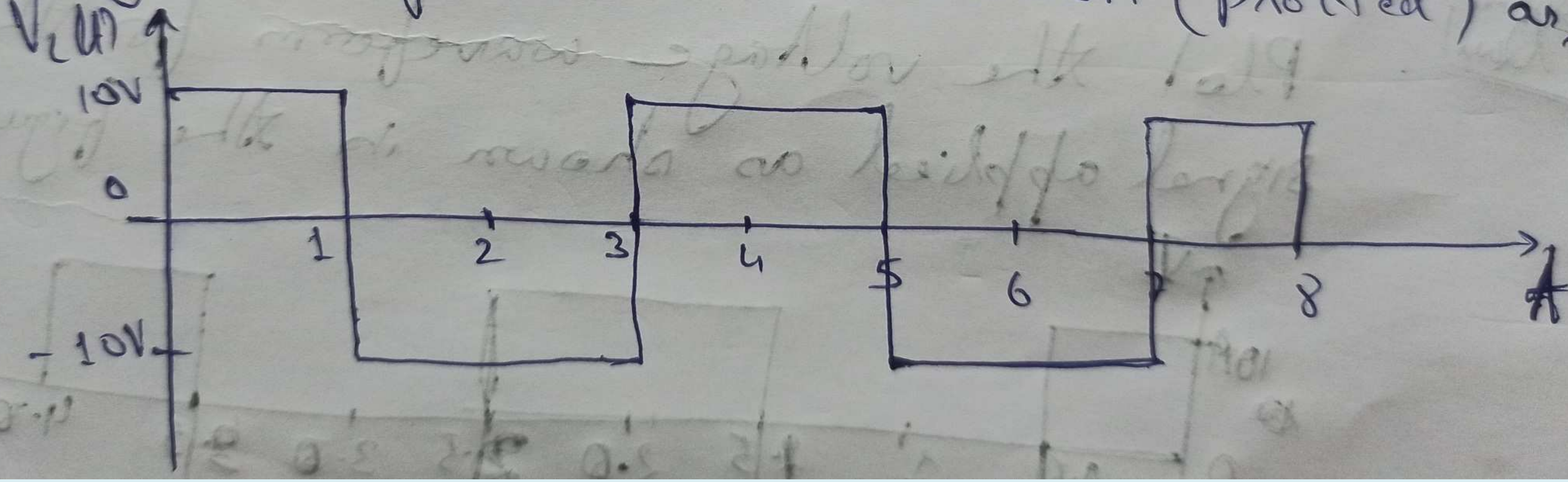
$$V_L(t) = 10\text{ V}; \quad 0 \le t \le 1\text{s}$$
$$= -10\text{ V}; \quad 1\text{s} \le t \le 3\text{s}$$
$$= 10\text{ V}; \quad 3\text{s} \le t \le 5\text{s}$$
$$= -10\text{ V}; \quad 5\text{s} \le t \le 7\text{s}$$
$$= 10\text{ V}; \quad 7\text{s} \le t \le 8\text{s}$$

Voltage waveform can be drawn (plotted) as,



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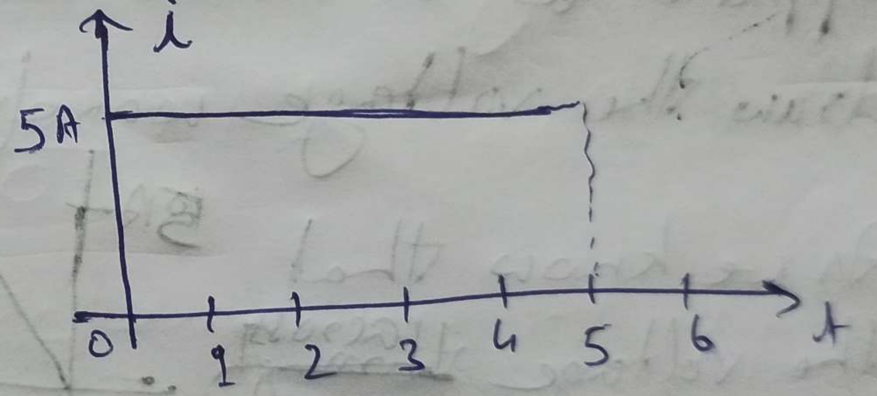
Nature of Voltage and current waveform through any Inductor :-

Let $i = 5A$ passes through inductor of Inductance 1 H for 5 sec, then find the voltage through the inductor.

- $i = 5A$ ⟶



We know,

$$V_L(t) = L\frac{di(t)}{dt}$$

$$= 1H\ \frac{i_L(5sec) - i_L(0sec)}{5-0} = \frac{1H \times (5A - 5A)}{5\ sec} = 0V$$

⟹

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What will be voltage at $t = 0$ sec

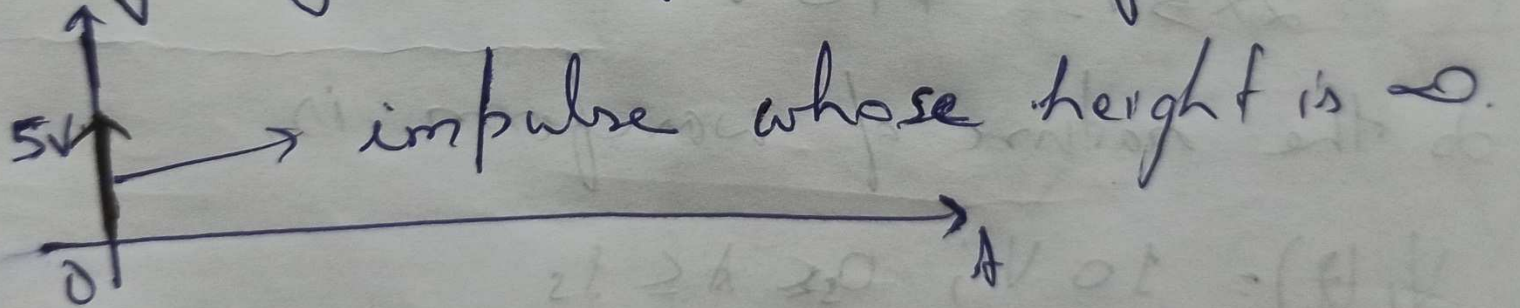
Current at 0^+ (s) is → 10 A and at 0^- (s) = 0 A

so change in current is $(10 - 0) = 10$ A

but change in time is = 0 sec ; so,

$$V_L(t)_{t=0} = 1\,H \times \frac{10A}{0} = \infty\,V$$

i.e. Voltage waveform is of nature.



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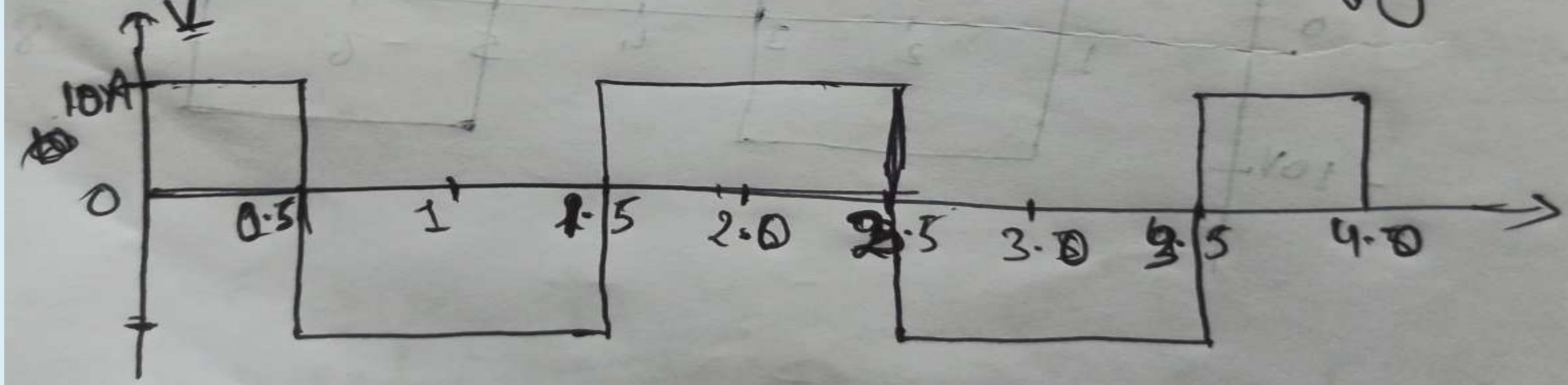
we represent the impulse signal by area of the impulse which is here given by change in height of applied current at t = 0 sec which is 5. So the area of this impulse signal is 5V.

Plot the voltage waveform for the current signal applied as shown in the figure below,



The inductance of the inductor is 0.5 Henry.

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For any query contact- 9771474020

Thank You