Basic Electrical Circuits
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Lecture - 19
Extreme Cases Open and Short Circuits

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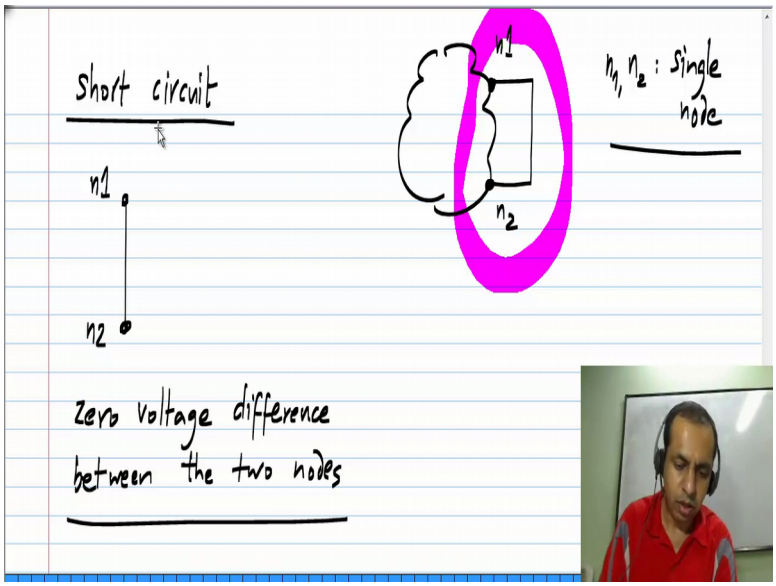

In this part we look at a couple of degenerate cases which are still concepts, which are useful in circuit design. And these are open and short circuits. Now when I say short circuit, I have to say that it is a short circuits between these two nodes n 1 and n 2. There are many ways to considered this. So, let say I have a node n 1 here, and I have node n 2 here, and I say that there is a short circuit between them. We know that a short circuit is nothing but an ideal wire connecting these two.

So, there are many ways to deal with this. So firstly, one thing we can do this, not treat this as two separate nodes, but treat them as a single node that is always possible. We do not even considered two separate nodes, but many times may be while in the course of analysis, we would have considered two separate nodes and there happens to a short circuits between them, all these are possible. So, we will look at the nature of the short circuit it is quite trivial really, but we still looked that. So, what are the short circuits between n 1 and n 2 mean, it means that there is zero voltage differences between the two nodes. Now zero voltage between these two nodes.

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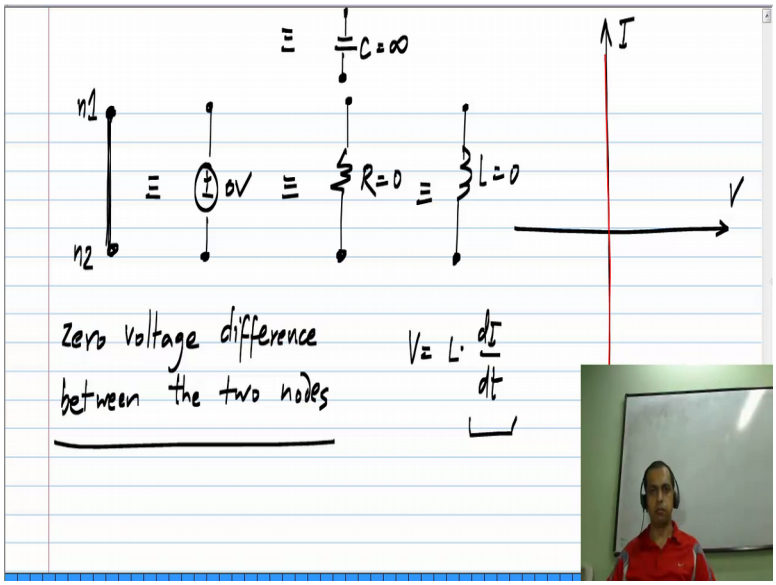

So, if I go and draw IV characteristic of this, obviously, the voltage is always zero, and any current can flow through the short circuit all this wire. So, the characteristic looks like this, such vertical line passing through the origin. Now from this it is obvious that this can be represented as a voltage source of value zero, which is also equivalent to a resistance source - a resistance of value zero. So, these obviously, you know that if R is 0 then from V equals IR; V will always be equal to zero. So, these are all equivalent concepts to having short circuits between these two nodes that is why I brought up this thing in the first place.

Now similarly, we can also think of this as zero inductance between two nodes, because we know that V is L times the time derivative of I this means that for any finite value of the time derivative the voltage will still be 0. And finally, I want go and prove this, but you can reason it out for yourselves that is also equivalent to having a capacitance, which is infinity. So the capacitance is infinity then the two nodes across which the capacitance is connected will be constrained to have the same value that is the two nodes will be at the same voltage.

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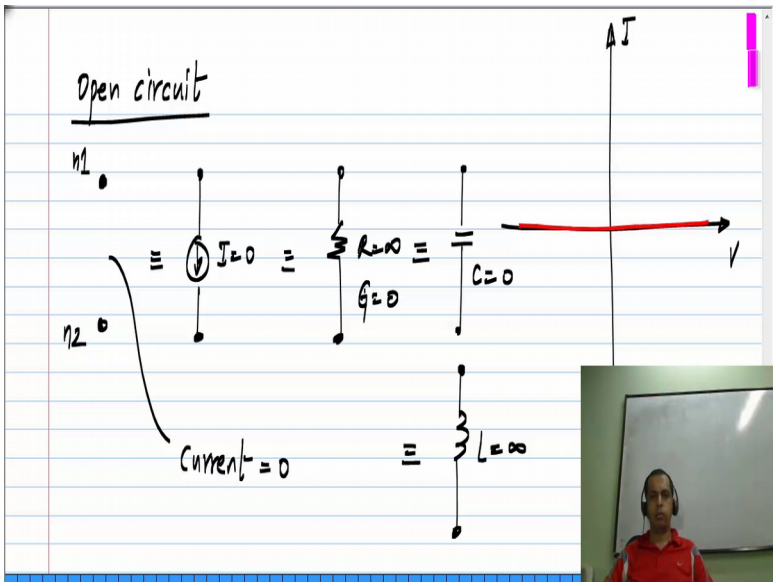

So, a similar concept is an open circuit. So, open circuit really means that there is no connection between these two nodes; and open circuits means no current flows between these two nodes; in other words, current equals 0. So, what does this mean, you can equivalently represented with zero current source, because if current is zero and I draw the I V characteristics of it. I will have a horizontal line passing through the origin that corresponds to I equal 0, so that is a zero valued current source, which is also equivalent to an infinite valued resistance or zero valued conductance. And again I want prove this, but you can very easily reason it out for yourselves that this is equivalent to a zero valued capacitance or an infinitely large inductance so that is an open circuit. So, sometimes it is useful to think of a either an open circuit or a short circuit as these elements with these extreme values.