Basic Electrical Circuits
Dr Nagendra Krishnapura
Department of Electrical Engineering
Indian Institute of Technology Madras

Lecture - 18
Current Source in Series with an Element and Voltage Source in Parallel with an Element

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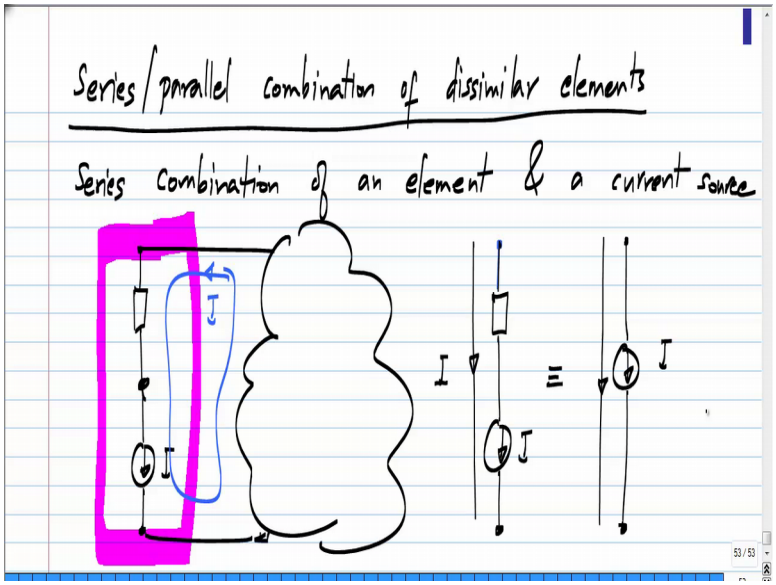

So far we have looked at elements of the same type in series or parallel that is we considered series combination of resistor or series combination of voltage sources and so on. But now what we look at is the series or parallel combination of dissimilar elements. I will not do this for every combination, but we will do it for a few that have some interesting properties. So, first let us look at series combination of an element and a current source that is I can have any element, it could be a resistor, inductor, voltage sources and in series with that we have a certain current – I. Now this is the combination I am considering. So, clearly if you connect this up to some circuit, we know that because of Kirchhoff law current here, the current that is flowing through the whole circuit like this has to be equal to I. So, this main slot, the series combination of any element and a current source is exactly equivalent to a current source.

So, this current source has a value I then obviously, it means that a current I will be flowing from here to there, and that is independent of what is the voltage across this current source; similarly it will be independent of what is the voltage across this whole

combination, because the voltage across the whole combination is nothing but the voltage across the current source which can be anything plus the voltage across this element. So, the result is also a current source, which forces a current I to flow in this direction regardless of the voltage across it. So, the series combination of current source and any element including a voltage source is a current source.

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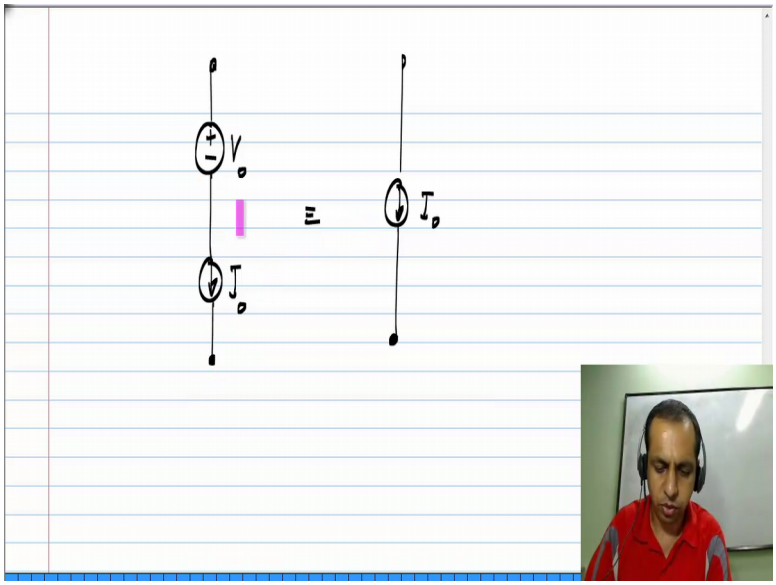

So, this means that if you have a voltage source and a current source in series. So, let us say this have some value V naught and this has some value I naught whole thing is equivalent to I current source. This is the perfectly legal connection the voltage across the current source can be anything, the current through a voltage source will happen to be I naught.

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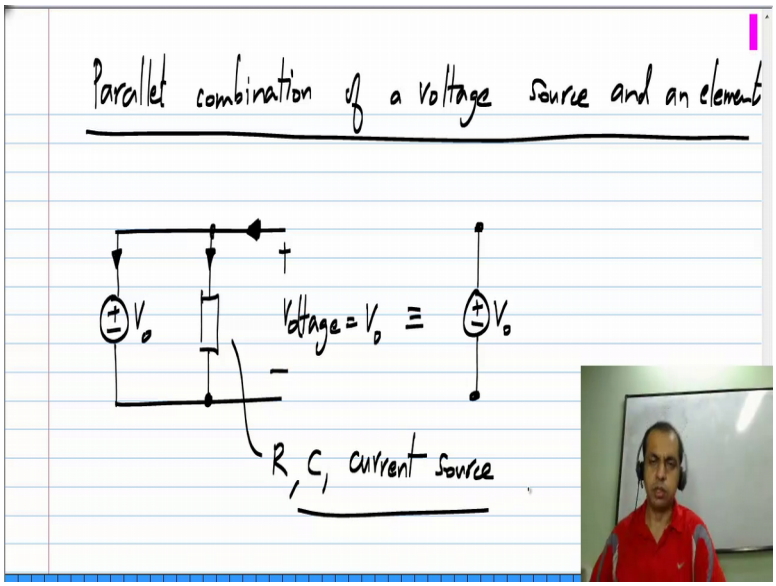

Similarly, we will consider the parallel combination of a voltage source and an element. Let say this voltage source have the value V naught, and we can connect any element across it. We know that across this, we will have a voltage equals V naught, and it will be regardless of what current is flowing through it, because the current through the voltage source can be anything; and this current is nothing but the current through the voltage source and the current through the element, which can also be anything. So, the parallel combination of a voltage source and an element is just equivalent to the same voltage source - V naught. So, this element can be anything it can be a resistor, it can be an inductor, it can be capacitor, it can be a resistor, it can be a capacitor, it can be a current source, so the parallel combination is just equivalent to a voltage source.