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

Lecture - 34

Now, we look at power and energy in an independent current source.

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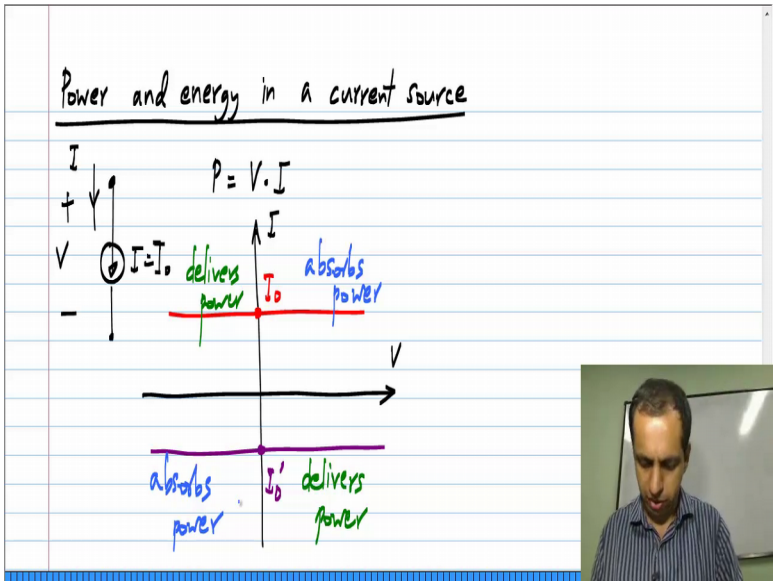

Current source maintains a current of I naught regardless of the voltage across it, this is the voltage across the current source, this is the current through the current source and the power as usual is the product V times I. Now, the I V characteristics of a current source are like this, I assume that this I naught the value of the current source is positive, but of course, it could well be negative. So, as before we see that in the first quadrant, where voltage and current are both positive, the current source absorbs power, whereas in the second quadrant, where the current is positive and the voltage is negative, the current source delivers power.

Similarly, if you took a negative valued current source, let me call this I naught prime then in the fourth quadrant, where the current is negative and the voltage is positive, the current source delivers power or it absorbs negative power and in the third quadrant, it absorbs power. So, just like a voltage source, a current source can either deliver or absorb power, so it can deliver power, so it is also not passive.

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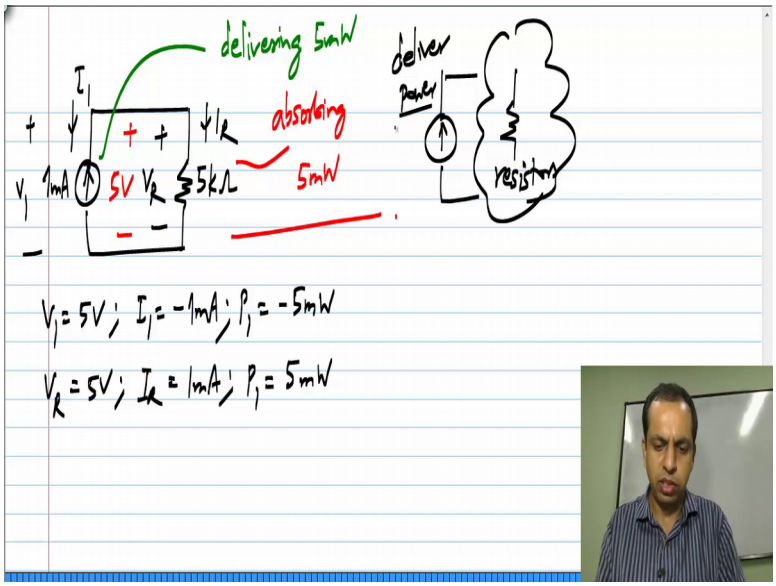

Now, the case of the current source is quite similar to that of the voltage source. I will still show an example, let say I have a 1 milliamp current source connected to a 5 kilo ohm resistor and as before I will choose V R and I R as voltage and current of the resistor according to the passives sign convention and V 1 and I 1 of the current source according to the passive sign convention. So, it is quite obvious that 1 milliamp flows through the resistor 5 kilo ohm resistor. So, a voltage of 5 volts appears between these terminals.

From this we know that V 1 is 5 volts and this current I 1 which is opposite in direction to the current source direction, I 1 is minus 1 milliamp here. So, their product P 1 which is V 1 times I 1 is minus 5 milli watts and as for as the resistor is concerned, V R is 5 volts and I R is 1 milliamp and their product is 1 milliamp times 5 volts, which is 5 milli watts. So, the current source in this case, this is delivering 5 milli watts or observing minus 5 mill watts and the resistor is observing 5 milli watts.

Now, as with the voltage source if you have a single current source connected to a resistive network, then this will be delivering power, because that is the only source of power or energy in the network.

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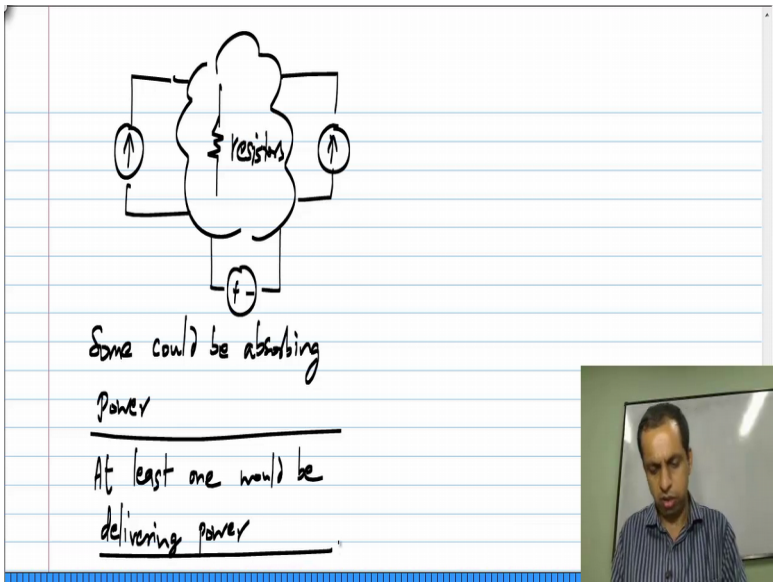

On the other hand, if you have multiple sources and I will show both voltage and current sources, we have multiple sources connected to a network with only resistors. Then, some of these sources could be absorbing power and at least one of them would be delivering power, so this is very much possible.

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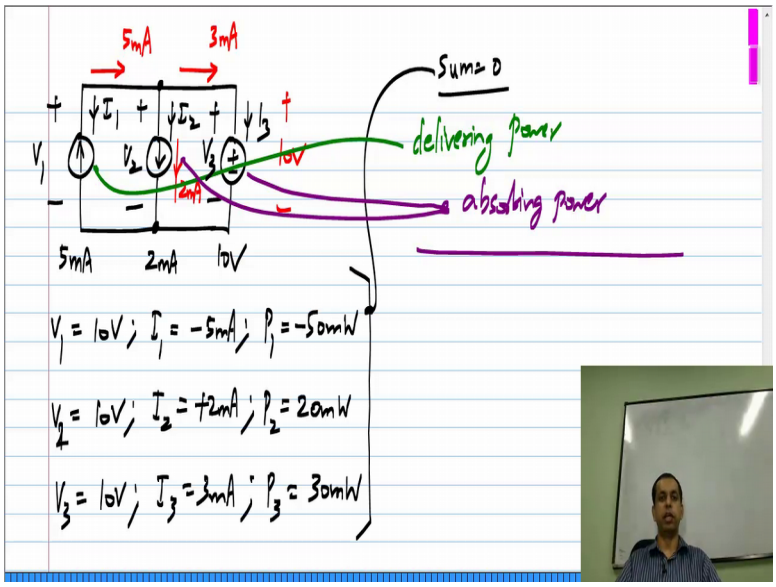

Let us take a simple example of a 5 milliamp current source in this direction in parallel with a 2 milliamp current in the downwards direction connected to a 10 volt voltage source. So, again I will formally define currents, after while you can do this almost automatically V 1 I 1, V 2 I 2 and V 3 I 3. So, first of all a simple circuit analysis basically Kirchhoff's current law tells you that, here we have 5 milliamp here due to this

current source and here we have 2 milli ampere due to that current source. So; that means, that we have 3 milliamp going that way.

So, from this we know everything and of course, these three elements are all in parallel. So, across all of them we have 10 volts, so V 1 is 10 volts and I 1 is minus 5 milli amperes. So, the first current source the 5 milliamp current source is absorbing a power of minus 50 mill watts that is minus 5 milliamps times 10 volts. The second current source has also 10 volts across it and V 2 is 10 volts and I 2 is plus 2 milliamps, that is clear from this direction and V 2, it is absorbing a power of 20 milli watts and finally, the voltage source has a voltage of 10 volts V 3 and a current I 3 of 3 milliamps, so it is absorbing 30 milli watts.

Again as before the sum equal 0, but for us now we see that this is delivering power and these two are absorbing power, just like a voltage source a current source can absorb or deliver power. And in this example we have three independent sources, one of them happens to be delivering power and other two happen to be absorbing power.