Basic Electrical Circuits
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Lecture – 09

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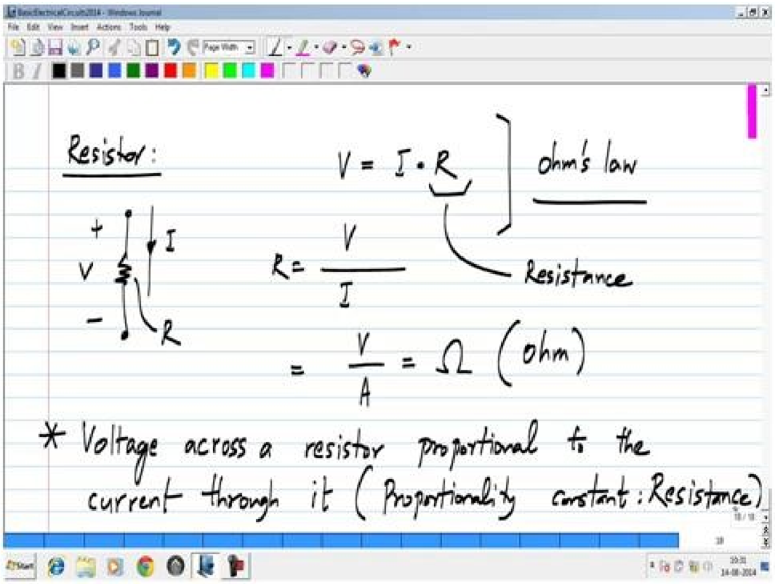

The next basic element, we will be looking at it is a resistor. What is the resistor, you are all almost certainly familiar with what the resistor is, it resists the flow of current. It is given by this symbol; and if you consider the voltage across it, and I – a current following a passive sign convention. What a resistor does is to establish the relationship between the voltage across the resistor and the current through the resistor through a proportionality constant which is the property of the resistor. So, whenever we specify the resistor, we also give its value R. What does this mean, the voltage is proportional to the current and this proportionality relationship is known as ohm's law. And the proportionality constant is called the Resistance. The resistance is the voltage across the resistor divided by the current through the resistor, and it has the units of volts per amperes which is basically given by the symbol omega which is called ohm. So, one ohm resistor has one volt across it when one ampere is passing through it. And the proportionality constant is the resistance.

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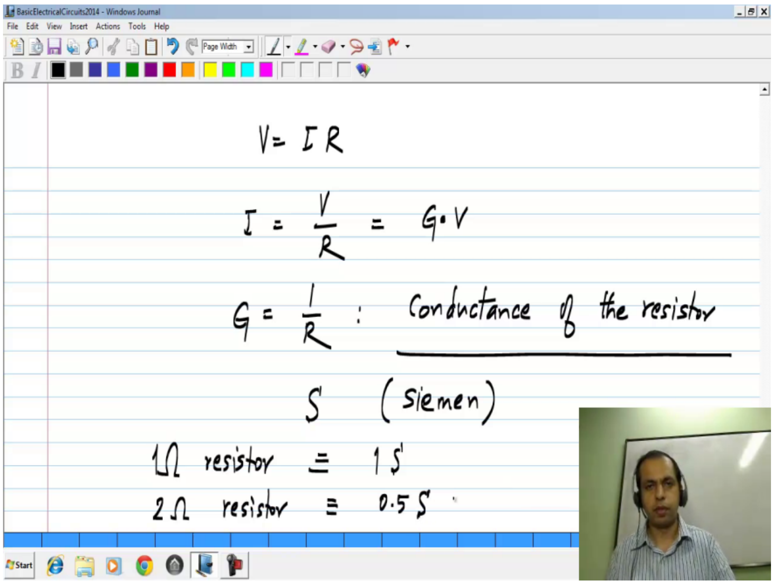

Now, the relationship V equals I R can be inverted to get I equals V by R or I equals G times V. And this G, which is 1 by R is known as the conductance of the resistor. And this conductance is measured in Siemens. So, if you have a 1 ohm resistor, it is same as saying it has the conductance of 1 Siemens; if you have a 2 ohms resistor, it is the same as saying the conductance is half the Siemens.

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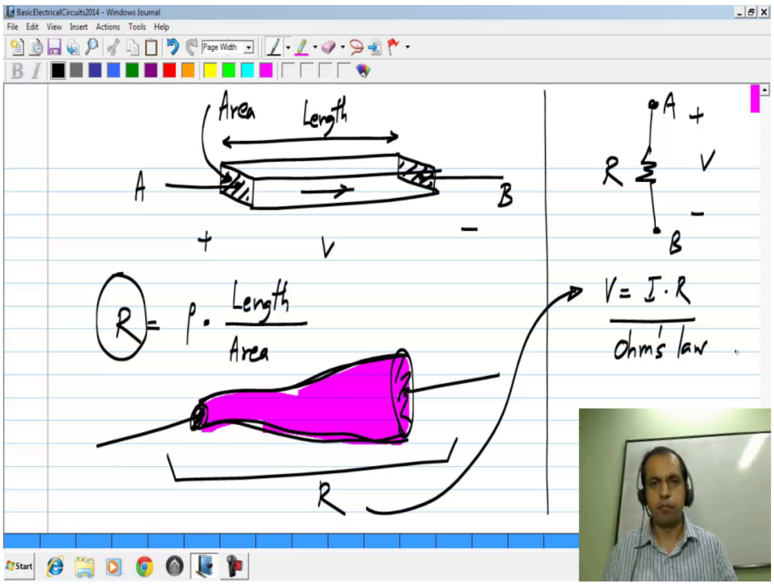

Now, I think again all of you know how a resistor is made. It is basically some resistive material, the prototype that you see in text books consists a rectangular bar of resistive material with one terminal here and other terminal there. As I showed earlier the symbol for a resistor is this with two terminals; let me call this A and B. And in resistor like that a current is assume to flow uniformly across the cross section in this way, when a voltage is applied here.

I will show the symbol on the side. And let say the cross sectional area of this face is something and the length along which the current flows is some length. And you know that the resistance is given by the resistivity times the length divided by cross sectional area. As I mentioned earlier while talking about circuits in general, we will not worry about these details. For us, the value of resistance is what is given; once the value is given all we need to use is the terminal relationship V equals I times R. We do not have to worry about how this resistance is calculated. Now, this formula is symbol enough for a rectangular bar like this, but if I had something uneven some uneven shape like this with curves and so on and I have a terminal here and the terminal there, it becomes quite complicated to carry out this calculation. But for analyzing circuits, we do not have to worry about it.

As long as it is a resistor, the voltage across it will be proportional to the current through it and the proportionality constant is given by R. Now, somebody whoever designing the resistor, who carry out the calculations for an art shape like this, if you do make an art shape resistor and tell you that between these, we have a certain resistance R and as far as we have concern we simply use this in our formula V equals I R to analyze circuits. So, this is what I also meant by we do not worry about special extension of things because we are concerned only with terminal characteristics, we will use only the terminal characteristics. So, life is a lot simpler for us if you do want to calculate how much resistance a bar contributes between some terminals, you do need to use electromagnetic. But once that resistance is determine, you can make circuits with it and analyze circuits with it by using the terminal characteristic which is given by ohm’s law.

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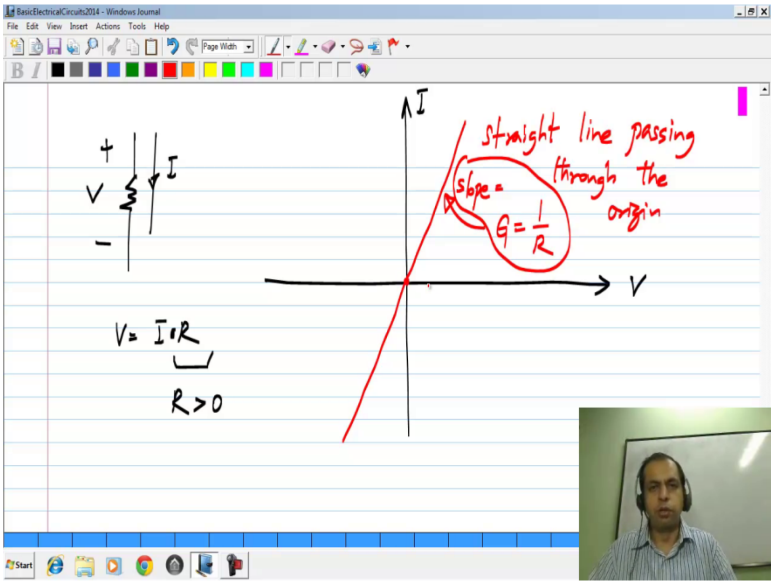

Now, as before we also sometimes depict picked the characteristic graphically, we have I and V, and V is given by I R. And if you take a physical resistor, the resistance will be positive; that means, that if you take a bar of material and connect two terminals to it and you measure the proportionality constant between V and I, you will find a positive constant. What will that curve look like, it will be a straight line passing through the origin. And the slope of this, remember we are plotting I on the y axis, V on the x axis; the proportionality constant is the conductance or the reciprocal of resistance. If you have plotted V versus I, the slope would be the resistance. Many times we can use this graphical characteristic to either visualize intuitively some solutions or even sometimes carry out the calculations.