Basic Electrical Circuits
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Lecture – 125

Now, another point I wish to make is that and you frequently here statements like node d c can go through a capacitor and so on.

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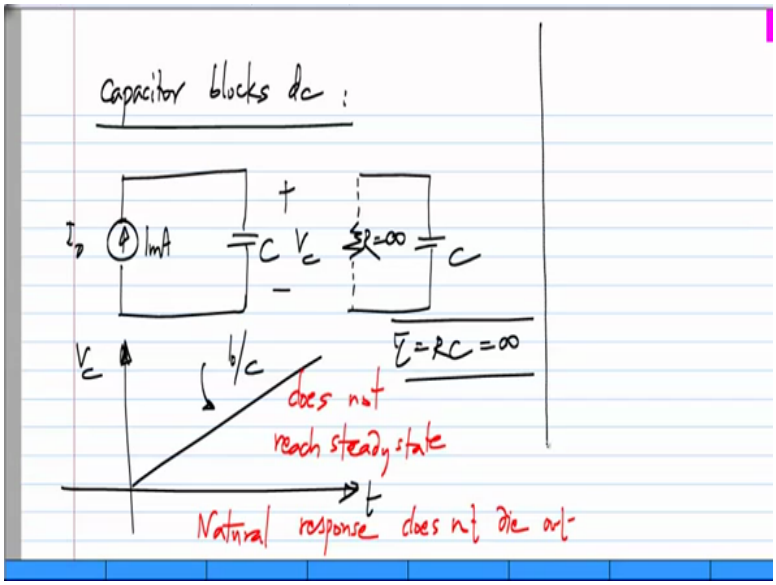

Now, this can sometimes get very confusing, because what if I make a circuit like this let say this is a 1 milli amp current a constant current and I just connected it into a capacitor. So, clearly by Kirchhoff current law this current has to be flowing through a capacitor and so what happened to this statement that d c cannot flow through a capacitor here d c is very much flowing through a capacitor.

So, this statement like a capacitor block d c or d c cannot flow through a capacitor this has to be stated a little more preciously. Now, that will be apparently if you examine the voltage here, what happens to the voltage, because the current is the constant a voltage will be a ramp. So, if this current is some I naught then V c verses t will be a ramp and whose slope is I naught divided by c. So, the point is the input is the constant with time, but this response V c is continuously changing with time and this will never stop you can see that even if you go all the way you take was infinity this will simply keep on growing.

So, the reality is that a circuit like this does not reach steady state or in other words the natural response does not die out and this is not surprising, because if you try to evaluate the time constant of this you set the source to 0 the independent sources to 0 and in that case you will be left only with the capacitor and an open circuit, you can think of it as an R which is infinity and earlier discuss that an open circuit is equivalent to an infinity large resistances.

So, the time constant tau which is R C is also infinity, the time constant is the infinity long. So, that means that this simply does not reach steady state at all. So, it is possible for d c to be a flowing through a capacitor, but such a circuit will not reach steady state, rather more preciously what it should be saying is the following.

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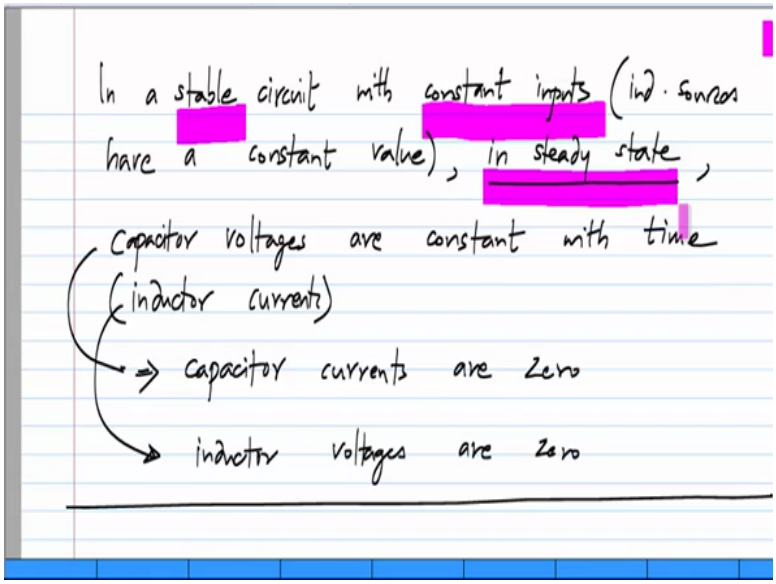

In a stable circuit with constant inputs; that means, that the independent sources in the circuit have a constant value then in steady state this is very important capacitor voltages are constant with time and exactly the same also holds for inductor currents. So, this means in turn that because the current is the time derivative of the voltage in a capacitor currents are 0 this by the way we are being looking for first order circuits, but these statements are true for circuits of any order.

So, if you have constant inputs and the circuit is stable, so that it is natural response die out then after it reach the steady state, the capacitor voltages will be constant with time and the capacitor currents will be 0. And exactly the same thing will be true of inductor currents, inductor currents will be constant with time and inductor voltages are 0. So, the

important thing is for this two happen many conditions need to be satisfied, you need to be having a circuit with the constant input and the circuit must reach steady state that is the circuit much be stable. So, that it reaches steady states in some time.

So, after it reaches steady state then you won't have either a d c current through a capacitor or a d c voltage across an inductor. So, this please understand the conditions otherwise I can easily took up some silly looking example like this, where d c is clearly flowing through the capacitor, but the point is this is not a stable circuit and it does not reach steady state.