Basic Electrical Circuits

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Lecture - 133

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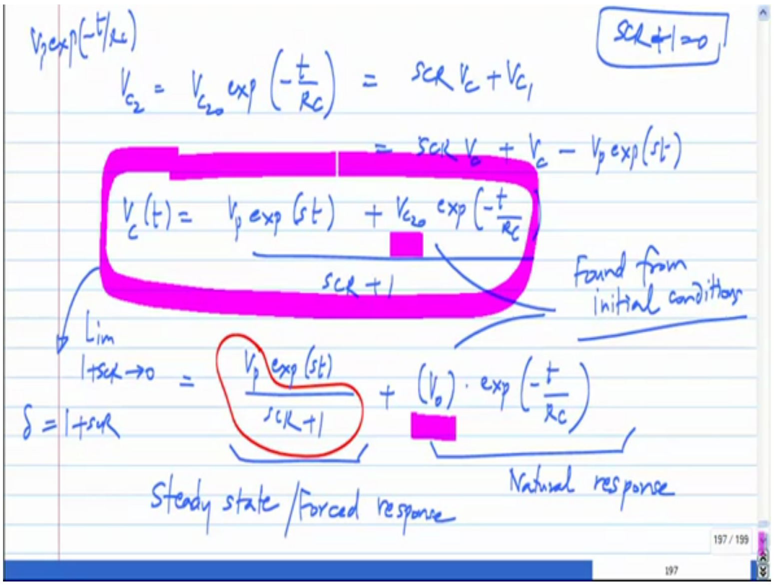

Now, later on interesting input we will see later why it is interesting a signify and actually I could have arbitrary ((Refer Time: 00:20)) here, so V p cos omega t plus phi. Then, again I find V c, but of course, I could find any other variable in the circuit also I will always use this very simple circuit as an example, because I do not want the algebra to over will, what I am trying to convey here, but this procedure can be use other things also, similarly for that exponential.

For a first order circuit along as you know that let say we had exponential s t extension in the actual circuit was very complicated you still know that study state response is exponential s t times something. And then, the natural response or the transient response is exponential minus 3 by the time constant of the circuit and by manipulating the constant with initial conditions and so on will be able to get the answer.

So, now, in this case what you think is the solution to this again I want to V c of t, V c of t it will possibly have multiple part, what do you think it consists of also have a little the natural response. And then, force response, what is the force response going to the it can be anything, because I mean if you differentiate cos you get sine and if you differentiate sine you get cos. Let me think of this sort of balancing act, where if you have cos omega t plus phi on this side you should have on the cancels.

But, then V c cannot we just cos omega plus phi, because when you differentiate it you get sine. So, you expect that is general form of it a many ways of writing this I could put some other angle theta there and then, try to cancel it also alpha cos omega t plus phi plus beta sine omega t plus phi I will write in this form, so clearly if I differentiate this I will get. So, now, you can put this in there and you have two constant alpha and beta. So, you have to balance the sine and you would have co sine, so from that you get these two constant.

We can never balance sine with the co sine does not possible. So, I would take the cost terms out and sine terms out and you can get the stop of course, this will give you only give the force response the general stop will have also the natural response. Please derive the complete response including natural response I will have separate lesson in which, I will the show the derivation you can compare your answer to mine. So, this is one way of doing it can you thing any other way of doing it I mean knowing, what we know, so far.

Another thing you can do is this V p cos omega t plus 5 is V p by 2 exponential j omega t plus 5 I mean whole thing is multiply this. So, we already know the solution to exponential s t, so this is nothing, but again I have another pie here, what you do this is exponential j phi exponential j omega t. So, that is just another multiplying factor, so I know the solution to V p exponential s t.

So, all have to do this sub suite s with this j omega and then, that V p with this V p two times with exponential j 5 the constant I have to adjust is not it that is all, there is some other constant here. So, I do it for this one and I do it for that one and I can add up the result you get the force response. Please derive the complete response including natural response I will have a separate lesson in which, I will show the derivation you can compare your answers to mind is this.

So, there are two ways of doing this first you know that if you have a sinusoid the solution is always some liner combination of sine and cos alpha cos plus beta sine you can always take it as the solution and then, you plug it into the differential equation and finally, constant. So, you will get two equation one from balancing the sine and other from balancing the cosine alternatively you can express the sinusoid as combination of complex exponential very, very useful concept actually does know life is electrical engineering without complex exponential or without complex algebra we will move to that.

So, you now have exponential that is easier you know that the study state response exponential is only that exponential with some scaling. So, you do it for exponential plus j omega t minus j omega t and add up the results. By the way one thing i dint emphasize earlier is that we always have this study state response and the natural response and we know that linear circuits obey super position, but in this case we have to little careful. The study state response follows super position by itself that is if you have an input x you find the study state response input y some other study state response.

The steady state responses will super force if we have alpha x plus beta y this will be alpha times the first solution plus beta times the second solution. The natural response also scales with the initial condition, but what you cannot do is or some initial condition you apply one input find the total response for the with the other input alone find the total response if you add up you will get the wrong result. So, the study state response itself follows super position and the natural response itself by itself scales with the initial condition you try out and see.

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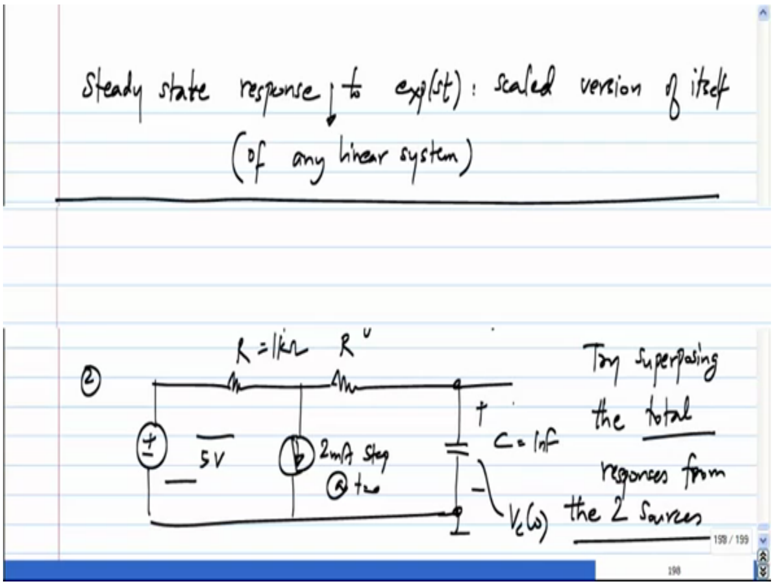

So, let say this steps to 5 volts a t equal to 0 and then, this also the 2 milliamps at the same time t equal to 0. So, may be you take this 1 kilo ohms and 1 nanofarad the particular things do not matter. So, now, first you find the total response taking everything together, but taking the Thevenin equivalents etcetera, then you try to do this super position take the total response with this 5 volts source alone total response with this 2 milliamp sources alone and add the two and see if you get the same result as the actual total response or not or if not what exactly the wrong result. So, the exercise is to.

Student: Try superposing the total response from the two sources when you have some given initial condition of the capacitor.

You assume that you have some V c l 0 on the capacitor.