Basic Electrical Circuits

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

Lecture - 150
Maximum Power Transfer and Conjugate Matching

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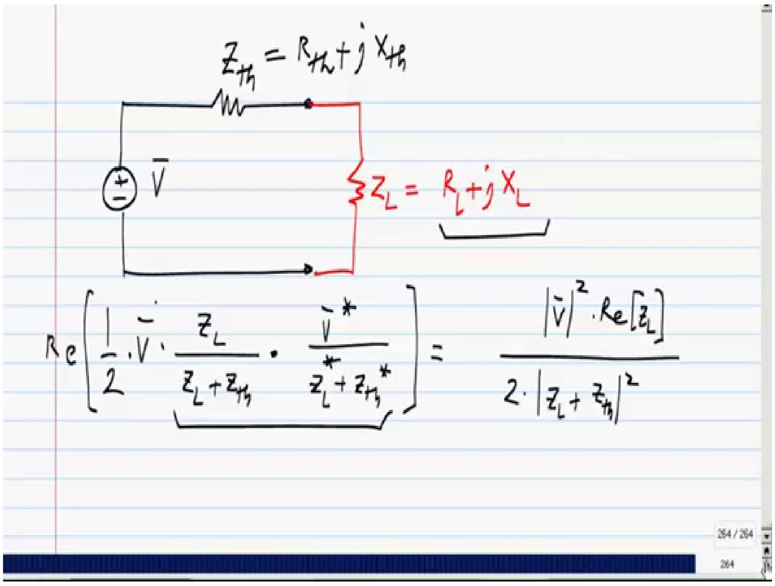

Now, let us go back to the topic where we left of in the last class, what was that maximum power transfer. Now we know enough about power with phasors to deal with that if you have any network with independent sources and R s, L s and C s, we can always represent that with some phasor V and equivalent impedance z th. So, this like V and R th except that both voltage V and impedance are complex in general. Now what we want to find out is, what is the load Z L, I should connect to it, so that i can absorb the maximum power from this V. So, let me call this R th plus j X th, I can always write it like that right any complex impedance, and this could be R L plus j X L. So, what is the power delivered to the load, what is the voltage across the load?

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So this is the voltage across the load. What is the current through the load, V by Z L plus Zth. And how do I get the power from this, I have to take the conjugate. The real part of that would be the power, and what is that, what is the denominator if I multiply a complex number and its complex conjugate? What is it? If I multiply a complex number and its conjugate what will I get?

Students: Module a square

Module a square ok and same thing happens between this and that. And finally, you will have only Z L left right. So, you will have that one, is this fine. And I have to maximize this by varying this one, so that the condition what the variables I have are R L and X L.

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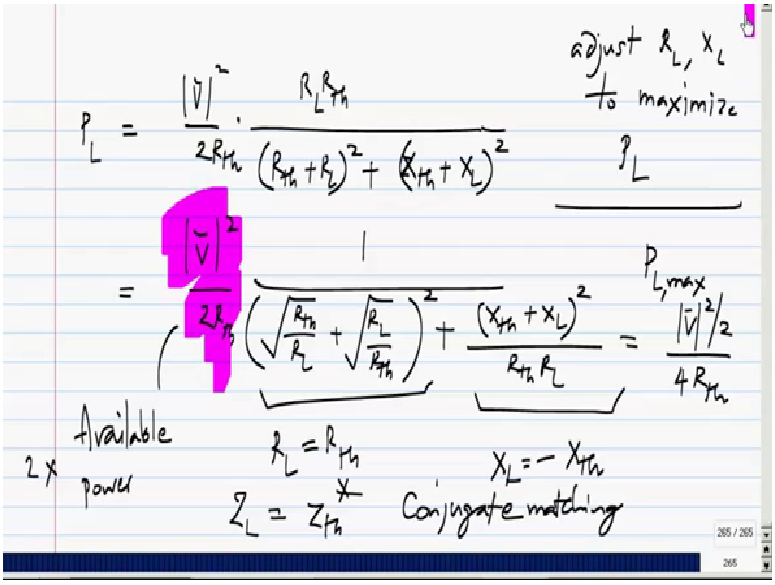

So, the power delivered to the load is mod V square by 2 real part of Z L which is R L and modulus of Z L plus Z th square, which is R th plus R L square plus X th plus X L square. And I have to adjust R L and X L to maximize P L. So, what are the conditions? Quickly.

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X L equals minus Xth and then Rth equals R l. So, the point is with reactants we can have negative stuff also. So, I think we can put it in the same form that we used earlier when we calculated the maximum power transfer for resistive circuits. If I take this R L inside this square, what will I get, did I miss something here, this is correct. Let me do this. When if I take this inside, I will get Rth by R L plus R L by Rth whole square plus Xth plus X L square divided by Rth R L. This part is four times the available power, and to minimize this, we have to make two terms equal to each other which is R L equals Rth; and to minimize this, I have to make X L equals minus Xth. So, what is the maximum power you can draw, what is it?

Students: ((Refer Time: 05:39)) V square by

V square by

Students: ((Refer Time: 05:45))

First of all this absolute of value V square by 2 that comes because it is sign wave. So, earlier what was the available power that d c square divided by four times Rth. Now also it is the same except that d c square is replaced by this peak square divided by 2. So this, what does it mean in terms of Z l, what should be Z L in relation to Zth.

Students: Complex conjugate.

Complex conjugate, So this is known as conjugate matching of the load. Again a very, very important and useful concept, when you have a limited available power especially in radio this happens that you have a very week signals and you have to draw all of into the load, you have to use conjugate matching in order to maximize the power transport. Please think about this, if there is any question, we will discuss it tomorrow.