Circuit Theory
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Lecture - 25
Problem Session 6: Two-Port Networks

Twenty-fifth lectures and this a problem session number 6, we continue solving problems on 2 port networks. We first take a couple of problems from the previous problem sheet, which was number 69.9. We have already solved in the class this morning. We go to 9.10.

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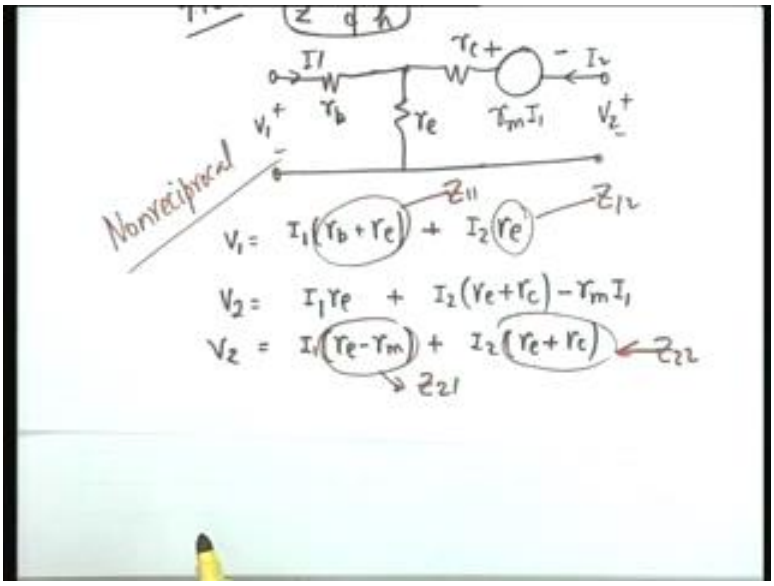

I shall, speak out the problem; the problem is to find z and h parameters of the common ammeter transistor, represented by it is T circuit model. The model is the resistance rb, resistance re, then a resistance rc. Then a voltage generator with this polarity rm times I1 and this is the 2 port V2, I2, V1, I1 to find the z and h parameters of this 2 port, which represents the equivalent circuit of a common ammeter transistor.

You note that this circuit, the first thing to notice is there is not purely, it is not composed of purely passive elements. It contains a generator which is controlled by a current at some other point correct. Current I1 controls this so this is a dependent, dependent generator, but find of the z parameters is absolutely no problem. z parameters we simply write the equations of the 2 voltages V1 and V2; V1 is I1 rb plus re I1 rb plus re plus I2 also flows to re. So, I2 re and V2 is equal to first I1 re, the drop across this plus I2 re plus rc. Then this generator I assume, I am taking KVL around this loop like this. So, it will minus rm I1. In other words V2 the modified equation becomes I1 re minus rm plus I2 re plus rc.

In other words this is; obviously, z11 z12 is re z21 is re minus rm and this z22. And you notice that: z21 and z12 are not equal and therefore, the network is non reciprocal. This is an example, of a non reciprocal network. To, find the h parameters.

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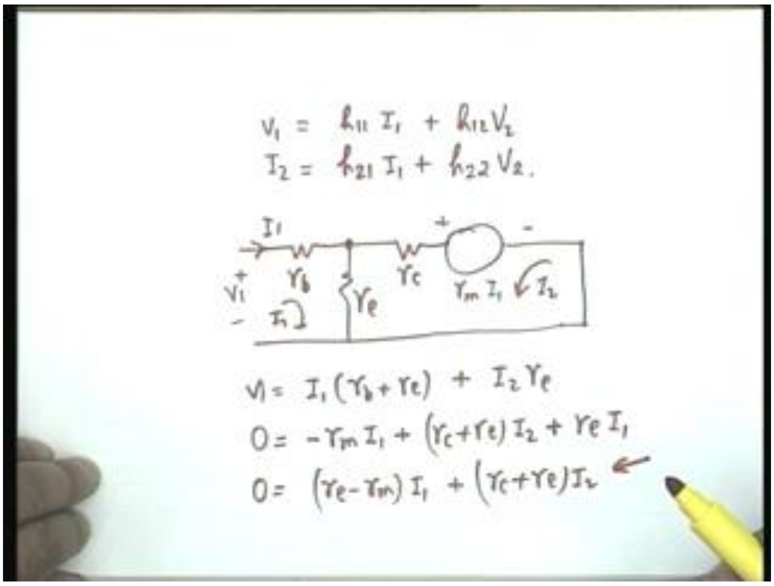

Let us look at the relationships. You know V1 and I2 these are the h parameter dependent variables and they are written in terms of I1 and V2. This is equal to h21 I1 plus h22 V2. So, our network is this rc rb re then a generator plus minus rm I1 and V2. To find h11, I find V1 by I1 with V2 equal to 0 this as short circuit all right.

Yeah; but, we have to find out z1 now, h11 is not 1 by z11 h11 is 1 by y11 isn't it right?

That's what we are finding out we are finding out V1 by I1 with this short circuit it. Now, how do we proceed, how do we proceed do we write 2 loop equations?

If we write a node equation, we will find the voltage of this node just 1 node which does that help in finding V1 and I1.

Yes, it does.

Is there any other way any other simpler way? No Thevenin? How can you apply Thevenin here? The simplest way here is to write the mesh equations, simplest way because the second mesh does have a control source which can be absorbed in I1. Let say, this is I2 and this is I1. So, V1 equal to I1 rb plus re plus I2 re and 0 equals to if I around this loop minus rm I1 minus rm I1 plus rc plus re I2 plus re I1. It is a same equation that we wrote earlier with the left hand side equal to 0 that is: 0 equal to re minus rm I1 plus rc plus re I2.

From the second equations, we find I2 in terms of I1 from this equation we find I2 in terms of I1 and substitute in the first equation that is it.

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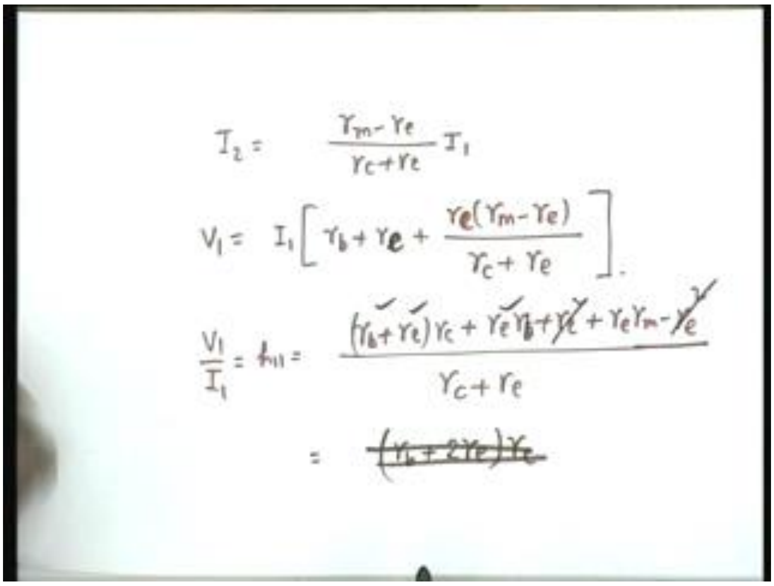

So, the result is like this: I2 is equal to rm minus re divided rc plus re times I1 therefore, V1 is equal to I1 times rb plus re plus I2 re therefore, plus re multiplied by rm minus re divided by rc plus re. And therefore, v 1 by I1 which is equal to h11 shall be equal to take rc plus re common here rb plus re multiplied by rc plus re rc plus re squared plus re rm minus re squared.

This is. Thanks for the certification, re squared and re squared cancel I wanted to show that this cancels there is no negative term and therefore, this is equal to rb plus well I could combine this rb plus re multiplied by rc. So, rb plus 2 re multiplied by rc this term this term this term.

Good well you simplify this I leave the rest to you. Similarly, we can found out h12 but, you have go back to the roots the definitions do not try a shortcut. When there are controlled sources or dependent sources word of caution do not try to play smart. In other words do not try to do it by inspection do it carefully, but control sources can cause havoc. We next do 9 11.

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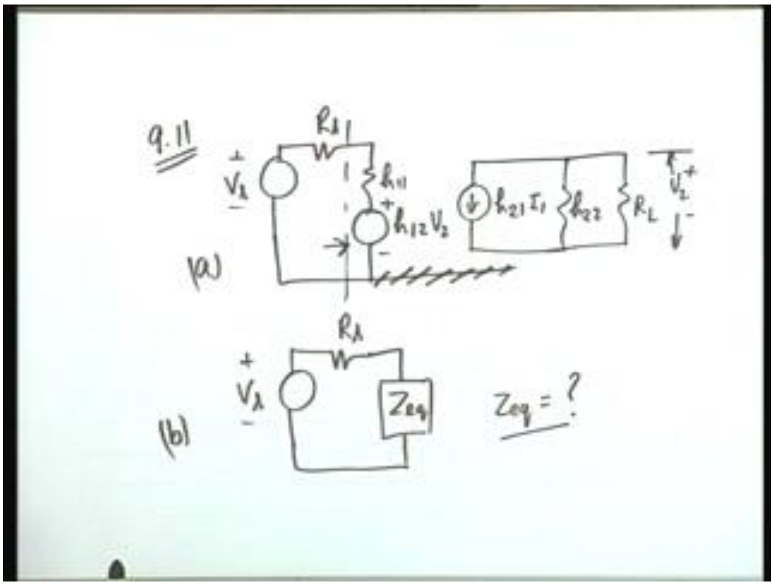

This is also from the previous set problem set 6 9 11 says: the circuit in part a of figure part a is this. We have a Vs Rs h11 this is in terms of h parameters plus minus h12 V2 no there is no common connection. The other part is h21 I1 then h22 then RL and this voltage is V2. This is part a of the figure the circuit in part a of the figure is to be described by an equivalent input circuits shown in part b Part b is Vs then Rs same as this and then a Zeq all right.

This is part b. The circuit in part a of the figure is to be described an equivalent input circuit shown in part b, determine Zeq in b as a function of the elements and voltages in a you have to find out Zeq that is the problem. Which means that you have to find out what the impedance here is? We can ignore the thing the connection to the left. We can connect a voltage source here and find current. Let us do that: there are several steps here several points where 1 may make a mistake.

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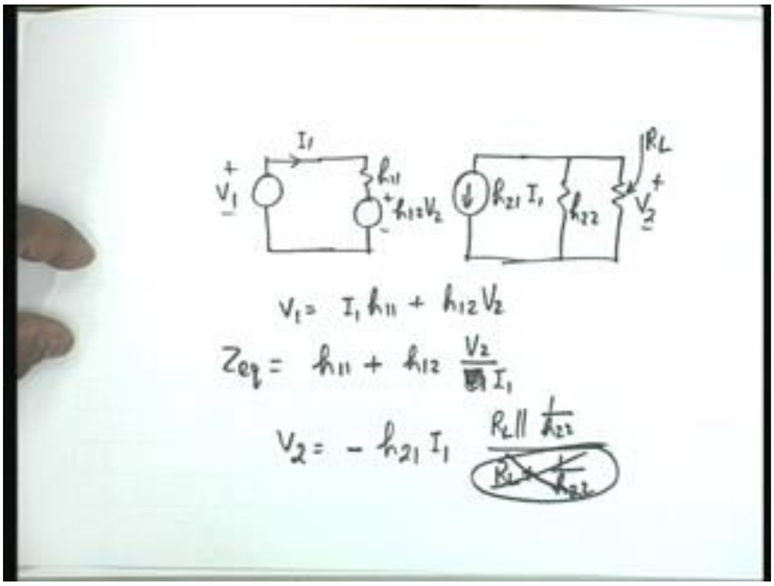

So, what you do is? We connect a V1 and h21 there are 2 control sources here not 1 a voltage source and the current source and 1 has to be very careful about not only sources, but, also dimensions these 2 and not birds of the same feather Is not it right? RL and h22, what is the dimension of h22?

Admittance and therefore, if you want to combine RL with h22 there parallel connection we have to take either 1 by RL plus h22 as the total admittance or RL parallel 1 by h22. If you want it into impedance. Now, what we have to find out? Is the input impedance and you notice that all I need is okay I need, I write the first equation V1 is I1 h11 plus h12 V2 all right this is the first equation. Now, in order to find out V1 by I1 which is the input impedance that is Zeq; obviously, this will be h11 plus h12 V2 by V1. No.

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I1 V2 by I1. So, all I need is V2 by I1 which is supplied by the second part of the circuit you can notice that: V2 is equal to V2 is equal to the negative of the voltage drop across this parallel combination by the flow of the current h21 I1. Therefore, by inspection no more equations need to be written this is minus you understand; why it is the minus sign? Because V2 and h21 and I1 do not agree with each other.

So, minus h21 I1 multiplied by RL parallel 1 by h22 be careful here divided by RL plus 1 over h22.

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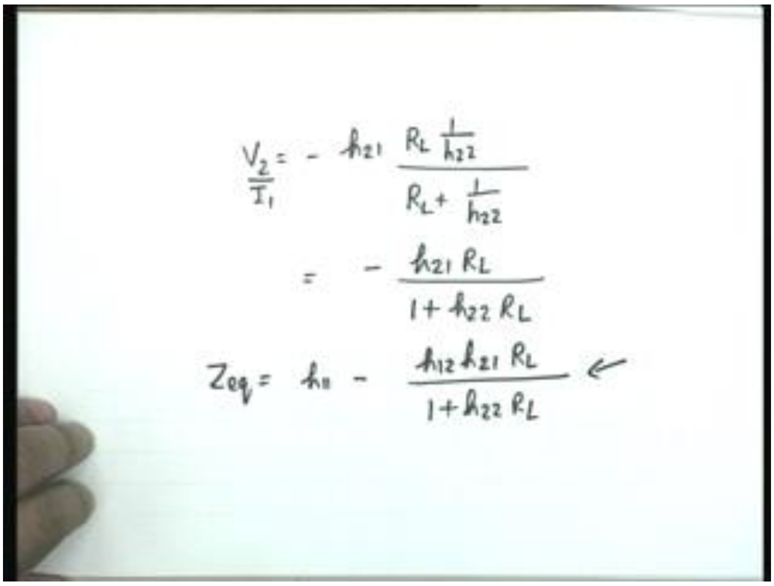

So, V2 is equal to minus h21 V2 by I1 equal to minus h21 then RL para RL multiplied by 1 by h22 divided RL plus 1 over h22. That is equal to minus h21 RL divided by 1 plus h22 RL. Therefore, the Zeq is equal to h11 then plus h12 multiplied by V2 by I1 and I have found out V2 by I1. So, it would be minus h12 h21 RL divided by 1 plus h22 RL that is the answer.

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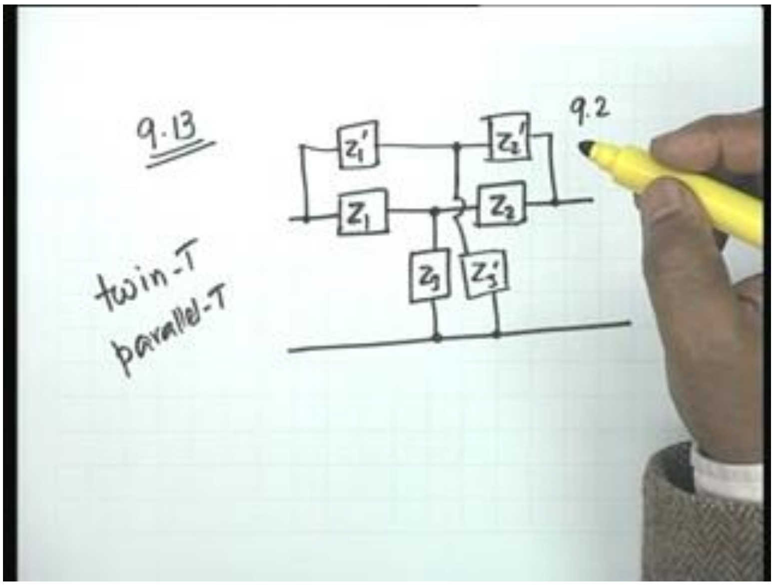

We go to the last problem of the previous session that is: 9.13. And the 9.13 says find the Y parameters of the twin-T circuit of problem 9 2c. Well problem 9 2c had 2T networks in parallel. So, it is called a twin-T. The circuit is of this form Z1 Z2 Z3 this is 1 of T's.

And the other T is connected in parallel that is: from here you get let say, Z1 prime then Z2 prime and the third element here is Z3 prime. This is a general twin-T network twin or also called parallel T.

Student: ((Refer Time: 17:30))

What is gyrator? We shall do this later. We shall do this I will, discuss this in the class what is the gyrator? Don't try this problem now try it later. This is the general twin-T or general parallel T and problem 9 2c was a special case of this, in which these 2 were resistances. This was a capacitance I hope so.

Student: ((Refer Time: 18:01))

These 2 are resistances, this is a capacitance Z3 is a capacitance. Then these 2 are capacitances and this is a resistance. Now, let us do it in general. Let us do it, for the general twin-T you can specialize the values later you put Z1 equal to 1, Z2 equal to 1 and so and so forth all right. Let us do it for the general case. Now, for the general case suppose, what we do now is: to apply the T pi transformation, T2 pi transformation.

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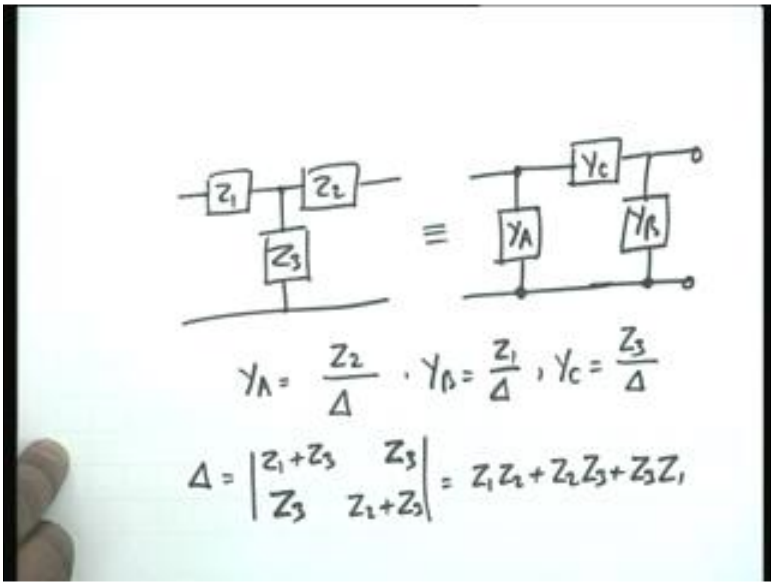

That is suppose, Z1 Z2 and Z3 suppose, this T is equivalent to let say, YA YC and YB. Suppose, this T is equivalent to this pi; pi network. We have already derived the relationship that is: YA should be equal to Z2 the opposite term Z2 divided by del where del is the determinant of the Z matrix that is simply equal to what is the Z matrix? Z1 plus Z3 z12 is Z3 Z3 and Z2 plus Z3. And if you notice this will be simply Z1 Z2 plus Z2 Z3 plus Z3 Z1 that is it Z3 square term cancels out.

So, this is del YA is this; YB is by symmetry Z1 divided by del and YC shall be equal to Z3 divided by del. So, we know YA YB YC in a similar manner primed parameters will give rise to will give rise to the primed admittances and then all you have to do is in this relation you replace the prime unprimed once by primed once. And finally, the equivalent pi network of this what you have is.

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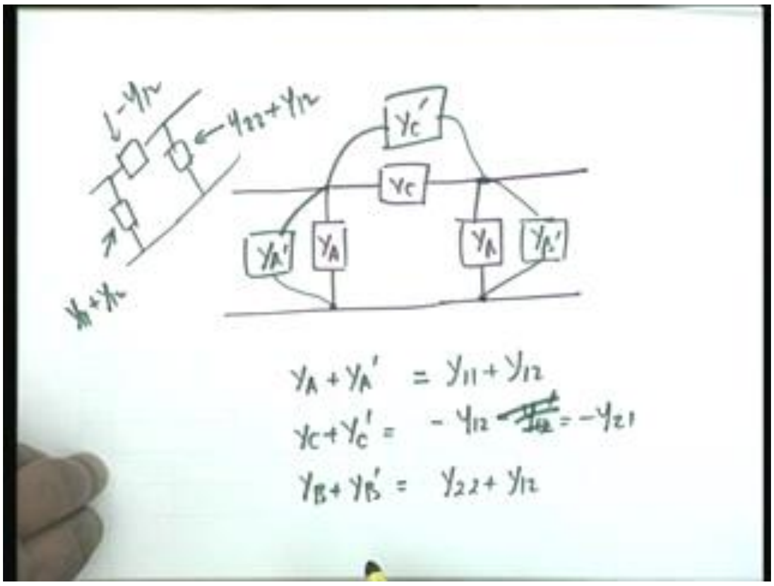

You have YA YC YB this is 1 of the equivalence. The other equivalent is exactly similar that is: between these 2 points between these 2 points will come YA prime between these 2 points will come YC prime and between these 2 points will come YB prime. And therefore, we can combine admittances and the total admittance of this would be YA plus YA prime here and if you recall, if you recall the Y parameter equivalent circuit in terms of the short circuit admittance parameters what does this among 2? This should be question is not clear.

Mathematical equivalent of any 2 port in terms of it is Y parameters is; the pi network a Mathematical equivalent here, it is also physical equivalent what were these elements? Y11 plus Y12 this element was minus Y12 and this element is Y22 plus y12. So, if you look at this, if you make the corresponding equivalences this should be Y11 plus Y12 then YC plus YC prime would be minus Y12 minus Y12 prime and I take A part no prime minus Y12. This is for the total network and YB plus YB prime would be equal to Y22 plus Y12.

This is also equal to minus Y21 from which now, you can find out Y11 Y22 and Y12. It will be instructive to find the expression for the y parameters of a general parallel T parallel T RC network you see in the 9 2c the 11 values are specified. Suppose, you do it for this it will be instruct you to do it.

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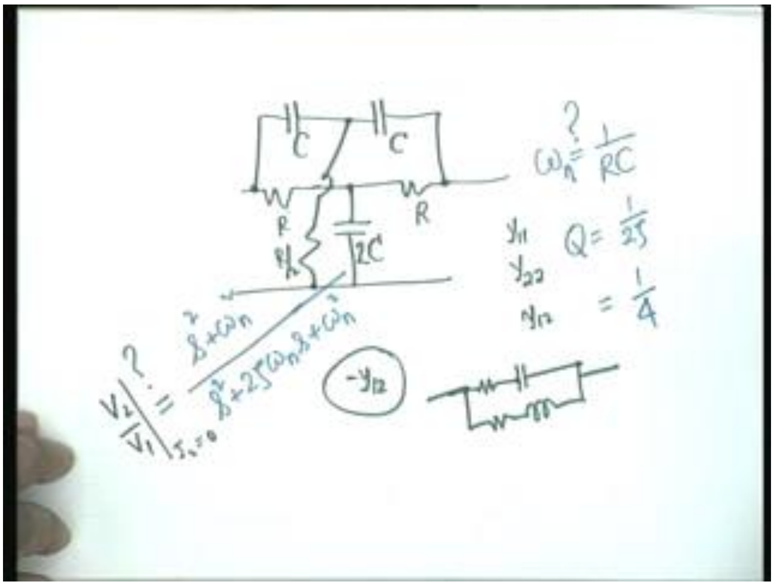

You have an R, you have an R then a C and then here the 2C I am specializing the values. And then you have a C and C in parallel with not 2R; R by 2 the parallel combination of R and R. Parallel combination of C and C is here a parallel combination R and R is here. It is instruct to you to find out the parameters Y11 Y22 and Y12. And you shall notice that minus Y12 parameter of this circuit shall look like this.

It will be a resistance in series with a capacitance and then a resistance in series with an inductance. The circuit did not contain any inductance, but the equivalent circuit only for this minus Y12 parameter looks like this. In which 1 of the resistances is negative, 1 of the resistance is C and L are positive but, 1 of the resistances is negative all right I want you to verify this which resistance is negative? And does this mean that we can generate inductor out of capacitor and resistors, passive network.

In other words can we realize this impedance? Consisting of an inductor a capacitor and resistors I want you to think about it. And I want you to find out the voltage transfer function V2 by V1 open circuit and are the condition that I2 equal to 0. And I want you to verify to verify my prediction it may be right, it may be wrong but, I want you to verify that this is of the form of the transfer function that, we worked out in problem number 2 of minor 1.

That is: it is of the form s squared plus omega n squared divided by s squared plus twice zeta omega n s plus omega n squared. Where omega n is equal to 1 over RC.

Student: ((Refer Time: 26:37))

Omega n is equal to 1 by RC, I want you to verify this.

Student: ((Refer Time: 26:43))

And I want you to find out what is the Q of the network? 1 over 2 z, you have to find this out? What is it? All right I also predict that this would be 1 quarter. So, zeta is equal to 2 what does it mean?

Student: ((Refer Time: 27:09))

Poles on the negative real axis they are not complex, even though we have an equivalent inductor here, while the inductor capacitor and the resistance is. So, conspire that poles are still on the negative real axis, but, I want you to do this completely all right. Our next problem will be from the new set of problems, problem set 7. And the first 1 that we work out is 9 14 .

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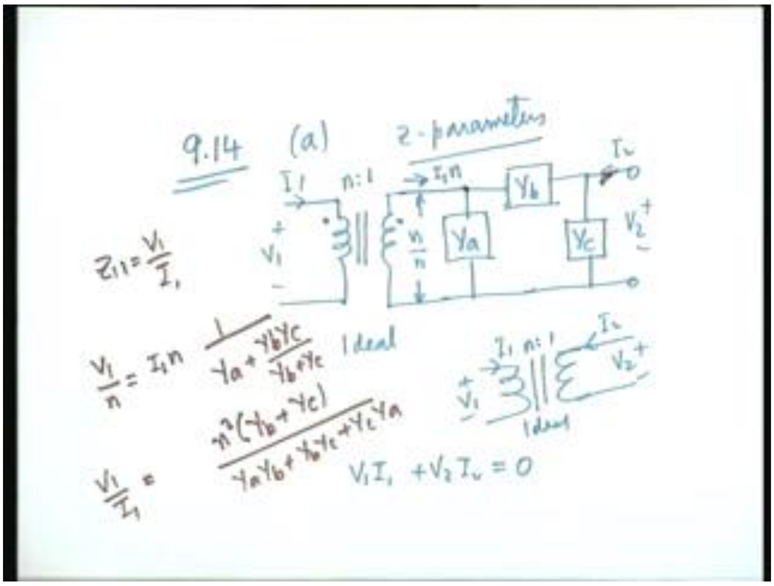

We will work out part a.

Student: ((Refer Time: 27:52))

Zeta has no significance Q has, Zeta is no longer cosine theta because cosine theta, theta is 0 but, Q has, Q is the frequency of null frequency at which the transmission is 0 divided by the bandwidth between half power points which you can show. I am throwing out challenges I claim all that I have claimed you have to prove either I am right or I am wrong I may be partially right I am partially right means; partially wrong right. 9 14 says: find the z parameters of the circuits a and b? We will work out a.

It is not a trivial example. So, I want you to notice carefully, I want you to find I want to find out the z parameters and this transformer is given as ideal. We will go back to our routes of ideal transformer the dots I am not given, we assume the dots like this, if they are not given you assume according to your convenience and this is convenient. Then you have a pi equivalent circuit that is Ya Yb and Yc to bring variety into experience, we have always assumed Yc here well this has been interchanged.

This should not W this is V2 I2 and this is V1 I1. You are required to find out the z parameters of this. The first thing we do is we do is: we go back to the definition of a transformer. So, an ideal transformer means; that the 2 inductances are infinite, but the ratio is finite, which means that if this voltage is V1 then this voltage should be V1 by n, n is the trans ratio. And we do not care about mutual inductance because mutual inductance is also infinite in such a manner the coefficient of coupling is 1.

Coefficient of coupling is 1 in addition we known the divide the device is passive, passive and loss less there are no losses. And therefore, the total power into the transformer should be 0. Which means that this current should be equal to I1n is that clear? Is this obvious, this is obvious is not it? V1 I1 is the power going in. So, the power going out must be V1 I1 or the power going mean from here must be minus V1 I1.

No you see that is: I wanted you to ask this question. It should be cleared once and for all; n is to 1 this is the ideal transformer. I am write ideal here. Then V1 I1 is the power going in and from the other terminal V2 I2 is the power going in this should be equal to 0. And if you put V2 equal to V1 by n then I2 becomes minus n I1 which means that I1 n goes out rather than coming in all right.

This is my that solves half the problem. Now, what we have to find out is Z11. Z11 all right. We look at this we look at this circuit. Z11 is simply under this condition V1 by I1 with I2 equal to 0 that means; this is left open, this is left open. Now, you notice that V1 by n this voltage must be equal to I1 n multiplied by the equivalent impedance presented by this combination and do it by inspection. V1 by I did not go to the input terminals.

Notice I do not need to all I need to find is the relation between V1 and I1 and the most convenient point is here. The voltage is V1 by n the current going out is I1 n. So, V1 by n equal to I1 n multiplied by the impedance how do I find the impedance1 by.

Student: ((Refer Time: 33:08))

Ya plus Yb Yc divided by Yb plus Yc. Therefore V1 by I1 is equal to n squared Yb plus Yc divided by Ya Yb plus Yb Yc plus Yc Ya is that clear? No loop equation, no node equation, no KVL, no KCL, no KVL of course, we have used. We are not used KVL we are used only Ohm’s law that voltage equal to current multiplied by the impedance that is all. So, we have found out Z11. To find out what else can we find out from here, Z21 what is the definition of Z21?

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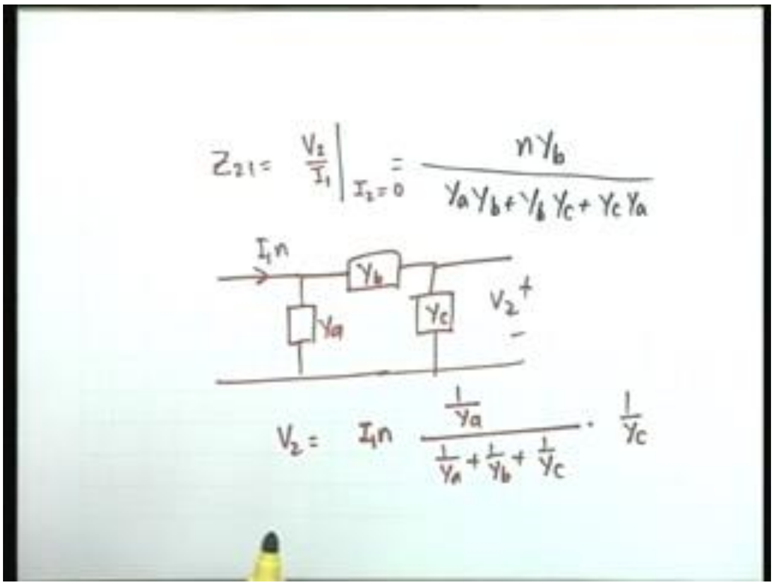

Z21 is V2 by I1 under the condition.

Student: ((Refer Time: 34:18))

I2 equal to 0. So, the same circuit holds good I will only explain and I leave the calculations to you I have to find out V2 in terms of I1.Obviously I can forget about the initial part of the circuit; what I had is let me, draw the essential part is that a current I1 n comes to a parallel combination of Ya then Yb then Yc. And this voltage is V2 I can forget about the rest of it; I need a relation between V2 and I1.

So, V2 is equal to I1 n divides into 2 parts 1 is along this the other along the other 1 and therefore, this will be 1 by Ya divided by I am doing it absolutely by inspection; current division in 2 parallel branches 1 by Ya plus 1 by Yb plus 1 by Yc multiplied by 1 over Yc. And therefore, you see the Z21 could be simply equal to I can write the expression now. V2 by I1 n times Yb in the numerator and in the denominator, we shall have Ya Yb plus Yb Yc plus Yc Ya. Agreed with a little practice these things will come automatically.

Next problem that is: to find out Z22 and Z12 there is a small trick there is a small trick the existence of a small trick has to be recognized. Let us see, what this is? Is there any question on this calculation of Z21 all right. Let’s calculate Z12 and Z22. For both of them.

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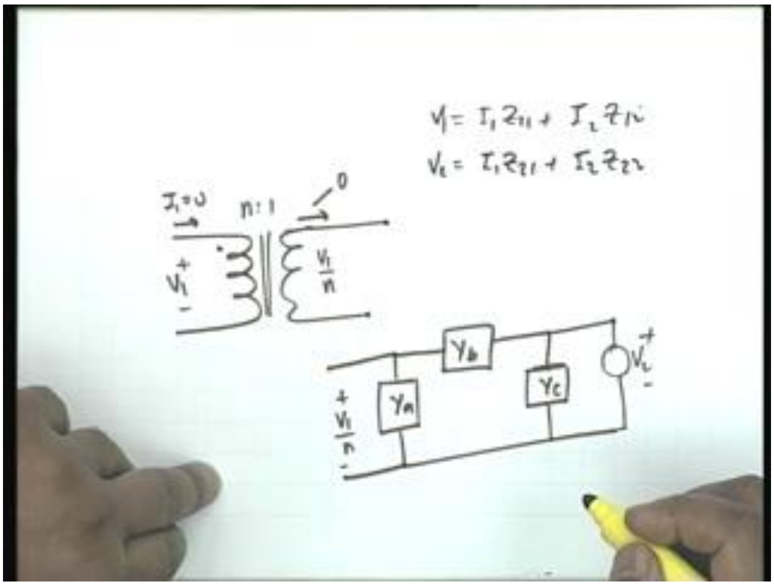

If you recall, V1 equal to I1 V11 plus I2 z12 and V2 equal to I1 z21 plus I2 z22. We want to calculate z12 and z22 for both of them I need I1 to be equal to 0, I1 equal to 0. So, let us draw the circuit. N is to 1 I1 equal to 0 means; that is source cannot be connected here source must be on the other side all right. Then I1 equal to 0 means; what this current also 0, 0 current which means; that these 2 terminals can be thought of as opens, if they are open then all I had in this circuit Ya Yb and Yc

Student: ((Refer Time: 37:36))

Current is 0 in the open circuit Yc there is no current here, but, there is the voltage here what is the voltage? This voltage was V1 open circuit of voltage when exist and this will be V1 by n. So, this is V1 by n. This is the trick there is the existence which is recognized and I have a V2 here. To have a V2 and this current is I2. So, what I have to do is to find out the admittance looking from here this should be: the impedance looking here this would be z22 V2 by I2 and; obviously, Z22.

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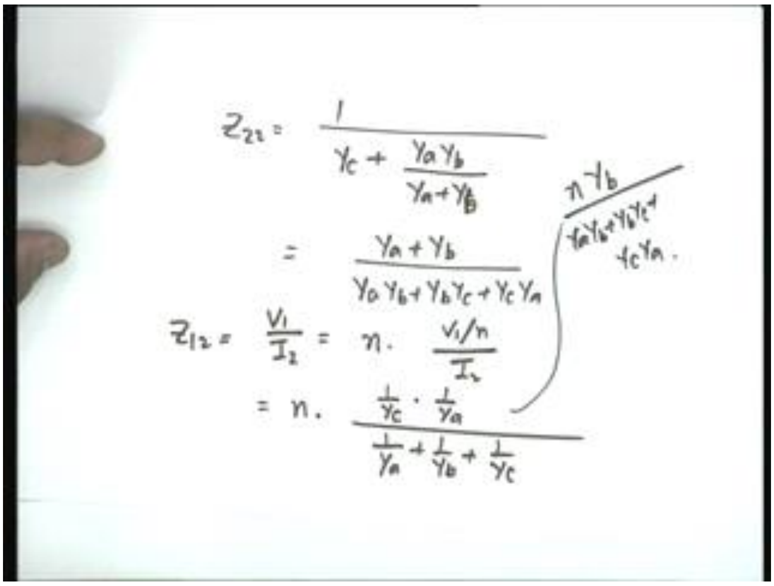

If you look at it carefully would be 1 over Yc plus Ya Yb divided by Ya plus Yb.

Student: ((Refer Time: 38:52))

Yb yes thank you. Which is equal to Ya plus Yb divided by the same expression that is: Ya Yb plus Yb Yc plus Yc Ya and z11 z12 is V1 by I2 V1 by I2. Now, what I have is I2, but, this is not V1 it is V1 by n and therefore, I can write this as, make a small modification I write this is n times V1 by n divided by I2 agreed. So, this is n times now I have to find out what current is flows here, what is the current? This is I2 multiplied by 1 over Yc divided by 1 over Yc plus 1 over Yb plus 1 over Ya. Is it too fast?

Student: ((Refer Time: 40:02))

Does not matter this is a current. This current flows in 2 directions 1 is through Yc and the other is through Yb and Ya series connection. So, the current division this current would be 1 by Yc this impedance divided by the sum of the impedances that is what I have done. And this current drops across Ya and therefore, what I shall have is 1 over Yc into 1 over Ya divided by 1 by Ya plus 1 by Yb plus 1 by Yc. And therefore, the expression would be n times Yb divided by the same expression Ya Yb plus Yb Yc plus Yc Ya.

Apparently a tough problem, but, the solution is not tough. Once you recognize what is happening in the ideal transformer that is it.

Student: ((Refer Time: 41:23))

Would be, would z11 change no z22 no. What will be the change in z12 and z21,would you also notice that; z12 and z21 are equal have you notice this that; there equal n times while they have to be equal because the transformer is a reciprocal device. So, is Ya Yb Yc. So, the total network is reciprocal. So, you verifies that z12 is equal to z21. Any question.

Student: ((Refer Time: 42:10))

If the transformer is not yes then it is reciprocal because it passes current equally when the non detective after all what is a transformer? Consists of 3 inductors, each inductor is a bilateral element and therefore, it is a reciprocal network. Last such.

Student: ((Refer Time: 42:31))]

If it is non ideal, it is more passive.

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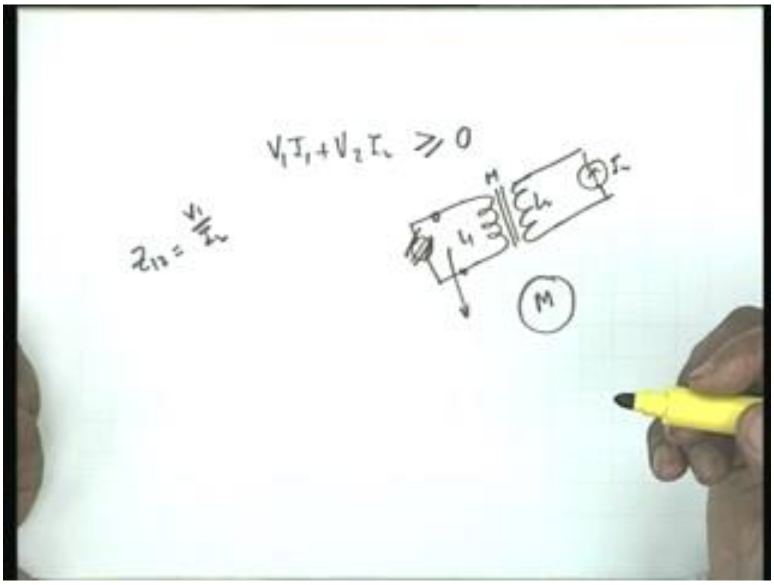

V1 I1 plus V2 I2 it is greater than equal to 0. For an ideal transformer, it is exactly equal to 0 for a non ideal transformer it may be greater than 0 a transformer is a passive device all right. The last problem of the day.

Student: ((Refer Time: 43:05))

Reciprocity of transformer once again, we equate the apply the definition apply the definition you want an ideal transformer or a non ideal it does not matter. Let's have a non ideal L1 L2 M, we apply a voltage here and what is the definition of z12, z12 V1 by I2. So, no you connect a current generator here and keep this open find the voltage here and you do other way around that is: you connect a current generator here go to the other edge.

This is Mathematical derivation, Mathematical verification of the fact that z12 equal to z21, but is this needed? That is the question. Think it is not needed because physically a transformer has 3 inductances L1 L2 and the third is not a physical inductance you cannot hold it in hand, it is because of the mutual coupling between the 2 but, equivalent the dimension is that of an inductance M. Which can pass current equally well in both directions that is whether, you generate flux here or you generate flux here the mutual coupling will be the same for the same amount of flux.

Therefore, M is also a you a bilateral element and there is no this in the way the transformer should not be reciprocal. The losses in the coils, they do not effect the reciprocity because they are pure resistances they also we conduct current equally well in both directions all right. The last problem of the day, we shall calculate, we shall use 9 18 and b. I am going to tell you something, a new technique for analyzing such networks which we have not done so far and the circuit is this. There is a 1 Ohm resistance, there is a 1Farad capacitance.

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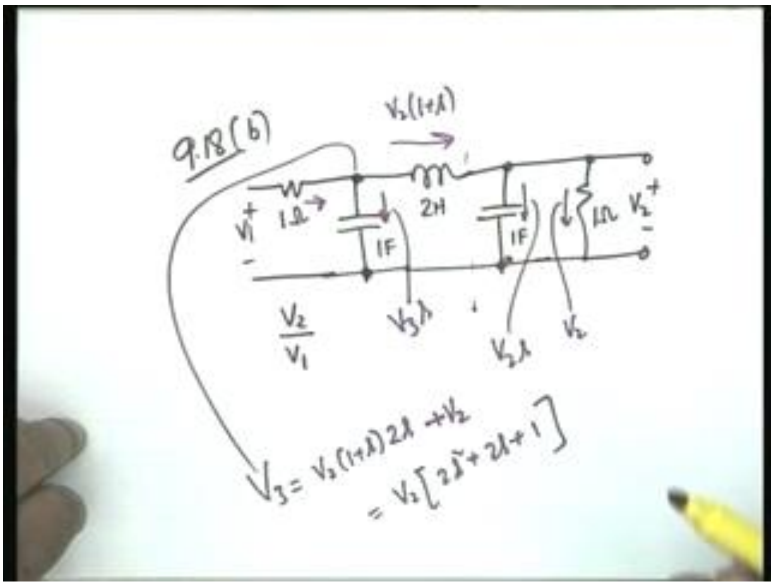

There is a 2 Henry inductor, there is a 1 Farad capacitance, 1 Ohm resistance and this voltage is V2. And this voltage is V1. The question asks for the transfer function V2 by V1. There are many ways that we can solve the problem 1 of the things is, we can write node equation, we can do that as only 1 node this is V2 this is V1. So, you have to find the equation, we have to find this value, we can write loop equations 1 2 you can either combine this into 1 or you can write a third loop equation, third mesh equation you can do that.

Now, what we are going, we can we can also apply Thevenini's theorem to the left of these lines then to the left of these lines or to the left of this line Thevenin's or Norton's whichever, case may be the calculations are the least in a third alternative which are going to see there is 1 more alternative this you could convert this pi into a T this pi into a T. And then calculate the voltage transfer function or you could convert this T into a pi you can do that.

There are many methods there are many methods which can be what I am going to tell you is going to be very extremely simple and this is as follows I come I start from here and go back I start from here and go back. What is the current through this? V2 then what is the current through this? V2 s then what is the current through this? a sum of these 2. So, V2 into 1 plus S agreed. Then what is this voltage? Let us call this voltage as V3 that will be V2 into 1 plus S multiplied by this impedance 2 s plus V2.

This drop plus this drop agreed is that clear? which is equal to you can express this is 2 s squared plus 2 s plus 1. So, I know this voltage V3 then I know this current this should be V3 times s. If I know this current and this current then I know this current is the sum of the 2 and then you find V1 is being is being a bit fast.

Student: ((Refer Time: 48:42))

No all right because is so simple is so transparent I know this current. So, I know the voltage V1 this is a drop across 1 Ohm plus V3 whatever, we found out all right. And you notice that we have found out a relation between V1 and V 2. I want you to verify that the final solution is.

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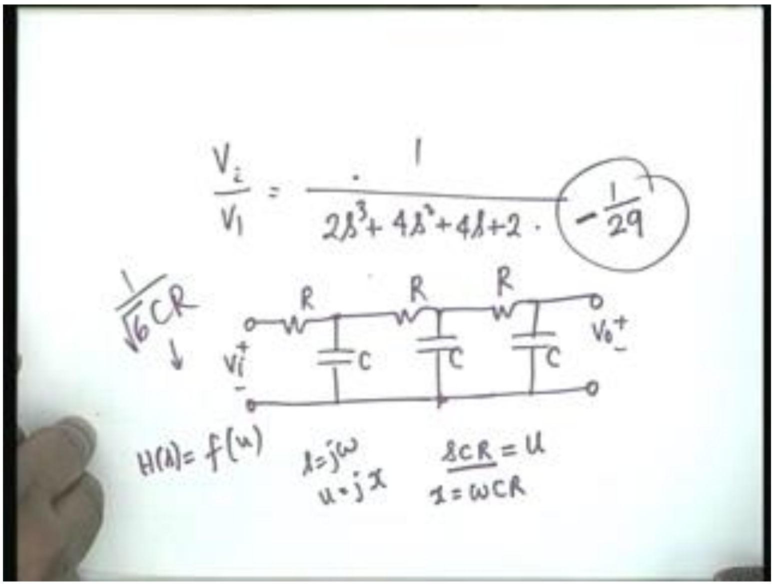

V2 by V1 equal to 1 by 2 s cubed plus 4 s squared plus 4 s plus 2 this is the solution. Now, once you find the solution, it is a nice practice, a good practice to check at some spot frequencies and the spot frequencies most convenient, spot frequencies are dc and infinity. Let's look at the circuit at dc; at dc this capacitor is open this inductor is a short this is open and therefore, you have voltage division between 1 Ohm and 1 Ohm transfer function should be half. Let us look at the expression if s is put equal to 0 its exactly half. At infinite frequency infinite frequency this is a short.

So, nothing should go there is not that right? Infinity frequency is a transfer function should be 0 not only, it is a short this is open. So, nothing should go to the output. Now, look at the expression when you put s equal to infinity this; obviously, 0. So, the transfer function in all probability is correct, but, I have not checked at all frequencies even this is a necessary condition, not sufficient for accuracy do you understand this. It is necessary, but it gives you a confidence I have done it correctly most probably it is correct.

I also give you 1 problem to solve in either when discussing mesh analysis or node analysis if you recall there is an oscillator question, Phase shifting network. Now, what you can do is, you can solve was it this circuit or C and R interchanged whatever, way it is you say assume this to be V0 this to be Vi, then work backwards. And in the process we are also some tricks of the trade which you learn, the product SCR shall continue to come.

And you will see only d is missing as for as the instructors name is concerned. That is why RC circuits are very popular with me I am most favorite. Now, this will continue to come Instead of writing this again and again you will save a bit of algebra, if you put this into some expression u. And then when you want to find out and you will see that; the transfer function H of s will be a function of u, you do not require C R and s separately it will be a function of u.

So, you can work in terms of u when s equal to j omega u equal to j times some quantity x where x is omega CR this give you simplification this notations give you simplification of the algebra all right because somewhere, you might miss the R. And that you have done the whole problem will become null enfilade. And did I say that there is a frequency at which the phase shift is exactly pi and this frequency is 1 over root six CR

So, u shall be equal to 1 over root 6 and I have this frequency the transfer function value is equal to the magnitude is 1 by 29.

Since, the phase shift is 180 degree the transfer function will become exactly minus 1 by 29 I want you to verify this for the last statement of the day once, again a problem which I set for you for the parallel T network that you have solved today by T pi conversion, by T pi conversion you can also do by mesh analysis, you can do by node analysis you can also do by another method and I want to outline this in half a minute what I have is.

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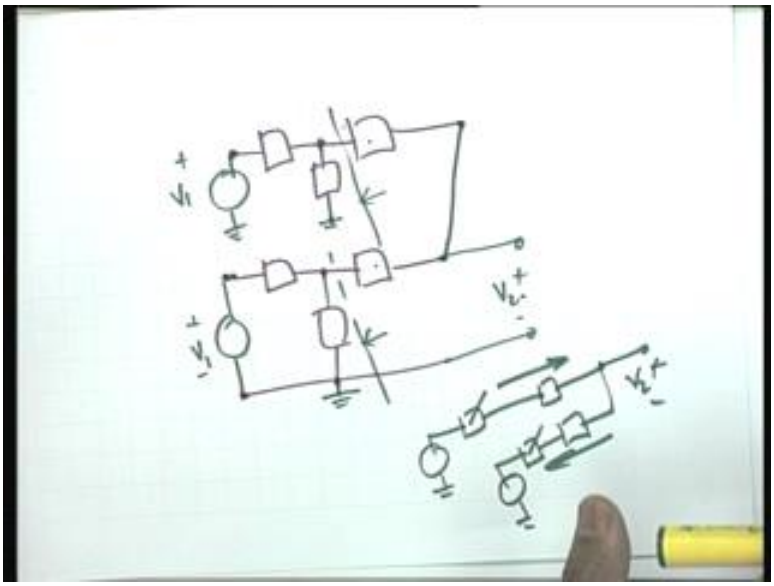

Let me now, name the elements please note what I am doing, what these are 2 T's and I connected in parallel. Let me show this by not agreed what I am done is I have connected this to this well if I say this is some symbol grounded this is my reference after all. All voltages are measured when this is also here. And then what I have done is I have connected this terminal to this terminal and this terminal to this terminal that is how parallel T is formed.

And I connected a source here V1 suppose, I do this connection this is my V2 but, I split the source into 2 sources. All I need is by what is that theorem called.

Student: ((Refer Time: 54:53))]

Compensation well all I need is a volt constant voltage V1 here that is all I need. So, what I am do is I will connect a voltage source V1 here and I will connect a voltage V1 here I can do that the potentials at these 2 points will be the same and they behave like physically connected to each other. And 2 sources V1 and V1 connected in parallel shall still be equivalent to 1 source giving a voltage of V1. Now, what you can do is or you are interested in finding V2 by V1.

So, you can apply Thevenin's theorem now, to the left of this line, to the left of this lines no loop analysis, no mesh analysis, no solution or simultaneous equation no all you do is apply Thevenin's theorem then what I have is 1 source and the other source in series with and this is V2 is not this what we will get? This is the Thevenin, this is the Thevenin. And this element is a third element this element and this element.

Student: ((Refer Time: 56:14))]

No this was not connected in their original either point of intersection where isolated this point was not connected to this point. No if it was connected and then it becomes a single field right. So, here what all we have to do is write 1 node equation that is or you argue like this current should be equal to this current that is all. From which V2 by V1 can be found out. If this can be done in 5 minutes mesh analysis or node analysis will require at least 20 minutes.

This is done by inspection no solution of simultaneous equation, no determination of determinant all right and when such a thing is done. It should be done with confidence. Last question if instead of a voltage source, it was a current source could you do this.

Could we split into 2 with equal current sources.

Student: ((Refer Time: 57:28))

Not at all, because 2 current sources in parallel I1 and I1 will give 2 I1 not I1.

Student: ((Refer Time: 57:36))

I claying that; there is no way that, a current source could have been dealt with an exactly the same manner. If we can find the way let me know.

Thank you.